THE INFLUENCE OF SUPPLY CHAIN PRACTICE ON SUPPLY CHAIN PERFORMANCE IN SOUTH AFRICA

BY

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DECLARATION

I, the undersigned, Progress Hove, hereby declare that this thesis entitled “The Influence of Supply Chain Practice on Supply Chain Performance in South Africa” is my own original work. It has not been and will not be submitted or presented for the award of any other Degree, Diploma, Fellowship or similar title at any other institution.

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Signature…….

Date…23. March 2015.

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DEDICATION

I dedicate this project to God for the wisdom and power he granted me in order to carry out and compile this research. Glory to his name. It is also dedicated to my son Mr Ronald Dube. I also dedicate this study to my family for their appreciation, kind-heartedness, the love and care that they have shown me and which has allowed me to gain confidence and has inspired me towards greater achievements.

ABSTRACT

The effective implementation of intra-firm and inter-firm supply chain practices and processes such as supply chain e-collaboration and sharing of important information among supply chain partners, is commonly associated with the creation of supply chain competitiveness and enhanced performance. However, little attention has, thus far, been given to the empirical investigation of the influence of the successful implementation of intra-firm supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance in South Africa. The principal objective of this study was to fill this void by investigating the influence of intra-firm supply chain practice on supply chain e-collaboration among supply chain partners in South Africa. Secondly, the study sought to determine the influence of supply chain e-collaboration on strategic information and supply chain competence among supply chain partners in South Africa. It also aimed to examine the influence of strategic information sharing on supply chain competence and ultimately on the supply chain performance of supply chain partners in South Africa. Lastly, the study sought to ascertain the influence of supply chain competence on supply chain performance of supply chain partners in South Africa.

A positivist approach that allowed a quantitative research method in data collection was used in this study. Data from a sample of 280 collaborating firm owners/managers from all the industries of South Africa's nine provinces was used for the final data analysis of this research. A principal component analysis was performed for factor reduction and dimensional groupings using SPSS 21 software. Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) were performed for model fit assessments and hypotheses tests respectively, using the Analysis of Moments of Structure (AMOS 21) software. Multiple Regression analysis was performed using SPSS 21 software, and was used for comparison and support of the weak and unsupported SEM hypotheses tests.

The principal finding of this study reveals that intra-firm supply chain practice has a strong positive and significant influence on supply chain e-collaboration among supply chain partners in South Africa. In addition, the results showed that supply chain e-collaboration can strongly and significantly enhance the sharing of strategic information among supply chain partners in South Africa. The findings further

revealed that supply chain e-collaboration has an ability to create a supply chain competence among supply chain partners in South Africa. The study's empirical findings also indicate that strategic information sharing has a weak positive and significant indirect influence on supply chain competence and supply chain performance. Lastly, the SEM findings showed that supply chain competence has a weak negative and insignificant influence on supply chain performance. However, the multiple regression analysis showed a weak negative and significant influence of supply chain competence on the supply chain performance of supply chain partners in South Africa.

The conclusions and implications of the empirical research findings are provided and recommendations are suggested. The study suggests a new supply chain management conceptual model for research. It also proposes a new supply chain management implementation framework to help guide firms to formulate strategies for improving supply chain performance. The study recommended that the collaborating firm owners/managers consider: training and education for all employees on the importance of supply chain practices and processes such as supply chain e-collaboration and strategic information sharing. Furthermore, it is recommended that collaborating firm owner/managers should consider adopting advanced technologies and information sharing structures to improve their supply chain performance. The collaborating firm owner/managers were also encouraged to align their incentives with the supply chain roles and activities assigned to the supply chain partners. Policy makers were encouraged to make e-business financing arrangements for supply chain collaborating firms; promote synergies between collaborating small and mediums firms and large technology vendors; and ensure affordability of supply chain e-collaboration technologies. The study attempted to address the intra-firm supply chain practice deficiencies on the side of both the supply chain e-collaborating firms and the government.

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LIST OF ABBREVIATIONS

CP	Supply chain performance
LKP	Leraning and knowledge perspective theory
RV	Relational view theory
SCC	Supply chain competence
SCE	Supply chain e-collaboration
SCM	Supply chain management
SCP	Supply chain practice
SEM	Structural Equation Modeling
SIS	Strategic information sharing

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CHAPTER 1

INTRODUCTION TO THE STUDY

1.1. INTRODUCTION AND BACKGROUND

It has been said that competition is increasingly shifting from individual companies to supply chains (Narasimhan, Kim & Tan 2008:5232; Roussel 2013:30; Rossouw & Binnekade 2013:1). This increasing consensus by scholars and practitioners has consequently put the performance of supply chains under the spotlight. Thus supply chain performance has become an important factor in achieving a firm's competitive advantage (Sezen 2008:233). This realisation has prompted firms to focus not only on internal business systems, but on wider aspects of supply chains as well since a weakness in a member of the supply chain can have a ripple effect on the entire supply chain system (Sanders 2011:8).

Supply chain management is founded upon four main elements, namely supply, operations, logistics and integration management (Wisner, Tan & Leong 2012:15; Mbanje & Lunga 2015:4). In supply chains, the performance of individual firms and that of the supply chain as a whole remain paramount. In this regard, Mentzer, De Witt, Keebler, Min, Nix, Smith and Zacharia (2001:18) note that the purpose of supply chain management is to improve the long term performance of the individual firms and the supply chain as a whole. Hugos (2006:50) posits that supply chain management requires simultaneous improvements in both customer service levels and the firm's internal operating efficiencies.

Improving internal operating efficiencies may require adopting systems such as just-in-time (JIT) production and inventory control, , effective supply chain planning as well as delivery systems (Zhou & Benton 2007:1348). In effect, this involves all activities meant to improve what could be referred to as intra-firm supply chain performance. On the other hand, improvement in supply chain management involves improvement in integration management. This could be referred to as inter-firm supply chain performance. Improving inter-firm supply chain performance requires and creates collaborative efficiencies and involves engaging in initiatives and practices that connect the supply chain management processes across firms (Lysons & Farrington 2012:218; IshtiaqIshaq, Kaliq, Hussain & Waqas 2012:91; Wagner & Bode 2008:307). This may include the adoption and integration of information

technology in supply chain management processes or any other activities meant to improve inter-firm supply chain performance.

Despite gaining importance, the notion of supply chain performance still requires further investigation and more understanding. Ambe and Badenhurst-Weiss (2012:11006) define supply chain performance as a monitoring process, undertaking a demonstrative analysis of whether the proper processes have been followed and the desired objectives were attained (Ambe & Badenhurst-Weiss 2012:11006). The current study defines supply chain performance as the supply chain's ability to respond timeously to customers' needs, deliver the right quantities and minimise production, as well as inventory costs.

Various measurement categories and models have been suggested for supply chain performance. They range from cost and non-cost (Lunga & Mbanje 2015:7), financial and business process perspectives (Chopra & Meindl 2010:53), to customer, financial, internal, as well as learning and growth (Taghipour, Bagheri, Khodarezaei & Farid 2015:145). In this study, supply chain performance is assessed by delivery reliability, responsiveness, speed, quality, cost and flexibility of the supply chain. Assessing supply chain performance enables firms to gain understanding and improve their entire business performance (Taghipour *et al*., 2015:145). Thus, it is important for firms to consider the nature of factors that influence supply chain performance. The current study focuses on the intra-firm and inter-firm supply chain practices that influence supply chain performance. Intra-firm supply chain practice investigated include supply chain planning, JIT production and inventory systems and delivery practice while inter-firm supply chain practices include supply chain e-collaboration, strategic information sharing and supply chain competence.

Supply chain practice has been defined from both an intra-firm and an inter-firm perspective. On the one hand, the intra-firm perspective definition of supply chain practice includes supply chain planning, JIT production and inventory systems, as well as the delivery practices (Zhou & Benton 2007:1348). On the other hand, supply chain practice from an inter-firm perspective includes among others, collaboration, strategic information sharing and supply chain competence (Day & Lichtenstein 2007:317; Chow, Christian, Madub, Chu-Hua, Min, Luc, Chinho & Hojung 2008:665). Due to increasing global competition, most firms are forced to employ intra-firm (supply chain) practices such as the supply chain planning, JIT production and

inventory systems, as well as the delivery systems (Mbanje & Lunga 2015:5). These intra-firm practices ensure low cost, high quality and reliable products, which enhances firm competitiveness and performance both in local and global markets (Shukla *et al.,* 2011:2061).

Managers worldwide confirm the success of efficient and effective intra-firm supply chain practices as evidenced by low cost, greater speed, new innovation and high levels of customer satisfaction in their firms (Spekman, Kamauff & Myhr 2002:44; Zhou & Benton 2007:1349; Wisner *et al*., 2012:270). Ivanov and Sokolov (2010:173), for instance, agrees that effective planning in supply chains can help firms to minimise their costs and earn higher profits or revenues, while poor planning results in loss of profits or revenues. Wisner *et al*. (2012:269) associate JIT production and inventory practices with the reduction in wasted movements of workers, customers and or work-in-progress, thus improving the overall supply chain responsiveness and efficiency. As such, the adoption of intra-firm supply chain practices in industries worldwide has steadily increased since the 1980s (Shukla *et al.,* 2011:2063). The current study examines the indirect influence of intra-firm supply chain practice on supply chain performance as mediated by the inter-firm practices of supply chain e-collaboration, strategic information sharing and supply chain competence.

The notion of e-collaboration has sprouted in supply chain management literature as a technology-enabled systems approach that integrates and synchronises a supply chain, promoting team work among multiple businesses with a shared purpose and a common work context (Coe 2004:5). It provides supply chain member firms with benefits such as reduced total systems costs as well as improved customer responsiveness (Coe 2004:5). Notwithstanding the perceived importance of collaboration and electronic collaboration (e-collaboration) at supply chain level, organisations continue to experience difficulties in their attempts to foster internal and external collaboration (Jayaram & Tan 2010:262). More so, international evidence reveals that firms are reluctant to adopt and implement technology-enabled collaborations in supply chains as they perceive technology as an inherently insecure and a complicated environment, despite the benefits and opportunities availed by supply chain e-collaboration systems (Ratnasingam 2006:117).

Strategic information sharing refers to communication or sharing of a firm's long term important and sensitive proprietary information between supply chain partners

(Bayraktar, Koh, Gunasekaran, Sari & Tatoglu 2008:194). According to Chopra and Meindl (2007:482), the creation and sharing of strategic information is a key supply chain management driver, which serves as the glue that allows the other supply chain drivers to work together with the goal of creating an integrated and coordinated supply chain. It provides the foundation on which supply chain processes execute transactions and managers make decisions. Thus, without the sharing of strategic information, a manager cannot know what customers want, how much inventory is in stock and when more products should be produced or transported. More so, the effective sharing of strategic information can enhance efficiency in a supply chain's operations, thereby producing a higher overall supply chain profit (Mbanje & Lunga 2015:6).

Nevertheless, the practice of strategic information sharing regularly involves a cost and can make firms to be hesitant to share their important information. In fact, researchers have revealed that many supply chain member firms are hesitant to share strategic information (Rashed, Azeem & Halim 2010:74; Prajogo & Olhager 2012:516; Ramanathan & Gunasekaran 2014:253). According to Chu and Lee (2006:1567), while firms agree that providing additional and strategic information to manufacturers would offer some savings to the manufacturers, but many retailers were sceptical about the benefits for their firms in sharing information with manufacturers. This can especially explain a situation where the risk and cost of sharing strategic information is solely a burden of the disclosing supply chain partner. This is also common where there is no mechanism defined prior to allocating some of the resultant additional profit as well as risks and costs to the disclosing supply chain partner (Chu & Lee 2006:1570). As such, partners in a supply chain might find the issue of sharing their strategic information with their partners under the above mentioned conditions as a costly practice without even considering the benefits (Rashed *et al*., 2010:62). Therefore, there is a need for a mechanism through which partners can consider the benefits, risks and costs of sharing information amongst each other, in order to create a supply chain competence.

Supply chain competence is defined as the collective learning of the entire supply chain; learning that emanates from the e-collaboration relationships and strategic information sharing between the supply chain partners, which unleash unique and inimitable value creating abilities by combining the core competencies of the individual partners (Chow *et al*., 2008:671). Breite and Koskinen (2014:11) attribute

such supply chain collective learning to the ability of a supply chain system to form learning entities and transform itself through the collective learning of all its individual supply chain partners. Previous studies confirm that collective learning is a source of competitive advantage for the entire supply chain and it stems from the communication, involvement and a deep commitment of the supply chain partners working across their firms' boundaries (Chow *et al*., 2008:671; De Wit & Meyer 2010:357). In addition, supply chain competence enables the supply chain member firms to collectively respond to market uncertainties and outperform their rivals in supply chain operations (Stratman & Roth 2002:624).

According to Chow et al. (2008:671) supply chain management is operationally and functionally stable when inter-firm supply chain practices are endorsed by participants and concerned areas are addressed. Thus, supply chain competence requires the ability to take full control of supply chain operations regardless of the environmental pandemonium (Spekman, Spear & Kamauff 2002:50). Therefore, the emphasis is on how to coordinate diverse skill sets from all the supply chain member firms and integrate them into the supply chain technical system (Chow *et al*., 2008:671). This can be made possible through effective implementation of intra-firm supply chain practices, which in turn support the inter-firm practice of supply chain e-collaboration and effective mutual sharing of strategic information.

Based on the above, the role of effective supply chain e-collaboration and strategic information sharing remains important in the current global landscape, mainly because of the trends of outsourcing and the value-added functions associated with external functions (Jayaram & Tan 2010:262). More so, there seem to be a gap in literature in terms of the influence of intra-firm supply chain practices on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. Thus, a detailed study on the intra-firm supply chain practices effects on supply chain e-collaboration, sharing of strategic information, supply chain competence creation and supply chain performance, stands to contribute towards literature.

1.2. PROBLEM STATEMENT

According to the Council for Scientific and Industrial Research Report (2014:16) there is a major gap between the knowledge of supply chain management and the successful implementation of supply chain collaboration strategies within South African organisations. In support, the Supply Chain Foresight Report (2015:49) recommended that supply chain collaboration, alignment and visibility are some of the key areas that need improvement in South Africa's supply chain management and have greater potential for future returns. Furthermore, the Supply Chain Foresight Report (2015:61) highlighted that only 29% of the South African firms are fully utilising supply chain collaboration strategies, while 46% are partly collaborating and 14% have plans to implement supply chain collaboration strategies. This clearly shows that there is a lot to be done in terms of supply chain management implementation in South Africa with regards to collaboration and information sharing.

Over the past decade (2005 to 2015), supply chain management research has advanced and extended to include a range of perspectives such as supplier relationships, supply chain network structure and collaboration (Lejeune & Yakova 2005; Sandberg 2007; Narasimhan *et al*., 2008; Breite & Koskinen 2014; Chinomona & Hove 2015). While some studies have explored the antecedents of supply chain performance, much still needs to be explored and understood about this concept. The existing literature on supply chain performance has largely focused on developed countries such as Australia (Jie, Parton & Cox 2007), Sweden (Forslund & Jonsson 2007), Germany (Wagner & Bode 2008), Taiwan (Liu 2009) and USA (Fawcett, Osterhaus, Magnan, Brau & McCarter 2007). With the exception of some developing countries such as Turkey and Bangladesh, one rarely comes across studies on supply chain performance that focused on developing countries (Sezen, 2008; Rashed, Azeem & Halim, 2010). South Africa is no exception in this regard.

Furthermore, while the relevant studies have investigated various antecedents of supply chain performance, none of these studies have combined intra-firm supply chain practice with the inter-firm practices of supply chain e-collaboration, strategic information sharing and supply chain competence as its antecedents. For instance, Sezen (2008) investigated the relationship between design, integration information sharing, and supply chain performance. Fawcett *et al*. (2009) examined the impact of information sharing on supply chain performance using semi-structured interviews.

Studies that examined the effects/impact of supply chain practices on performance only focused on inter-firm supply chain practice (Sukati, Hamid, Baharun & Yusoff 2012; Chow *et al*., 2008). Rarely can one find studies that examined the influence of intra-firm supply chain practices on supply chain performance, with the inter-firm practices as mediators. Although Zhou and Benton (2007) focused on intra-firm supply chain practice, these were linked to supply chain management and not to supply chain performance through the inter-firm practices of supply chain e-collaboration, strategic information sharing and supply chain competence. The absence of such a link between intra-firm supply chain practice and supply chain performance through the inter-firm practices of e-collaboration, strategic information sharing and supply chain competence makes this study significant in filling such a research gap. This study, therefore, focused on the entire range of supply chains in South African firms where less has been done in terms of research.

1.3. RESEARCH QUESTIONS

An in-depth knowledge on supply chain management can help both the private and public sectors to realise all the benefits brought by an effective supply chain management system. To gain in-depth knowledge needed on supply chain management this study seeks to answer the following research questions:

- What influence do intra-firm supply chain practices have on supply chain e-collaboration?
- What influence does supply chain e-collaboration have on strategic information sharing?
- What influence does supply chain e-collaboration have on supply chain competence?
- What influence does strategic information sharing have on supply chain competence?
- What influence does supply chain competence have on supply chain performance?

1.4. PRIMARY OBJECTIVE OF THE STUDY

The purpose of this study is to investigate the influence of intra-firm supply chain practices on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance.

1.4.1. Theoretical Objectives

The theoretical objectives of the study are:

- to review literature on intra-firm supply chain practices;
- to review literature on supply chain e-collaboration;
- to review literature on strategic information sharing;
- to review literature on supply chain competence; and
- to review literature on supply chain performance.

1.4.2. Empirical Objectives

The study's empirical objectives are:

- to investigate the influence of intra-firm supply chain practices on supply chain e-collaborations among supply chain partners in South Africa;
- to determine the influence of supply chain e-collaboration on strategic information sharing among supply chain partners in South Africa;
- to ascertain the influence of supply chain e-collaboration on supply chain competence of supply chain partners in South Africa;
- to determine the influence of strategic information sharing on supply chain competence of supply chain partners in South Africa;
- to examine the influence of strategic information sharing on supply chain performance of supply chain partners in South Africa; and
- to ascertain the influence of supply chain competence on supply chain performance of supply chain partners in South Africa.

1.5. RESEARCH HYPOTHESES

The research hypotheses for this study are:

$H0_1$: Intra-firm supply chain practices have a negative influence on supply chain e-collaboration among supply chain partners in South Africa.

H_1: Intra-firm supply chain practices have a positive influence on supply chain e-collaboration among supply chain partners in South Africa.

$H0_2$**:** Supply chain e-collaboration has a negative influence on the sharing of strategic information among supply chain partners in South Africa.

H_2**:** Supply chain e-collaboration has a positive influence on the sharing of strategic information among supply chain partners in South Africa.

$H0_3$**:** Supply chain e-collaboration has a negative influence on the development of a supply chain competence among supply chain partners in South Africa.

H_3**:** Supply chain e-collaboration has a positive influence on the development of a supply chain competence among supply chain partners in South Africa.

$H0_4$**:** Strategic information sharing has a negative influence on the development of a supply chain competence among supply chain partners in South Africa.

H_4**:** Strategic information sharing has a positive influence on the development of a supply chain competence among supply chain partners in South Africa.

$H0_5$**:** Supply chain competence has a negative influence on supply chain performance among supply chain partners in South Africa.

$H0_5$**:** Supply chain competence has a negative influence on supply chain performance among supply chain partners in South Africa.

H_5**:** Supply chain competence has a positive influence on supply chain performance among supply chain partners in South Africa.

1.6. RESEARCH DESIGN AND METHODOLOGY

A research design or plan is a detailed blueprint used to guide a marketing research study towards its objectives (Aaker, Kumar & Day 2004:73). It encompasses the methodology and procedures employed to conduct scientific research such as research philosophies, research design, sampling design, measurement items and scale, data collection procedures as well as data analysis procedures and statistical approach.

1.6.1. Quantitative Research

Quantitative research follows a scientific method, usually descriptive in nature, and helps the researcher determine causal relationships between variables, and the data can be interpreted using statistical analysis (Berndt & Petzer 2011:348). This study follows a descriptive analysis since the underlying relationships of variables surrounding the problem are known (Cant, Gerber-Nel, Nel & Kotze 2003:33-37). A

quantitative research technique was employed in order to obtain the supply chain member firm managers' perceptions of the influence of supply chain practices on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance.

As such, this research makes use of a quantitative technique that generally involves the collection of primary data from a large number of supply chain member firms in South Africa. This was done with the intention of generalising the results to the wider population of South Africa. Quantitative primary research was conducted by employing a self-administered questionnaire in the gathering of primary data for the study. The questionnaire was designed to allow the performance of the Confirmatory Factor Analysis indices, such as the Chi-Square/Degree of Freedom, the Comparative Fit Analysis and the Incremental Index of Fit. More so, a cross-sectional study was conducted due to time limitations, which restricted the use of longitudinal studies.

1.6.2. Sampling Design

The design of samples is a particularly important aspect of survey methodology, and provides a basis for the sound measurement of economic and social phenomena from surveys of businesses and households. It encompasses the target population, sampling frame, sample method or technique and size.

1.6.2.1. Target population

A population is the collection of elements (people or objects) about which the researcher wants to make inferences and the total group of people who could be asked to participate in the research study (Berndt & Petzer 2011:347). The supply chain member firms' managers and owners are the target population of this study and those firms which are members of the South African Production and Inventory Control Society (SAPICS) South Africa were considered. The current population of the SAPICS members is 1964 and comprised the target population of this study.

1.6.2.2. Sampling frame

Aaker *et al*. (2004:760) refer to a sampling frame as a listing of population members that is used to create a random sample and may include individuals, households or institutions. For the purposes of this study, all 1964 supply chain/procurement

managers who are members of the SAPICS South Africa constitute this study's sampling frame.

1.6.2.3. Sampling size

Sample size is a function of change in the population parameters under study and the estimation of the quantity needed by the researcher (Wegner 2000:86-87). Generally, larger samples result in more precise and robust statistical findings, while smaller samples result in less precise and unreliable findings (Terre Blanche *et al*., 2006:236). The determination of the final sample size involves judgment, especially where convenience sampling was employed, and calculation where random sampling was used by the researcher. In this study, simple random probability was employed and a sample size of 280 supply chain/procurement managers on the SAPICS database registered member firms was used.

1.6.2.4. Sampling method

Sampling, as defined by Berndt and Petzer (2011:349), is the process of selecting a sample, so that by selecting some of the elements of the population the researcher can draw certain conclusions about the population. This study employed a probability sample, mainly because of its representativeness of the target population, which enhances the generalisability of the results to a larger population (Berndt & Petzer, 2011:349). Thus, the 1964 supply chain/procurement managers on the SAPICS South Africa database was sampled using simple random sampling, which dictates that each population element has a known non-zero chance of being selected (Aaker *et al*., 2004:764). Simple random sampling is easy to use and minimises selection bias.

1.6.3. Data Gathering Technique

Questionnaire protocol serves as the primary means for data collection from the supply chain member firm managers. The questionnaire was developed primarily on the basis of instruments used in other studies (operationalisation and item measurement section). Multi-item scaled questions (particularly Likert scales) were used to test the research hypotheses. Thus, most of the questions contained in the questionnaire were 5-point Likert scale questions.

The scope of this study covers all the nine provinces in South Africa since SAPICS members are in all the nine provinces. In addition, the scope covers all the nine official sectors (retailing, manufacturing, wholesaling, construction, tourism, agriculture, financial, mining and transport), since supply chains cut across all sectors. As earlier noted, self-administered questionnaires were used for data collection. However, given the distance involved between the nine provinces in South Africa, data was primarily collected during the SAPICS 36th Annual Conference held at Sun City from the 2nd to 4th of June 2014. The questionnaires also were converted into monk internet based surveys to reduce costs. Telephonic follow-ups as well as emails were made to yield a higher response rate.

1.6.4. Operationalisation and Measurements

A measurement can be defined as a standardised process of assigning numbers or other symbols to certain characteristics of the objects of interest, according to some specified rules, in order to predict or gauge some underlying scale which can only be partially measured by a single item or variable (Aaker et al., 2004:283). For the purposes of this study, the research measurements were adopted and operationalised primarily on the basis of previous works and consultation with field and academic experts. A review of the relevant literature resulted in five main constructs, and these are: intra-firm supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. The study made some minor modifications to the adapted measures in order to suit the purpose and context of the current research.

1.6.5. Data Analysis

Data analysis is not an end in itself; its purpose is to produce information that helps address the problem at hand (Malhotra 1999:434).

1.6.5.1. Data analysis procedure and statistical approach

This section focuses on the data analysis procedures and statistical approaches used in this study. The research data gathered for this study was coded in short phrases and cleansed using Excel spread sheets to make it easier to enter into the analysing software for further analysis. Descriptive analysis for personal and company

information of the supply chain member firm managers was performed using SPSS 21 software packages.

- Model fit assessment

The data collected on the research constructs was analysed using a two-step procedure, as suggested by Anderson and Gerbin (1988), in Chinomona (2013:49). First, the accuracy of multi-item construct measures were assessed, followed by a test of the research model and hypotheses. In both data analysis stages, the current study tends towards the use of the structural equation modeling technique (SEM). A confirmatory factor analysis (CFA) was performed using Amos 21 in order to access the measurement model. In addition, Amos 21 was employed as the computation SEM software. The following model fit indicators were used to assess the fitness of the model to the sample data: chi-square value over degree of freedom (χ^2/df), the values of Goodness-of-Fit Index (GFI/AGFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), and Tucker-Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA).

- Hypotheses testing

To test the research hypotheses, a path analysis was performed to indicate the path coefficient and significance levels of the posited six linear relationships between the five research constructs. A multiple regression analysis was also performed using SPSS 21 for comparison purposes with the weak and insignificant SEM hypotheses tests results.

1.6.6. Reliability and Validity of the Measurement Instrument

1.6.6.1. Reliability of the measurement instrument

Reliability refers to the similarity of results provided by the independent but comparable measures of the same object or construct, or an index of consistence (Iacobucci & Churchill 2010:258). The study employed Item-total correlation values, Cronbach's coefficient alpha (α), Composite Reliability (CR) and Average Variance Extracted (AVE) to check the measurement reliability.

1.6.6.2. Validity of the measurement instrument

Validity can be defined as the extent to which differences in observed scale scores reflect true differences between objects on the characteristics being measured, rather than systematic or random errors (Cant *et al*., 2003:235). It is divided into two: convergent and discriminant validity. In this study convergent validity was measured using Item-to-total correlation, factor loadings and Average Variance Extracted values On the other hand, discriminant validity was measured using Average Variance Extracted Value versus Shared Variance and Inter-construct Correlation Matrix.

1.7. CHAPTER CLASSIFICATION

Chapter 1: Introduction and background to the study

This chapter outlines the background of the research and the research problem.

Chapter 2: Theoretical Framework

The chapter focuses on the theories used to explain the relationships between the five research constructs of this study.

Chapter 3: Supply Chain Management

The chapter provides a discussion on intra-firm supply chain practice, as well as the inter-firm practices of supply chain collaboration and e-collaboration, strategic information sharing and supply chain competence. It then focuses on explaining the previous evidence on links studied by other authors on the research variables and singles out the intra-firm supply chain practice, e-collaboration, information sharing, supply chain competence and performance factors.

Chapter 4: Conceptual Model and Hypotheses Development

This chapter provides this study's research conceptual model as well as the development of hypotheses based on the theoretical and review of previous studies provided in Chapter 3.

Chapter 5: Research Design and Methodology

The chapter outlines the research philosophies, methods and design, sampling design, data collection as well as data analysis procedures employed in this study.

Chapter 6: Empirical Results of the Study

The chapter provides scientifically analysed and presents the research findings. It also presents the conceptual model of the study, as well as the development of hypotheses.

Chapter 7: Conclusions and Recommendations

The chapter presents some concluding remarks on the research and offers a few recommendations; it highlights the most important findings of the study.

CHAPTER 2

THEORIES IN SUPPLY CHAIN MANAGEMENT

2.1 INTRODUCTION

This chapter reviews the theories used to explain supply chain management. The first section revolves around the two theories in which this study is grounded, the Relational view and the Learning and Knowledge perspective. The Relational View (RV) is the main theory while the Learning and Knowledge Perspective is the secondary theory of this study. Therefore, the RV theory is discussed first while the Learning and LKP theory is discussed second.

Several theories borrowed from other disciplines such as sociology, socio-politics and economics have been used to explain the influence of supply chain management practices on firms and supply chain performance. This study focuses on the RV and the LKP theories as the theoretical foundations of the influence of supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance in South Africa. The RV receives attention in the next section.

2.2. RELATIONAL VIEW

The RV is a theory popularised by Dyer and Singh in 1998. Its development has been inspired by previous theoretical and empirical evidence on sources of rents and competitive advantage. The history and development of the RV is discussed in the next paragraphs.

2.2.1. The History and Development of the Relational View

The history of the RV theory can be traced back to the work of Asanuma (1989), who found that the relation specific skills developed between the Japanese suppliers and automakers resulted in the collaborating firms achieving surplus profits and competitive advantages. The theory was popularised by Dyer and Singh in 1998 and is founded upon arm's length market relationships, which singles out four sources of a firm's competitive advantage which are: non-specific asset investment; minimal information exchange; low levels of interdependence; low transaction costs, and minimal investment in governance mechanism (Wu 2013:22). The RV theory is

formed on the basis that productivity gains in the value chain were found to be possible when trading partners are willing to invest in specific relationships and combine their resources in an inimitable way (Wieland & Marcus 2012:303).

However, as in accordance with Singh (2008:2), it is imperative to note that the genesis of the RV theory has been directly driven by three different sets of influences. These are: gaps in literature on the sources of superior returns (rents) and competitive advantage from alliances; prior empirical research conducted by Dyer in 1993 and 1996 on the vertical alliances, which highlighted the possible sources of rents and competitive advantage from alliances in general; and the empirical study conducted by Singh in 1997, which explored the nature of synergies and conditions under which firms can generate joint value through such transactions (Singh 2008:3).

- Gaps in Alliance Literature

Over the past decades, business practices, processes and strategies have rapidly changed as a result of technological evolvements and extreme competition. In these very demanding business conditions, a firm's success depends on the ability and speed with which the firm reacts to developments in especially the digital market (Low & Chen 2013:180). As such, firms are compelled to assess their business operations and examine their internal and external connections with their business partners in order to satisfy changing customer needs, react to the new business models and strategies of their rivals, and capitalise on the unveiling opportunities from new technological developments (Low & Chen 2013:180). More so, competition in the modern business world has shifted from individual firms to supply chains in which these firms belong (Bayraktar, Demirbag, Koh, Tatoglu & Zaim 2008:133).

In light of such developments, enhanced competitiveness requires that firms ceaselessly integrate within a network of businesses and organisations. This integration of firms within a network has resulted in more emphasis being placed on supply chain management (SCM). Consequently, the focus of strategic management studies investigating the sources of firms' competitive advantage and performance have shifted from an individual firm belonging to an industry with structural characteristics (the Market Based View), to an individual firm that accumulates heterogeneous resources (the Resource Based View) and to a network of firm relationships (the Relational View) (Lavie 2006:639).

The extant literature (Lavie 2006; Wu 2013) on the sources of firms' competitive advantage consent that the RV theory is not a replacement of previous theories. Their view suggests that the RV theory supplements both the Market and Resource Based Views, and further claim that it extends the concept of critical resources of the Resource Based View to relational resources. The next section provides a brief discussion of the Market and the Resource Based views.

a) The Market Based View

The Market Based View is a theory postulated by Porter in 1980. It holds that a firm's supernormal returns (firm performance) are primarily explained by its membership in an industry with specific and favourable structural characteristics. These encompass the relative bargaining power of buyers and suppliers, the existence of barriers to new entry, rivalry among existing firms and the existence of substitute products (Porter 1980:3). In other words, the activities of the industry in which a firm belongs is the primary source of the firm's competitive edge against its rivals. As a result, several studies conducted on a firm's sources of competitive advantage focused on the industry in which a firm belongs as a unit of analysis for explaining the individual firm's differential performance (Singh 2008:2).

b) The Resource Based View

The Resource Based View was officially named in 1984 by Wernerfelt. However, its roots stem from the works of Penrose (1959). The theory postulates that the heterogeneity of a firm's resources mainly explain its superior returns (firm performance) (Kraaijenbrink, Spender & Groen 2010:351). It further holds that firms able to accumulate rare, valuable, inimitable and non-substitutable resources and capabilities will achieve a competitive advantage over their competitors (Kraaijenbrink *et al*., 2010:351). The Resource Based View advocates that a firm's competitive advantage is a result of the heterogeneous resources and capabilities owned and controlled by that individual firm (Kraaijenbrink *et al*., 2010:350). Consequently, the investigation on sources of a firm's competitive advantage has focused on its internal resources (Singh 2008:2). More so, most studies conducted on the sources of a firm's competitive advantage shifted focus to using a firm as the main unit of analysis for explaining its differential performance (Dyer & Singh 1998:660). According to Singh (2008:1), the Resource Based View advocates that an individual firm should attempt to protect rather than share its valuable proprietary information to prevent

knowledge spillovers, which could eliminate the firm's competitive edge over its competitors. However, a firm's critical resources may span beyond an individual firm's boundaries and need to be shared systematically among the alliance partners in order to generate rents for all the partners (Wu 2013:22).

The Market and the Resource Based Views have significantly and substantially contributed to the initial understanding of the sources of a firm's competitive advantage where firms compete on an individual basis (Dyer & Singh 1998:660). However, as earlier noted, the evolution in technology have also shifted the rules of business competition worldwide, currently emphasising competition between supply chains (networks) rather than that of individual firms. Consequently, the Market and Resource Based Views have been reported to be inadequate in explaining the sources of differential performance and competitive advantages in alliances (Lavie 2006:639). This is because these theories overlooked the fact that the advantages (or disadvantages) of an individual firm are often linked to the advantages (or disadvantages) of a network of relationships (in essence a supply chain) in which the firm is embedded.

It is from such deficiencies in literature that the notion of the RV theory is founded, to supplement and complement the two theories (Market and Resource Based Views) on firms' competitive advantage. For instance, as earlier noted, where the Resource Based View suggests that an individual firm should protect its critical resources such as valuable proprietary knowledge, the RV theory requires that firms systematically share their resources, even their critical and valuable proprietary knowledge with their alliance partners. More so, the firms should willingly accept knowledge spill-overs to competitors in return for access to their alliance partners' stock of critical and valuable proprietary knowledge as well, in order to generate rents and a competitive edge over their competitors (Singh 2008:2). The current study is in agreement with the RV theory especially on the basis that technonology is driving firms in the contemporary business world to share their resources with their supply chain member firms to remain competitive.

2.2.2. Assumptions of the Relational View

As noted earlier, the RV theory is an extended version of the Resource Based View that extends from the critical resources to the relational resources. The theory thus assumes that the critical resources of a firm may extend beyond the firm's boundaries and may be embedded in the inter-organisational processes and routines (Chinomona & Hove 2015:65). The theory holds that the relationship between firms or a pair of network/dyad of firms is an increasingly important unit of analysis for understanding firms' differential performance (relational rents) and competitive advantage. The RV theory identifies four potential sources of inter-organisational competitive advantage, which are: inter-organisational relation-specific assets; knowledge sharing; complementary resources/capabilities endowment and effective governance (Walker, Schotanus, Bakker & Harland 2013:2). The next paragraphs provide a brief discussion of the four identified sources of relational rents.

- Inter-Organisational Relation-Specific Assets

As noted earlier, production gains in an alliance or supply chain are possible when the member firms are willing to make investments that are specific to their relationship with other alliance/supply chain member firms (Chinomona & Hove 2015:65). In other words, this source of relational rents requires that firms choose to seek competitive advantages by creating assets that are highly specialised in relation to the assets of an alliance partner(s) in order to develop a competitive edge against rivals. The relation-specific assets range from site asset specificity, physical asset specificity to human asset specificity.

Site asset specificity has been defined as a situation in which successive production stages that are immobile in nature are located to one another (Dyer & Singh 1998:661). The physical asset specificity refers to tangible capital investments that are made for specific transactions such as dies and machinery that tailor processes to certain exchange partners (Dyer & Singh 1998:661). Human asset specificity has been defined as the transaction specific know-how accumulated by transactions through long term relationships (Rosenzweig 2009:464). For instance, the Toyota guest engineers who learnt the Toyota systems, procedures and the individuals idiosyncratic to Toyota were known as the buying firms. Therefore, relation specific assets assist firms to lower the total costs of the value chain, lead to greater product differentiation, faster product developments and relatively few defects (Rosenzweig

2009:464). Levinthal and Wu (2010:40), however, argue that asset specificity results in sunk costs, which increase the risk of alliance partners.

- Inter-Organisational Knowledge-Sharing Routines

The inter-organisational knowledge sharing routine is a source of relational rents that requires the alliance partners to share their knowledge with each other in order to learn and develop a competitive advantage. Inter-organisational information sharing routine is a regular pattern of inter-firm interactions that allow transfer, recombination or creation of specialised knowledge (Rosenzweig 2009:464). A study by Von Hippel (1988:6) advocates that a production network with superior mechanisms to transfer knowledge among the buyers, suppliers and manufacturers, will be able to innovate to a large extent compared to production networks with less effective mechanisms/routines of sharing knowledge. In other words, firms that are unable to position themselves in learning networks or alliances, experience a competitive disadvantage (Powell, Kopur & Smith-Doerr 1996:118).

In addition, Dyer and Singh (1998:665) advocate that the creation of knowledge sharing routines and mechanisms through network or alliance partners are in most cases the principal source of new ideas and information that generate innovations and technologies that enhance performance. They further argue that the key facilitator for the creation of knowledge sharing routines through alliances is ensuring the positive side of partner specific absorptive capacity and avoiding its downside. This can be done through employing incentives to encourage transparency and discourage free riding among alliance partners. Absorptive capacity refers to the level of a firm's prior related knowledge, which confers an ability to recognise the value of new information, assimilate and apply it to commercial ends (Cao & Zhang 2013:23). However, knowledge sharing is also facilitated by trust among alliance partners (Adler 2001:6), proper identification of partners (Zollo, Reuer & Singh 2002:710) and the mechanism of alliance governance (Lavie 2006:645).

- Complementary Resources/Capabilities

The complementary resources/capabilities are a source of relational rent that depends on a firm's ability to develop a competitive advantage using its heterogeneous resources in relation with the complementary resources/capabilities of an alliance partner. Complementary resource endowments refer to the distinctive

resources of alliance partners that collectively generate higher relational rents than the total of the rents from individual firms endowed of each partner (Walker *et al*., 2013:2). The relational resources that generate relational rents through alliances require that: neither firm in the alliance can purchase the resources in a required secondary market; and that the resources must be indivisible in order to create an incentive for every firm in the alliance to access the complementary or relational resources (Lavie 2006:645). However, the process of generating relational rents has been associated with the following challenges: that firms must find each other and recognise the potential value of combining resources; and that it is often too costly and difficult, if not impossible, to place value on the relational/complementary resources of potential partners (Wieland & Marcus 2012:303).

- Effective Governance

Governance is the fourth source of relational rents identified by Dyer and Singh (1998), and develops relational rents through its influence on transaction costs as well as the alliance partners' willingness to participate in value-creation initiatives. According to Wu (2007:252), effective governance encompasses minimising transaction costs and maximising opportunity value creation initiatives. Network or alliance partners that enforce efficient governance structures will have a competitive edge over network partners that do not employ such mechanisms (Cao & Zhang 2013:19). Dyer and Singh (1998) in their study identify two types of governance used by alliance partners: firstly, the governance that relies on third-party enforcement of agreements (such as legal contracts); secondly, the governance that self-enforces agreements, and does not involve any third parties to determine whether a breach of contract has occurred (Lavie 2006:647). In other words, on the one hand the governance involving third party enforcement of agreements requires that dispute resolution in alliances involve a third party enforcer, whether it be the state (for example through contracts) or a legitimate organisation authority.

On the other hand, self-enforcing agreements governance employs safeguards that permit self-enforcement when resolving disputes in alliances and these include trust for each other, reputation and financial hostage (Chinomona & Hove 2015:65). According to Dyer and Singh (1998:669), self-enforcing safeguards are more effective than third party enforcing agreements. This is mainly because self-enforcing safeguards yield a lot of benefits to the alliance partners, which include: reducing

transaction costs such as contracting costs, monitoring, adaptation and re-contracting costs between alliance partners. It also supports the sharing of tacit information and exchange of resources that cannot be easily done in the markets (Chinomona & Hove 2015:64-65).

The RV theory has also proposed four isolating mechanisms that can help sustain an alliance's competitive advantage. These include inter-organisational asset connectedness, partner scarcity/rareness, resource indivisibility/co-evolution of capabilities and the institutional environment. Its mechanisms are explained in the following sections.

- Inter-Organisational Asset Connectedness

The inter-organisational asset connectedness mechanism requires that the alliance partners have their assets connected inimitably together in order to preserve the relational rents and the competitive advantage generated through the alliance. Investment in relation specific assets is also subject to the way partners accumulate their asset stock and connect them together (Walker *et al*., 2013:3).

- Partner Scarcity/Rareness

The partner scarcity or rareness is a mechanism that posits that competitors experience some difficulties when finding potential partners for creating similar competitive advantage through inter-organisational relationships involving situations such as a high degree of resource dependence and a high level of complementarity (Dyer, Singh & Kale 2008:146). Thus, the alliance partners can preserve their relational rents and competitive advantage from their alliance as the competitors cannot easily find partners to imitate similar relational rents through an alliance.

- Resource Indivisibility/Co-evolution of Capabilities

Resource indivisibility as defined by Cool, Costa and Diericks (2002:217) refers to assets or capabilities that may have co-evolved with the network or alliance over time such that they become inimitable and indivisible. As such, the alliance partners can preserve their relational rents and competitive advantage through their indivisible and inimitable alliance capabilities.

- The Institutional Environment

The institutional environment explains the resource mobility barriers as a function of a firm's unwillingness to acquire and imitate resources (Oliver 1997:704). Huff and Kelley (2003:83) argue that the institutional environment may enhance or constrain reputation, trust and cooperation among alliance partners. Where trust, goodwill and cooperation are enhanced among the alliance partners, partners can preserve their relational rents through resource mobility within the alliance.

The RV theory has been criticised for not examining the issues concerning efficiency enhanced by competition (Molina 1999:185). More so, it does not account for the potential disadvantages that may result from close inter-organisational relationships such as loss of proprietary information, management complexities, financial and organisational risk, risk of becoming a dependent partner and partially losing decision autonomy (Wu 2007:252).

Relating the RV theory to the current study, this study submits that an effort by supply chain member firms to collaborate with each other through technology is likely to create a supportive inter-organizational environment that can enhance the effective sharing of strategic and essential information. The other likelihood is that the supply chain member firms may learn collectively and create a supply chain competence which may ultimately improve the performance of the entire supply chain. The application of the RV theory is further provided in sections of Chapter 3 in this study. The LKP is discussed in the next section.

2.3. THE LEARNING AND KNOWLEDGE PERSPECTIVE THEORY

The development of the LKP theory can be linked to the works of Kogut (1988) and Hamel (1991). The theory postulates that supply chain partners establish network or alliance relationships to exploit opportunities that reveal knowledge creation and organisational learning (Cao 2007:21). Verwaal and Hesselmans (2004:444) in support argue that firms can strengthen their competitive advantage through knowledge creation and organisational learning. The theory views collaboration in supply chains as an effective means of transferring knowledge and new technical skills across firms (Cao 2007:17). This is mainly because collaboration in supply chains provides a conducive environment for learning (Verwaal & Hesselmans 2004:445) and enhances partner-enabled knowledge creation in markets (Malhotra,

Gasains & El-Sawy 2005:22). The argument is that collaboration in supply chains facilitates the sharing of tacit knowledge among supply chain member firms, and it might be difficult for individual firms to find and buy such knowledge in the market due to its tacit nature. This implies that firms can only access tacit knowledge of the other firms through relationships such as collaborations in supply chains, which creates an advantage only to the collaborating partners.

The LKP theory submits that there are two types of learning activity that take place in supply chain collaborations, and these are: exploitation and exploration learning (Cao 2007:17; Subramani 2004:47). On the one hand, exploitation learning results from the supply chain collaboration activities aimed at improving a firm's existing capabilities (Subramani 2004:47). On the other hand, exploration learning results from supply chain collaboration activities aimed at discovering new opportunities for the firm, for example, improving a firm's absorptive capacity (Subramani 2004:47). As noted earlier in the RV theory, the absorptive capacity of a firm which is its ability to recognise the value of new and external knowledge, assimilate and apply it to commercial ends, is the primary determinant of a firm's learning ability through supply chain collaboration (Cao 2007:17). More so, a firm's ability to learn can be determined by employee quality, knowledge base, organisational culture and the quality of information systems (Cao 2007:17). However, the LKP theory, similarly to the RV theory, has been criticised for inadequately addressing the required level of privileged information sharing for collaborating supply chain members in fear of risky information leakages (Cao 2007:18).

In this study the LKP theory is employed as a secondary and supporting theory to the RV theory. It is used to explain the influence of supply chain e-collaboration on strategic sharing of information about the unique as well as tacit capabilities accruing to the supply chain member firms, which usually are not available for sale in the markets. The LKP theory is also employed to explain the resultant supply chain competence as well as supply chain performance in the following chapters.

2.4. CHAPTER SUMMARY

The chapter discussed in detail the RV, which is the main theory as well as the LKP, the supporting theory. The history and development of the RV theory was provided and its assumptions were explained. Gaps in the alliance literature together with the previous empirical evidence from Dyer and Singh's studies were the two main attributing factors in the development of the RV theory. The LKPtheory was also discussed in detail. The next chapter (Chapter 3) focuses on the previous literature on intra-firm supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance.

CHAPTER 3

A REVIEW OF SUPPLY CHAIN MANAGEMENT PRACTICES

3.1. INTRODUCTION

In contemporary business environments, survival and growth are the watchwords, while failure is the most persuading event that compels most businesses forward (Supply Chain Foresight 2009:21). Consequently, most modern firms are primarily concerned with practices and strategies that enhance cost containment as well as efficiency in order to enhance their survival and growth chances. Technology has enabled supply chain collaborations among firms with their suppliers; customers as well as competitors have recently augmented and implemented cost containment and efficiency as an important business practice. The purpose of this chapter is to provide both a theoretical and empirical assessment of literature on intra-firm supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. The next sections focus on supply chain management and practice globally as well as in South Africa.

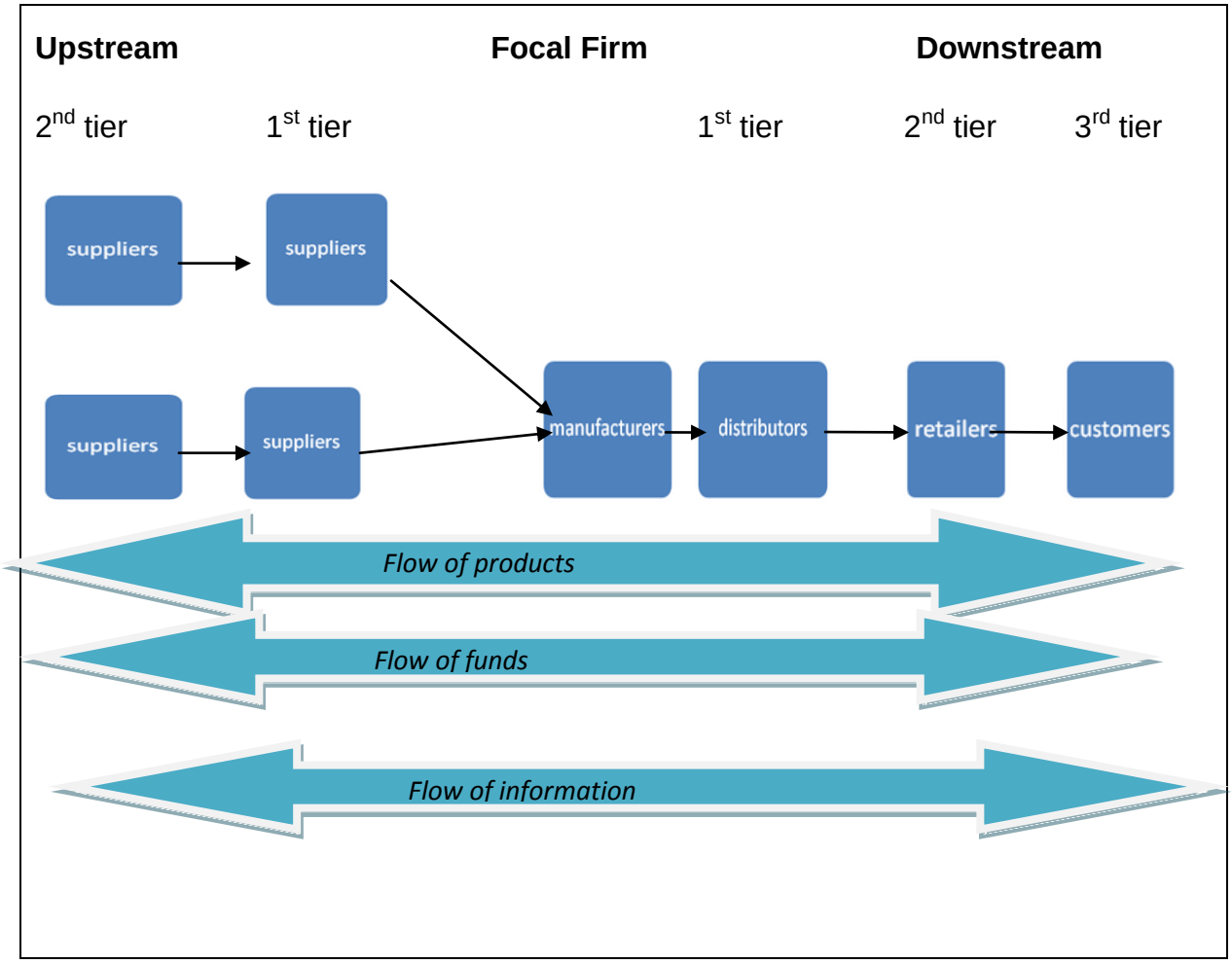
3.2. SUPPLY CHAIN

This section provides the theoretical and empirical evidence on intra-firm supply chain practices. It commences by discussing the concept of supply chain and supply chain management, its evolution along with definitions, and focuses on supply chain practices. Furthermore, prior to the empirical review section, intra-firm supply chain practices are grounded on the RV theory. Finally, empirical evidence on supply chain practices is presented.

Mangan, Lalwani, Butcher and Javadpour (2012:10) define supply chain as a network of all business entities involved, through the upstream and downstream linkages, in the various processes and activities that create value to the end customer in the form of products and services. The APICS Dictionary (2010:148) refers to it as a ‘global network used to deliver products and services from raw materials to end customers through an engineered flow of information, physical distribution and cash’. Thus, key to a supply chain are the upstream-downstream connections between firms in the same network which enables them to deliver value

(in the form of products/services) to ultimate customers across the globe. A pictorial representation of a supply chain is depicted in Figure 3.1.

Figure 3.1: A Supply Chain



Source: Sanders (2012:3)

As can be seen from Figure 3.1 above, a supply chain is a network of all business entities ranging from the suppliers, manufacturers, wholesalers/distributors and retailers that are involved in producing and delivering the final product to the end customer (Sanders 2012:3). As advocated by Sanders (2012:3), a supply chain encompasses the sourcing of raw materials and parts from the suppliers, the transformation of raw materials into semi-finished products and assembling them into finished products by manufacturers, the storage of goods in warehouses, order entry and tracking, distribution and delivery to the final customer by the distributors as well as retailers. It involves the flow of products, funds as well as information from the tier 2 suppliers through the focal firm down to the tier 3 or final customers.

According to Sanders (2012:5), tier 1 suppliers are the suppliers that directly supply goods and services to the focal firm or manufacturer of the original equipment. The tier 2 suppliers are the firms that directly supply the focal firm's tier 1 suppliers with goods and services. The tier 1 customers are the wholesalers or distributors who directly buy the finished products from the focal firm and sell them to the retailers. Tier 2 customers are the retailing firms which directly buy goods from the wholesalers and sell them to the end users. Tier 3 customers are the end users or consumers of the products sold by the retailers (Sanders 2012:5). The management of the linkages between the firms in a supply chain in the production of goods and services is known as supply chain management, which is discussed in the next section.

3.3. THE SUPPLY CHAIN MANAGEMENT FRAMEWORK

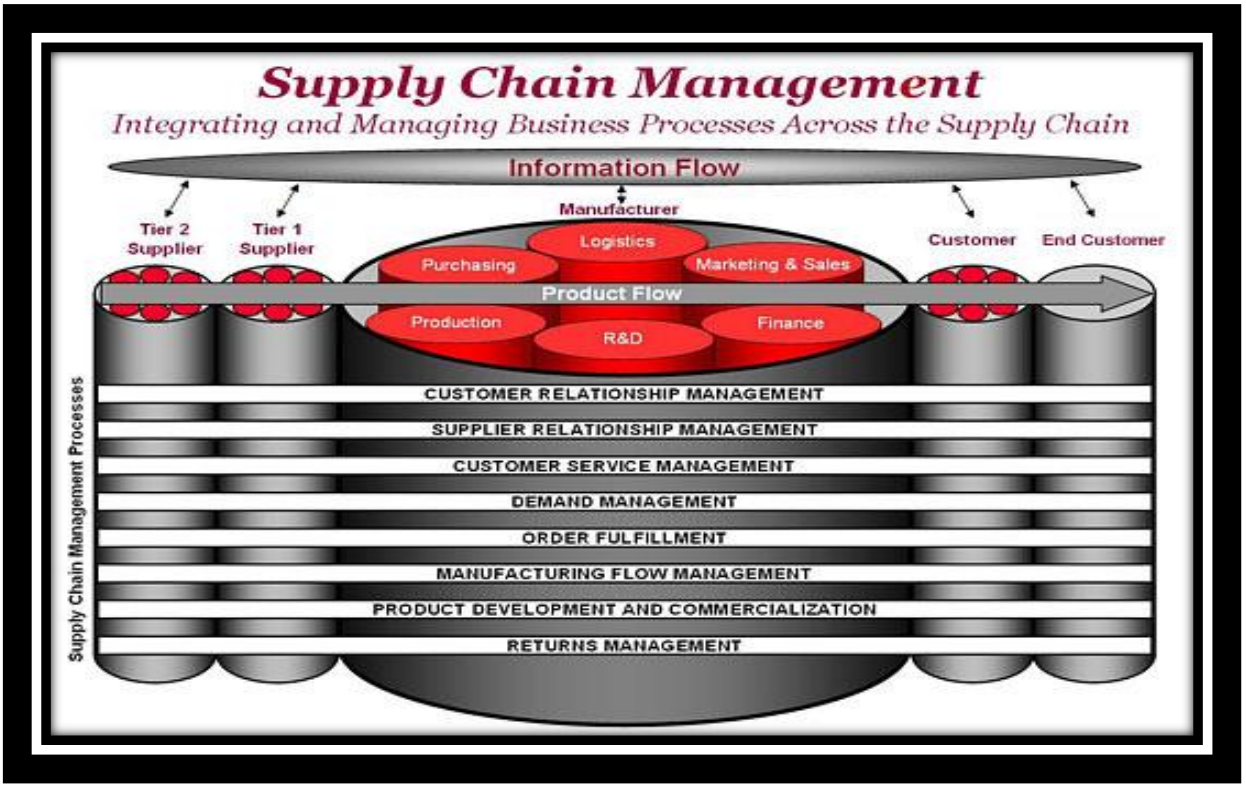
As advocated by Taderera (2010:11) effective supply chain management requires that the primary cross-functional supply chain business processes be integrated both within the firm and across the network of firms that comprise the supply chain. Supply chain management is the management of interconnections of businesses and firms which relate to each other through upstream and downstream connections. These connections are between the different processes that produce value in the form of products and services to the ultimate consumer (Slack *et al*., 2001:4). The Global Supply Chain Forum (GSCF) cited in Slack *et al*. (2001:4) referred to supply chain management as "the key process integration from the end user customers through to the original suppliers that provide value adding products, services and information for customers and other stakeholders." In other words, effective supply chain management entails a shift from the management of individual functions to the integration of activities into key supply chain processes. Its main focus is on the management of key relationships as well as improving performance.

Taderera (2010:11) advocates that supply chain management must address the problems to do with business process integration and information flow. This means that business process integration must be through the supply chain with the intention of sharing valuable information such as demand signals, forecasts, inventory, transportation and potential collaborations, among other aspects (Taderera 2010:11). Nevertheless, many business executives in the contemporary business world fail to attain the basic key business processes integration, and as a result yield poor performance (Lambert 2008:6). Lambert (2008:6) reports that the root cause of such

failure is the business executives' lack of a full understanding of the supply chain management processes and the linkages required to integrate them.

A supply chain management framework is claimed to help provide such understanding of supply chain business processes and their required linkages through the supply chain management components (Lambert 2008:6, Stock & Lambert 2001:58). Several supply chain management frameworks have been suggested by various authors. The notable examples include the SCORS framework by the Supply Chain Council and the three interrelated elements of supply chain management framework by Lambert and Cooper (2000). This study adopts the three interrelated elements of supply chain management framework suggested by Lambert and Cooper (2000) because it befits the study's purpose. Figure 3.2 presents the supply chain management framework.

FIGURE 3.2: Supply Chain Management Framework



Source: Lambert (2008:6)

Figure 3.2 illustrates a supply chain management framework. As described by Lambert and Cooper (2000:69), a supply chain management framework comprises three interrelated elements which are: supply chain network structure, supply chain

business processes, and supply chain management components. These elements are discussed in the next sections.

3.3.1. Supply Chain Network Structure

A supply chain network structure constitutes the supply chain member firms, structural dimensions of the network and the links between these firms across a supply chain (Stock & Lambert 2001:58, Lambert & Cooper 2000:69).

3.3.1.1. Supply chain member firms

The supply chain member firms are shown in Figure 3.2, as tier 1 and 2 supplier, manufacturer, customer as well as end customer. Manufacturers, also commonly known as the original equipment manufacturers (OEMs), are firms that produce the final good/product for sale in the consumer market (Sarokin 2014), for example, a car, computer or an airplane. Practical examples of the manufactures or OEMs in the case of, for instance, an automotive industry, include Toyota, Ford and General Motors among others.

Firms that supply the manufacturers or OEMs with their required sub-assemblies, materials and components are often structured into tiers that show their level of direct access and accountability (commercial distance) to the manufacturers (Sarokin 2014). Tier 1 suppliers directly supply components or provide service to the manufacturers or OEMs. For instance, in the case of an automotive industry, the tier 1 suppliers meet the required specifications and state of completion by providing the manufacturers or OEMs such as Toyota and Ford with components like seats, exhaust gas sensors, tires, brakes, battery packs, windows and engines. The tier 2 suppliers are the direct suppliers of materials to the tier 1 suppliers (Sarokin 2014). An example in an automotive industry will be that of a firm supplying paint for the bumpers to a tier 1 supplier.

A customer as shown in Figure 3.2 is a firm that purchases final products for resale to other firms or individuals. An example will include all the garages such as the Fouche Motors and the Motor World purchasing cars and other vehicles from the automotive manufacturers or OEMs like Toyota, Ford and General Motors, in order to resale them to the end users. The End user customers are the final users or consumers of the final products such as cars and other vehicles in the case of an automotive industry (Sarokin 2014).

The tier 1 and 2 suppliers, manufacturers, customers as well as end user customers are the supply chain members, and have been classified by Lambert and Cooper (2000:70) into primary and secondary members. Stock and Lambert (2001:63) define primary members as 'all those self-governing strategic business units who perform value adding activities (operational and or managerial) in the business processes, designed to produce a specific output for a particular customer or market'. Supporting members in accordance with Lambert and Cooper (2000:70) refer to firms that focus on the resources, knowledge, utilities and or assets provision to the primary members. It is therefore imperative that firms in a supply chain demonstrate the ability to distinguish between their primary and supporting member firms. This is essential in order for firms to choose the most appropriate links and relationships to nature and invest in. According to Lambert and Cooper (2000:81), successful supply chain management requires firms to integrate their business processes with their key and primary supply chain members. In other words, firms need to invest in their links and relationships with the primary supply chain members and develop them into collaborations that encourage them to share strategic information with each other.

3.3.1.2. Structural dimensions of the network

The structural dimensions of the network include the horizontal and vertical structure as well as the horizontal position of a firm in a supply chain (Stock & Lambert 2001:64, Lambert & Cooper 2000:71). Stock and Lambert (2001:64) define the horizontal structure as the amount of tiers present across the supply chain. For instance, where there are numerous tiers, the horizontal structure becomes long, whereas, with few tiers, the horizontal structure is short. The vertical structure as defined by Lambert and Cooper (2000:71) is the amount of suppliers and or customers represented in each tier. With few suppliers or customers at each tier level, the vertical structure becomes narrow, while with numerous suppliers or customers, the vertical structure is wider. The horizontal position of a firm in the supply chain is another important structural dimension of the network. Firms need to consider their horizontal positions in a supply chain in order for them to identify and develop suitable relationships and links with their key supply chain members (Stock & Lambert 2001:64). In a supply chain, a firm could be positioned at or near the original source of supply, be at or near the end user/customer, or be positioned somewhere between the original source of supply and end user (Stock & Lambert 2001:64; Lambert & Cooper 2000:71).

All in all, the supply chain network is an important determining factor in a number of supply chain practices. For instance, a firm needs to have sound knowledge and understanding of its primary supply chain members before investing in long term contracts with long term relationships that can lead to collaborations and coordination of business processes. More so, a firm's knowledge and understanding of its position in a supply chain network can encourage effective supply chain planning, JIT production and delivery practices. Supply chain business processes are discussed in the next section.

3.3.2. Supply Chain Business Processes

Supply chain business processes in accordance with Stock and Lambert (2001:58) are the 'activities that generate a particular output of value to the customer'. Eight key supply chain business processes have been identified by Lambert and Cooper (2000:72) and are depicted by the supply chain management framework in Figure 3.2. The supply chain business processes embrace: 'customer relationship management, customer service management, demand management, order fulfilment, manufacturing flow management, procurement, product development and commercialisation as well as returns management' (Stock & Lambert 2001:68, Lambert & Cooper 2000:72).

3.3.2.1. Customer relationship management

Chopra and Meindl (2010:473) refer to customer relationship management as the processes that focus on downstream interactions between the firm and its customers. According to Li *et al*. (2006:109), customer relationship management constitutes the entire range of practices that are used for the purpose of building and managing a firm's long term relationships with its customers, managing the complaints of customers as well as improving customer satisfaction. The major processes of customer relationship management include marketing, sell, order management and call/service centre (Chopra & Meindl 2010:473). Li *et al*. (2006:109) consider customer relationship management as an important component of supply chain management practices. Sukati, Hamid, Baharun and Said (2011:4) in support, add that a firm's customer relationship management practices can generate its success in supply chain management practices efforts as well as improve its performance.

As an important element of supply chain management practices, a firm's close relations with its customers enables and encourages long term relationships that can lead to collaborations as well as the sharing of strategic information between the firm and its customers. More so, a firm's close relations with its customers can allow a firm to differentiate its products from those of its competitors, sustain customer loyalty and rapidly extend the value it provides to its customers (Sukati *et al*., 2011:4).

3.3.2.2. Supplier relationship management

According to Chopra and Meindl (2010:477), supplier relationship management includes those processes that deal with the interactions between a firm and its upstream suppliers in a supply chain. It provides the structure for methods of developing and maintaining relationships with suppliers (Lambert 2008:6). The supplier relationship management processes include design collaboration, sourcing, negotiating, buying and supply collaboration (Chopra & Meindl 2010:478). Lambert (2008:6) emphasises that a firm needs to develop close relationships with a small subset of its key suppliers, based on the value that the firm gets from those suppliers over time. Lambert (2008:6) further appends that in most cases firms tend to keep their most traditional relationships with suppliers because they consider them to be key. As in the case of customer relationship management, a firm's closer relations with its key long term suppliers can lead to the establishment of long term collaborations and the sharing of strategic information. This in turn creates a sustainable competitive advantage and improves the performance of the firm as well as for the entire supply chain.

3.3.2.3. Customer service management

Customer service management has been described by Lambert (2008:6) as the supply chain business process developed by customer teams as part of the customer relationship management process, and deals with the administration of the product and service agreements. It aims at solving the problems before they affect the customer. Effective customer service management requires the service management team to be aligned with the other process teams to ensure that promises made in the product and service agreements are delivered as planned (Lysons & Farrington 2012:93; Lambert 2008:6). This will create a competitive advantage for the firm and the supply chain as a whole.

3.3.2.4. Demand management

Demand management, as defined by Lambert (2008:7), is a supply chain business process that matches customers' requirements with the supply chain capabilities. The process involves demand forecasting, harmonising supply and demand, enhancing flexibility as well as reducing variability (Salazar 2012:1). Sound and effective demand management processes employ both the point-of-sale and key customer data to reduce uncertainty as well as providing efficient information flows throughout the supply chain (Burt, Petcavage & Pinkerton 2010:530; Lambert 2008:7). More so, demand management in advanced applications allows for the synchronisation of customer demand and production rates in inventory management globally (Lysons & Farrington 2012:94). Proper demand management is key to supply chain practices that involve the sharing of strategic information such as the demand forecast and variability. More so, it can provide a competence for a firm and the entire supply chain especially when interfaced with other supply chain business processes like customer and supplier relationship management, as well as customer service management.

3.3.2.5. Order fulfilment

Order fulfilment is a supply chain business process that embraces all the activities required in designing a network and enabling a firm to meet its customer requests at a minimal total delivered cost (Lambert 2008:7). This process aims at developing a seamless process which ranges from various customer segments to the firm and to its suppliers. Order fulfilment is a process which requires implementation across functions and encourages higher levels of coordination and collaborations between a firm and its key suppliers as well as customers (Lambert 2008:7). More so, it requires the firm to integrate its manufacturing, distribution and transportation plans with those of its primary suppliers as well as customers (Lysons & Farrington 2012:94; Stock & Lambert 2001:70). Such integrations between firms in a supply chain help these firms to promptly meet their customer requirements and reduce total delivered cost to customer (Stock & Lambert 2001:70).

3.3.2.6. Manufacturing flow management

Lambert (2008:7) refers to the manufacturing flow management as a supply chain business process which constitutes all the essential activities in obtaining,

implementing, as well as managing the manufacturing flexibility in the supply chain along with moving products in, through and out of the plants. Manufacturing flexibility, as in accordance with Lambert (2008:7), shows the ability of a firm to make a wide range of products in a timely manner at the lowest possible cost. Manufacturing flow management processes can encourage the implementation of the JIT supply chain practices. In addition, through the achievement of the desired level of manufacturing flexibility, the manufacturing flow management processes can encourage collaborations between a firm and its key suppliers as well as its customers. More so, manufacturing flexibility can help create a sustainable competence for the firm as well as the entire supply chain.

3.3.2.7. Product development and commercialisation

Product development and commercialisation is a supply chain business process that integrates suppliers and customers in the product development process with an aim of reducing time to market (Lambert & Cooper 2000:74). Its team needs to synchronise with both the customer and supplier relationship management process teams in the identification of the (un)articulated customer needs; the selection of materials and suppliers as well as the production technology development necessary for manufacturing and implementing the best product flow for the product/market combination (Lysons & Farrington 2012:94; Stock & Lambert 2000:71). Successful product development and commercialisation requires the implementation of the JIT supply chain practices, long term collaborations, and sharing of strategic information between a firm and its suppliers as well as its customers. This enables firms to develop the right products with shorter life cycles. More so, effective product development and commercialisation can be a source of both a firm's and the entire supply chain's competence.

3.3.2.8. Returns Management

Lambert (2008:7) refers to returns management as the supply chain business process that involves the management of activities associated with returns, reverse logistics and avoidance within the firms as well as across the key members of the supply chain. This process, if properly implemented, allows a firm to efficiently manage the reverse product flow by identifying opportunities to reduce unwanted returns as well as controlling reusable assets such as containers (Stock & Lambert 2001:71). The returns management process is crucial as it has the potential to

reduce costs and increase revenues by eliminating the supply chain management practices and performance failures that cause unwanted returns (Lysons & Farrington 2012:94; Lambert & Cooper 2000:76). The supply chain business processes can be integrated using the supply chain management components discussed in the next section.

3.3.3. Supply Chain Management Components

Supply chain management components are the third element in the supply chain management framework. The components are: planning and control, work structure, organisational structure, information flow, product flow facility structure, power and leadership structure, as well as culture and attitude (Stock & Lambert 2001:75). Firms in a supply chain need to plan for the integration of their business processes with each other in order to estimate for the costs involved and the expected returns. They also need to put a control system in place as a measure of supply chain business process integration and success of the entire supply chain.

Work structure as a supply chain management component serves as an indicator of a firm's ways of performing its tasks and activities (Lambert & Cooper 2000:78). This component can help reveal the areas where the firm is not performing well and where it will need assistance from its key members. The work structure element works hand in hand with the product flow facility structure, which is a network structure for sourcing, manufacturing and distribution across the supply chain. These two structures (work and product flow facility) play an important role during a firm's selection of key members with whom to connect and integrate its supply chain business processes in an attempt to improve firm and supply chain performance.

The level of supply chain business processes integration is measured by the organisational structure of firms or supply chain (Lambert & Cooper 2000:78). An organisational structure is a system used to delineate the sets of relations between functions in a firm or firms in a supply chain, where there is delegation, control and coordination of various work roles along with responsibilities (Grossi, Royakkers & Dignum 2007:225). A firm's or supply chain's organisational structure is an important determinant of the information flow facility structure. In other words, an organisational structure of a firm or supply chain can establish the ways through which information flows from one level to another within a firm or supply chain.

According to Lambert and Cooper (2000:78), the type of information shared and exchanged among the supply chain members along with the frequency of updating it has a strong influence on the efficiency of a supply chain. As such, firms need to properly manage their information and its flow in order to improve their supply chain efficiency and performance. The information flow facility in a supply chain can be influenced by the power and leadership structure across the supply chain. In other words, the exercise of power by leaders or lack thereof can influence the other supply chain member firms' commitment levels and participation (Lambert & Cooper 2000:78). This will in turn affect the supply chain members' willingness to share and exchange information with each other (Lambert & Cooper 2000:78).

Culture and attitude also have an effect on the information flow structure and the integration of supply chain business processes in a supply chain (Lambert & Cooper 2000:78). Thus, for firms in a supply chain to successfully integrate their supply chain business processes and effectively manage their information flow structures, there is need for compatibility in terms of their corporate cultures and individuals' attitudes (Stock & Lambert 2001:77). In other words, for a successful supply chain business processes integration and improved supply chain performance, the supply chain member firms need to establish a common ground on how their employees are valued and incorporated in the management of the firms (Lambert & Cooper 2000:78).

3.4. THE OVERVIEW AND EVOLUTION OF SUPPLY CHAIN MANAGEMENT

According to Crandall, Crandall and Chen (2010:6) the origins of supply chain management can be traced to the introductory stages of early trade, where the traders obtained goods from the merchants and delivered the requested goods to the buyers. Its development has been substantially influenced by various aspects, ranging from logistics and transportation, operations management, materials and distribution management, marketing, purchasing as well as evolutions in information technology (Jain, Dangayach, Agarwal & Banerjee 2010:11). According to Wisner, Tan and Leong (2012:14), supply chain management has evolved along two parallel parts which are: the purchasing and supply chain management emphasis from the industrial buyers; and the transportation and logistics emphasis from the wholesalers and the retailers.

Supply chain management is founded upon four main elements, which are supply, operations, logistics and integration management (Wisner *et al*., 2012:15; Mbanje & Lunga 2015:4). Supply management refers to the identification, acquisition, access, positioning and management of a firm's required or potentially required resources in order to achieve its strategic objectives (Institute of Supply Management 2010). Although purchasing is still the core activity, the primary activities of supply management have extended beyond the basic purchasing function (Wisner *et al*., 2012:37). Thus, supply management activities now include logistics, negotiations, contract development and administration, inventory control management, as well as supplier relationship management (Wisner *et al*., 2012:37). Supply management, through its purchasing activity, helps to maximise customer satisfaction. This is because purchasing actively seeks for better materials and reliable suppliers, closely working with and exploiting the expertise of strategic suppliers to improve the quality of raw materials that involve the suppliers as well as the purchasing personnel in product design and development (Wisner *et al*., 2012:37).

Operations management is regarded as the second foundation of supply chain management. It is mainly concerned with demand management, the materials requirement plan (MRP) systems for effective inventory management, the enterprise resource planning (ERP) systems, which provide real time sales data to firms, the lean systems and the six sigma quality (Mbanje & Lunga 2015:4-5). Operations management enables the firm to produce the right amount of products. It also ensures finished products to conform to the specific components of cost, quality and customer service requirements (Wisner *et al*., 2012:17).

Logistics management is the third foundation of supply chain management. It involves a trade-off between the delivery cost and timing or customer service (Wisner *et al*., 2012:18). According to Lysons and Farrington (2012:87) logistics management 'may be regarded as a subsystem of the larger enterprise or a system of which purchasing, manufacturing, storage and transportation are a subsystem'. The primary focus of logistics management is on logistics management, customer relationship management, network design, global supply chains, sustainability and service response logistics (Wisner *et al*., 2012:18). Logistics management through its requirement of high levels of planning and coordination between the firm, customer and several logistics services used, such as transportation, warehousing, break-bulk

and repackaging services, enables firms to deliver products to the customer at the right time, quality and volume (Wisner *et al*., 2012:18; de Villiers *et al*., 2008:3).

Integration management is the fourth foundation of supply chain management. According to Wisner *et al*. (2012:21), a successful supply chain integration process occurs when the participants realise that effective supply chain management must be part of each member's strategic planning process. More so, it occurs where the policies and objectives of each firm are jointly determined and based on the end customer's needs and what the supply chain as a whole can do for them. The integration process is claimed to require high levels of internal functional integration of activities within each participating firms, such that the supply chain acts as one entity (Wisner *et al*., 2012:22). Integration management is an essential foundation of supply chain management because it enables firms to work together in order to maximise the total supply chain profits. This is done by determining the optimal purchase quantities, product availabilities, service levels, lead times, production quantities, use of technology and product support at each level within the supply chain (Wisner *et al*., 2012:22).

3.4.1. Supply Chain Management Definitions

As alluded to earlier, supply chain management offers indisputable benefits with eventual positive impacts on supply chain partners' performance. Business organisations worldwide are adopting the phenomenon with a view to achieve their objectives (de Villiers *et al*., 2008:28). In fact, supply chain management has become part of the acceptable new business model for various players across all industries (Mbanje & Lunga 2015:5). Its perceived importance since inception has led to various research, largely in developed countries to help with improving the network system (de Villiers *et al*., 2008:28).

Over time, through research, much commendable progress has been made towards understanding the fundamental nature of supply chain management. Yet, unless a reliable conceptual base is developed, the notion and practice of supply chain management might be in jeopardy (Chen & Paulraj 2004:120). More so, many authors have highlighted the pressing need for clearly defined constructs and conceptual frameworks to advance the field (Chen & Paulraj 2004:120).

While there is an increasing body of literature summing up definitions regarding supply chain management, the concept mainly encompasses the coordination of production, inventory, location and transportation among participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served (Hugos 2006:4). Lambert and Cooper (2000:66) define it as the integration of key business processes from the customer through to the original suppliers that provides products, services, and information that add value for the customers and other stakeholders.

In addition, Ivanov and Sokolov (2010:255) refer to supply chain management as a scientific discipline that studies human decisions in relation to cross-enterprise collaboration processes to transform and use resources in the most rational way along the entire value chain, from customers up to raw materials' suppliers, based on functional and structural integration, cooperation and coordination throughout. It is the global network used to deliver products and services from raw materials to the end customers through an engineered flow of information, physical distribution and cash (Kerber & Dreckshage 2011:1). According to Mentzer, De Witt, Keebler, Min, Nix, Smith and Zacharia (2001:18), supply chain management is the systematic strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long term performance of the individual firms and the supply chain as a whole.

Slack, Chambers and Johnston (2001:4) refer to it as the management of the interconnection of businesses and firms which relate to each other through upstream and downstream connections between the different processes that produce value in the form of products and services to the ultimate consumer. In other words, supply chain management brings a systems approach to understanding and managing the different activities needed to coordinate the flow of products and services to best serve the ultimate customer. Thus, effective supply chain management requires simultaneous improvements in both customer service levels and the internal operating efficiencies of the firm in the supply chain (Hugos 2006:50). However, to create such efficiencies, firms need to engage in initiatives and practices that connect the supply chain management processes across firms, for instance, adoption and integration of information technology in supply chain management processes, which

allow just-in-time production and inventory control systems, effective supply chain planning as well as delivery systems.

3.5. THE INTRA-FIRM SUPPLY CHAIN PRACTICES

Various authors have defined supply chain practices differently, ranging from a set of a firm's activities, or technologies to a firm's initiatives. Li, Rangu-Nathan, Rangu-Nathan and Rao (2006:109) have defined supply chain practices as a set of activities performed by firms to enhance efficient management of the supply chain. According to da Silva, Neto and Pires (2012:10), supply chain practices incorporate cooperation, training as well as support in the development of products, processes, purchases and delivery systems with a firm's suppliers. Van der Vaart and Van Donk (2008:47) define them as tangible activities or technologies that play a primary role in the collaboration among the focal firm, its suppliers and customers. In light of the above definitions, supply chain practices are therefore defined in this study as a set of intra-firm tangible activities, technologies or initiatives which encompass the supply chain planning, the JIT production and inventory control systems, as well as the delivery practices. These intra-firm practices are implemented by supply chain members (ranging from the focal firm, suppliers to customers), in order to enhance effective and efficient supply chain performance. Previous evidence on intra-firm supply chain practices is provided in the next section.

3.5.1. Review of Previous Studies on Supply Chain Practice

This section provides previous evidence on supply chain practices. It narrows down to explain the three main intra-firm supply chain practices employed in this study: the supply chain planning practice, JIT production and inventory practice and the delivery practice.

Day and Lichtenstein (2007) investigated the relationship between supply management practices, strategic orientation and organisational performance. In their study, Day and Lichtenstein (2007:317) categorised supply chain management practices into internal supply management processes and externally focused management practices (for example the buyer-supplier relationship development and supplier performance evaluation). Their study performed a fit-as-moderation approach, which employed the analysis variance to test the relationships. The findings of their study revealed that supply management practice, particularly the

purchasing practice, has an impact on firm performance, especially when the purchasing practice is strategically aligned to the business unit strategy.

A study by Bayraktar *et al*. (2008) investigated the relationship between information systems, supply chain management practices and operational performance, in a survey of 203 manufacturing Small and Medium Enterprises (SMEs) in Turkey. Their study employed twelve items to measure supply chain management practices including: close partnership with suppliers and with customers, just-in-time supply, e-procurement, outsourcing, subcontracting, strategic planning, supply chain benchmarking, the number of suppliers, third party logistics providers (3PLs) and holding safety stock. Using a structural equation modelling data analysis technique, their findings of the study showed that supply chain management practices positively influence operation performance of SMEs.

Li *et al*. (2006:107-124) examined the impact of supply chain management practices on competitive advantage and organisational performance. They measured supply chain management practices using five dimensions: strategic supplier partnership, customer relationship, levels of information sharing, quality of information sharing and postponement. Their study employed a structural equation modelling technique to test the posited relationships. Their findings indicated that higher levels of supply chain management practices can enhance competitive advantage and improve organisational performance.

Zhou and Benton (2007:1348-1365) investigated the integration of information sharing and intra-firm supply chain practice in supply chain management in North American firms. The study used three categories of intra-firm supply chain practice, which included: supply chain planning, just-in-time production and delivery practiceThe current study adopts the three categories of supply chain practice employed by Zhou and Benton (2007), and brief discussions of these three intra-firm practices are given in the next section.

a) Supply Chain Planning Practice

Supply chain planning as defined by Ivanov and Sokolov (2010:173) is ‘a purposeful, organised and continuous process including the synthesis of supply chain structures and elements, the analysis of their current state and interaction, the forecasting of their development for some period and the forming of mission-oriented programmes

as well as schedules for the transition to a required (optional) structural macro-state'. It seeks to accurately forecast future demands of the firm and coordinate several functions within the firm, its suppliers as well as its customers (Zhou & Benton 2007:1349). Supply chain planning practices are important to firms because they enable them to process information from suppliers, customers and internal operations (Zhou & Benton 2007:1349). In addition, effective planning in supply chains can help firms to minimise their costs and earn higher profits or revenues, while poor planning results in loss of profits or revenues (Ivanov & Sokolov 2010:173). Following the study by Zhou and Benton (2007), the current study seeks to measure the effectiveness of the supply chain planning practice through the implementation of the supply chain demand forecast and coordination practices.

b) Just-In-Time (JIT) Production Practice

According to Wisner *et al*. (2012:546), just-in-time production is a practice associated with Taiichi Ohno, a Toyota manager and his JIT kanban system, which encompasses continuous problem solving to eliminate waste. The JIT production and inventory practice comprises five elements, which are: the pull system, cycle time reduction, cellular manufacturing, agile manufacturing strategy and bottleneck removal (Zhou & Benton 2007:1349). A pull system has been defined by Wisner *et al*. (2012:549) as 'an operating system where synchronised work takes place only upon authorisation from another downstream user in the system rather than strictly to a forecast'. It seeks to precisely and timely meet customer demand. In JIT production and inventory practices, excess inventories are considered a waste because they tend to hide several purchasing, production and quality problems within a firm. As such, through the cycle time reduction practice, firms are required to reduce their inventory levels by, for example, reducing their purchase order quantities and production lot sizes (Wisner *et al*., 2012:270). Cycle time can also be reduced by moving the machine tools closer to the machines, improving tooling or die coupling, having standardised setup procedures and purchasing machines that require less setup time (Wisner *et al*., 2012:270). As argued by Zhou and Benton (2007:1349), cycle time reductions from running small batches allow firms to improve quality and timeliness feedback.

Cellular manufacturing in accordance with Wisner *et al*. (2012:270) is designed to process any product's parts, components or jobs requiring similar processing steps, hence saving duplication of equipment and labour. An agile manufacturing strategy as advocated by Zhou and Benton (2007:1349) is a practice that enables firms' production systems to cope with rapid changes in demand, which in turn enhances effectiveness of the entire supply chain. The bottleneck removal is a practice that balances resources and maximises production output (Zhou & Benton 2007:1349). Above all, JIT production and inventory practices help firms reduce wasted movements of workers, customers and or work-in-progress, thus improving the overall supply chain responsiveness and efficiency (Wisner *et al*., 2012:269).

c) Delivery Practice

According to Kerber and Brian (2011:192), delivery practice is an important element of achieving customer satisfaction by providing customers with the products they want when they want them. The key to effective delivery practice is delivering raw materials on time in order to deliver the finished goods on time to the customer (Kerber & Brian 2011:192). Delivery practice can be categorised into reliable delivery and flexibility in production and delivery. Reliable delivery requires that suppliers deliver products on schedule and in the right amounts required (Kerber & Brian 2011:192). Flexibility in production and delivery practice requires that suppliers be able to respond to customers' constant change in tastes with flexibility in production and delivery. In other words, the suppliers should not only be able to timely deliver products, but that they also be flexible enough to respond to the customers' change in tastes and requirements. All in all, effective delivery practice in supply chains is an outcome of effective planning and JIT production practices. Where the supply chain member firms are reluctant to effectively implement either the supply chain planning practice and/or the JIT production practice, delivery becomes untimely and ineffective. The next section provides a discussion on supply chain collaboration and e-collaboration.

3.6. SUPPLY CHAIN COLLABORATION AND E-COLLABORATION

3.6.1. Supply Chain Collaboration

Various authors have defined supply chain collaboration in different ways, ranging from a business process (Sheu, Yen & Chae 2006:16), a long term partnership (Cao 2007:53), to a supply chain organisational level (Ivanov & Sokolov 2010:7). Supply chain collaboration as defined by Cao (2007:53) is a long-term partnership in which supply chain member firms, sharing common goals, closely work together in order to achieve competitive advantages that exceed those achieved by a firm working individually. Sheu *et al*. (2006:16) in support of this, refers to it as a business process in which two or more supply chain member firms work together to achieve common goals as well as derive more mutual benefits than achieved by a firm working alone.

Ivanov and Sokolov (2010:7) have ranked supply chain collaboration the highest out of five supply chain organisation levels. The levels are in ascending order: open market negotiations - lowest; cooperation - low; communication or integration - middle; coordination - high; and collaboration - the highest level. According to Ivanov and Sokolov (2010:7), the open market negotiations deal with supply on the basis of commerce offers. Cooperation refers to the ability of a firm to make use of its long-term contracts with suppliers and customers to manage its supplies and demands. Communication/integration involves the building of channels and links within and outside the firm (Ivanov & Sokolov 2010:7).

Coordination refers to the systematic use of channels and links that result from cooperation such as e-mails, fax, the ERP system and transportation, to interchange information on, for instance, demand planning, inventory levels and/ or shipment control with RFID chips (Chinomona & Hove 2015:22). Finally, collaboration is defined by Ivanov and Sokolov (2010:7) as the highest level of supply chain organisation at which a firm ‘if along with integration and coordination, attracts both suppliers and customers to new product design and development, co-creates joint business collaborate in joint promotion actions and sales forecasts, as well as taking part in sharing of the know-how’. Thus, supply chain collaboration, in accordance with Ivanov and Sokolov (2010:7), contains joint business strategies, joint promotions, sales and order forecasts, the sharing of technological know-how as well as process synchronisation.

Ivanov and Sokolov (2010:7) report that, worldwide, only a few supply chains have attained the highest collaboration and synchronisation level. More so, they indicate that about 50% of these supply chains can be positioned between the communication/integration level as well as the simple coordination level. Furthermore, between 15% and 20% of supply chains are reported to be at an advanced stage of coordination (Ivanov & Sokolov 2010:7). From the above, communication/integration seems to be the most common practice in supply chains. In other words, most firms are currently concerned mainly with building links and channels within the firm as well as from their long term contracts with customers and suppliers (The Supply Chain Foresight 2015:19).

As seen from the definitions of Ivanov and Sokolov's (2010:7)'s five levels of supply chain organisation, collaboration is different from integration (the simple partnerships and alliances between firms). With the invention and integration of technology, collaboration could be enhanced or constrained in supply chains. The next section focuses on supply chain e-collaboration.

3.6.2. Supply Chain e-Collaboration

As earlier noted, collaboration in a supply chain is gradually extending to embrace new technological inventions and innovations to capitalise on the benefits of technology integrated collaborations. Recent developments and advances in inter-organisational software and communication technologies, along with the trends towards digitalisation, globalisation, mass customisation and networking, as well as mass customisation in supply chain management have led to the development of the e-collaboration concept (Tatsiopoulos 2002:517). E-collaboration has been recognised as a new way of doing business in which firms compete with each other, that also offers a strategic device with potential to vitally transform traditional business relationships. Nevertheless, emerging in the late 1990s, supply chain e-collaboration is still in its infancy (Chow *et al.,* 2008:666; Supply Chain Foresight 2015:20).

There is a confusing assortment in both academic and practical areas of what e-collaboration really implies and how it differs from traditional collaboration. On the one hand, some authors such as Carr (2003:41-49) and Cao and Zhang (2010:358-367) advocate that e-collaboration no longer creates a competitive advantage for firms because it has now become a 'must'. On the other hand, other authors such as

Chu and Lee (2006:1567-1579) assert that e-collaboration can provide competitive advantages if a firm leverages the inbuilt 'intelligence' in the supply chain management network and transforms the current business processes. However, without doubt a technology-enabled supply chain collaboration has greatly changed the coordinated activities of a dynamic supply chain network (Chow *et al*., 2008:665). Scholars such as Williams, Esper and Ozment (2002:705) as well as Chow *et al*. (2008:667), in support of e-collaboration, have submitted arguments that even the value and importance of supply chain e-collaboration has changed due to the shifts from traditional supply chain management to electronic supply chain management approaches. Given such shifts, the need arises to investigate whether e-collaboration enhances or constrains the sharing of strategic information among supply chain member firms; whether it creates a supply chain competence with a competitive edge for the entire supply chain and ultimately influences overall supply chain performance.

Supply chain e-collaboration has been defined by various authors in many different ways. It has been referred to as an extension of the conventional collaboration approach in a digital era (Ma 2008:66). It refers to the joint activities by firms, which are based on inter-organisational learning through long term inter-organisational relationships, and involves joint planning, coordination, advertising and promotions done through the aid of technology (Choi & Ko 2012:551). Mayrhofer and Back (2003:7) define it as the computer mediated process of two or more people from different locations, working together on a common purpose or goal, where the participants are committed and interdependent and work in a common context using shared resources supported by (web-based) electronic tools.

Supply chain e-collaboration in accordance with Coe (2004:5) is a systems approach in which multiple businesses work as a team, aided by information technology to integrate and optimise the entire supply chain in order to reduce the total systems costs and improve customer responsiveness. From the above definitions of supply chain e-collaboration the following key elements can be singled out: (a) it is a computer mediated process, (b) firms in different locations work interdependently in a common context with a common goal or purpose and share resources (c) involves inter-organisational long-term relationships and learning. In light of these key elements and definitions, supply chain e-collaboration in this study is therefore defined as a technology-mediated process in which firms in different locations

(suppliers, focal firm and customers) work interdependently sharing resources with a common goal or purpose to develop long term relationships and interorganisational learning, and ultimately supply chain performance in a common context.

Ma (2008:67) identified three types of supply chain e-collaboration, which are vertical, horizontal and diagonal. Vertical supply chain e-collaboration occurs when suppliers and customers in a supply chain employ technology to collaborate (Ma 2008:67). It can either occur as supplier e-collaboration or customer e-collaboration. Supplier e-collaboration refers to the technology integrated collaboration that occurs between a firm and its suppliers. Customer e-collaboration is the technology mediated collaboration that occurs between a firm and its customers. Horizontal e-collaboration occurs when firms in the same industry, which sell similar products or services adopt technology in their collaboration activities (Ma 2008:67). For instance, if, say, Toyota and Nissan, the car assemblers, decide to jointly produce a car with the aid of technology, the phenomena will be referred to as an horizontal e-collaboration. Diagonal e-collaboration is the technology mediated collaboration that occurs between or among firms from different industries (Ma 2008:67). An example will be that of Toyota, a car manufacturer and assembler collaborating with, say, Dell company, a computer manufacturer and assembler, with the aid of technology to produce a new product.

Firms in a supply chain employ various technological tools to collaborate with their suppliers, customers and even within the internal functions of the firm. Chong, Ooi and Sonal (2009:152) identified three categories of e-collaboration systems which fall under the supply chain e-collaboration tools. The systems include the message based, the electronic procurement hubs and market places as well as the shared collaborative systems. The message based system deals with the transmission of information to supply chain applications of partnering firms by using technology. The system encompasses the projected shortages tools, the delivery and design tools; and the business strategy tools (Chong *et al*., 2009:152). The projected shortages tool scans the buyer's production plan to project expected material shortages (Chong *et al*., 2009:152).

The design tool enables the use of interactive engineering drawing and storage of computer assisted designs (CAD) by all the supply chain partnering firms (Shannak 2013:13). More so, it ensures that the final product design meets the requirements of

all supply chain partners (Shannak 2013:13). Business strategy tools enable supply chain partnering firms to collect and share the actions they need to support their supply chain objectives and mission (Chong *et al*., 2009:152).

The shared collaborative systems involve tools such as supply chain planning and forecasting; capacity planning, direct procurement, and replenishment tools. The supply chain planning and forecasting tool is responsible for exchanging the forecast information provided by both the buyer and supplier required in the planning of activities of the entire supply chain. Capacity planning tools help determine the capacity size required to produce a product or service (Shannak 2013:13). The direct procurement tools are mainly concerned with the forwarding of the purchasing orders to prequalified suppliers. Replenishment tools are the drivers of the ordering system from the firm (Chong *et al*., 2009:152). Thus when the materials are needed on the production line, an order will be placed through the replenishment system (Chong *et al*., 2009:152).

The electronic procurement hubs and market place system refers to the web-based system that facilitates and promotes buying and selling to induce collaboration among supply chain partnering firms across the selected industry (Chong *et al*., 2009:152). The next section focuses on the empirical evidence on supply chain e-collaboration.

3.6.2.1. Review of Previous Studies on Supply Chain e-Collaboration

This section provides previous evidence on supply chain e-collaboration. It will narrow down to explain the three main types of supply chain e-collaboration employed in this study: the supplier e-collaboration, customer and internal e-collaboration.

A study by McIvor, Humphreys and McCurry in 2003 examined the influence of electronic commerce technologies to enable firms pursue more collaborative relations with their suppliers. Using a comprehensive literature review, the findings of the study revealed that electronic commerce technologies can be used as a powerful tool to integrate and coordinate cross functional teams across boundaries. The findings also showed that there is clear evidence which reports that e-commerce technologies enhance customer information management and transaction processing efficiency,

which in turn improves demand forecasting, thereby enhancing closer relationships with suppliers.

Ma (2008) conducted a study on e-collaboration, which analysed the e-collaboration situation in the tourism and hospitality industry in China. It applied theories of e-collaboration, Internet and e-business from other industries to tourism and the hospitality industry. Three types of e-collaboration were identified which include: vertical relationships, which refer to the collaboration between suppliers and buyers; horizontal relationships, which is the collaboration between competing firms; and diagonal relationships, which refer to the collaboration between firms in different industries and sectors. The findings of the study reported that vertical and horizontal e-collaboration is more often seen in tourism and hospitality industries than in the diagonal. More so, the findings revealed that e-collaboration is a good strategy more for SMEs who compete with stronger competitors. The findings also suggested that e-collaboration can help widen the market, enhance a firm's competitive position, add value, reduce costs, bridge communication and lessen cultural conflicts.

A study by Wang, Potter, Narm and Beevor in 2011, explored the drivers and the implications of collaborative electronic logistics market places using a case of a fast moving consumer goods industry in the United Kingdom. Using the Resource Based view and transaction cost economics theories, the study examined the motives for interorganisational collaboration in the e-logistics marketplaces. Twenty interviews were conducted to collect data from the shippers, transport companies and the technology provider using collaborative electronic logistics. Process mapping and qualitative data analysis techniques were performed to obtain the findings of the study. The findings reported that trust, relational and power issues are the inhibitors of a rapid take up and sustainable e-marketplace. In addition, the results showed that there is more limited horizontal collaboration between carriers than shippers. More so, the findings indicated that the shippers enjoyed other benefits such as improved process efficiency due to streamlining, receiving more accurate information and having better control order to delivery through improved visibility, which enhances proactive customer responses as a result of collaboration.

Choi and Ko (2012) examined the role of electronic collaboration enabled through the use of inter-organisational information systems of a firm's development capabilities such as interorganisational learning in the United Kingdom. The study used online

surveys to collect data from 130 respondents. The Lisrel data analysis software package was employed to perform a confirmatory factor analysis in testing the research hypotheses. The findings reported an indirect relationship between e-collaboration and firm performance. In addition, the results showed that e-collaboration plays a key role in facilitating and triggering inter-organisational learning forms such as information sharing, relationship specific knowledge, memory and development of shared meaning, and fostering mutual understanding in interorganisational relationships.

Based on the above, numerous gaps can be identified. First, most of the literature has focused on the developed nations such as China and United Kingdom. Rarely can studies be found in the South African context. Most studies investigated e-collaboration and not supply chain e-collaboration. The methodologies employed mostly include the qualitative techniques and comprehensive literature review, with the exception of Choi and Ko's (2012) study, which employed quantitative confirmatory factor analysis using Lisrel. This study, therefore, seeks to contribute to the supply chain e-collaboration literature and empirical evidence using quantitative methods that perform a structural equation model, and confirmatory factor analysis using Amos software, in South Africa. The next section provides a discussion on strategic information sharing among supply chain partnering firms.

3.7. STRATEGIC INFORMATION SHARING

Strategic information creation and sharing is a key driver of supply chain management, which serves as the engine that allows the other supply chain drivers to work together with the goal of creating an integrated and coordinated supply chain (Chopra & Meindl 2007:482). According to Cox, Dick and Rutner (2012:50), supply chain partnering firms may share information ranging from inventory levels, product descriptions, pricing, shipment tracking and promotional calendars. Liu and Kumar (2003:533) in its support, add that the information objects be shared among supply chain partners that include: inventory management, product information, order management, production management, service and support as well as a supply chain plan.

Inventory management comprises information on replenishment order forecasts, inventory levels, the actual replenishment orders as well as goods' receipts. Product information includes product management profiles and design. Order management

requires information on the sales forecasts, catalogue or quotations, the actual sales orders as well as the order delivery and shipment notice. Production management information objects contain information on the master production plan, capacity plan, production orders and the bill of materials. Service and support requires information on the technical service as well as support data and feedback from customers. The supply chain plan needs to be shared as it contains information that will guide all the collaborative supply chain processes in order to optimise the entire supply chain (Liu & Kumar 2003:533). Thus without such information being shared, a manager cannot know the market uncertainties such as what customers want or prefer. The manager also cannot know how much inventory is in stock and when more products should be produced or transported. In other words, strategic information sharing provides the foundation on which supply chain processes execute transactions and managers make decisions.

Information sharing has been defined by Shou, Yang, Zhang and Su (2013:2) as the extent to which a firm openly communicates important and sensitive information to its partners. Shin, Collier and Wilson (2000:167) refer to it as the sharing and transferring of information within or across the structure of the organisation, focusing on providing a context for efficient sharing of this valuable, intangible resource. In this study, strategic information sharing refers to communication or sharing of a firm's long term important and sensitive proprietary information between supply chain partners (Bayraktar *et al*., 2008:194).

There are various structures through which the strategic information can be shared. Information sharing structure refers to the description of the range of each supply chain partner's private information and the communication of that information with the other supply chain partners (Liu & Kumar 2003:525). Liu and Kumar (2003:525) identify three structures of information sharing which are sequential, reciprocal as well as being the hub-and-spokes. Sequential information sharing is a one way information flow structure in which the output of one supply chain partner's activity flows into the next partner's as its input. Consequently, such a flow and sharing of information links the collaborative processes between the neighbouring supply chain partners into a sequential chain.

An example would be that of Toyota and its suppliers that are closely located to the Toyota assembling plants. Information is shared in a sequential manner from

Toyota's suppliers to Toyota the manufacturing and assembling firm. It is imperative to note that each pair of supply chain partners in this structure can establish their own practices and procedures for information sharing without the help of any universal standard. In such a structure, partnering firms can use electronic data interchange (EDI) or some other communication mechanisms (Liu & Kumar 2003:525).

Reciprocal information sharing is a more complex structure in which information flows in two directions among multiple supply chain partners. This bi-directional flow of information among multiple partners can cause some irregularities between the shared information of different supply chain partners. A suitable example will be that of Dell whose relationships are not hindered by geographical location, thus allowing it to share information with its multiple supply chain partners worldwide. However, there is a need to synchronise and integrate the strategic information, sharing interactive processes to enhance coordination, and reduce uncertainty and conflict, which may result among collaborating supply chain partners (Liu & Kumar 2003:525).

The Hub-and-spoke is a web based information sharing structure, which is based on a central hub that communicates with all supply chain partners. Normally, a web based electronic hub in this structure serves as a virtual marketplace for all supply chain partners, which facilitates a full range of business processes and interactions between these partners. The main functions of the e-hub include coordinating, storing, aggregating, and maintaining information about each supply chain partner, making decisions, as well as communicating such decisions to all the partners. A centralised hub enhances effective collaborative planning, forecasting, and replenishment (CPFR) (Liu & Kumar 2003:525).

Effective and efficient strategic information sharing is determined by the presence of three factors, which are trust among supply chain partners, contract and equally shared bargaining power among partners (Piderit, Flowerday & Von Solms 2011:4). Trust, as defined by Chopra and Meindl (2010:550), is the belief that each supply chain partner has an interest in the other's welfare such that they will not take any actions without considering the effect on the other partners. In other words, for information sharing to be effective, supply chain partners need to believe in each other's actions and their ability to look out for each other. A contract, in accordance with Piderit *et al*. (2011:8) is an agreement among supply chain partners in a specific market that specifies objectives, areas of decision domain, the level of information

sharing, performance measures and transfer payments. Thus a contract is essential among supply chain partners as it reveals the levels of information that each partner is obliged to share with the other partners.

Bargaining power is another key success factor of information sharing in supply chains. According to Van Weele (2010:197), the bargaining power among the supply chain partners should be equally shared in order to avoid domination of one partner over the other. It is through equity in bargaining power that supply chain partners can effectively share their strategic information with each other. Therefore, it is imperative that the supply chain partners ensure the presence of trust, contract and equally shared power in order to effectively share their strategic information with each other and derive benefits from it.

Strategic information sharing, if conducted effectively, can provide the supply chain partnering firms with a wide range of benefits. Simatupang and Sridharan (2001:18) report some of the benefits of information sharing in supply chains, which are: providing contractual clarity to partners, helping to deal with market uncertainties and facilitating supply chain coordination, as well as reducing opportunism among partners. Contractual clarity refers to the provision of relevant information for reviewing the resources needed to evaluate the contract and deciding on whether to modify, extend or terminate it (Simatupang & Sridharan 2001:8). In other words, information sharing provides clarity in terms of the contractual rights and responsibilities of the supply chain partners. It also optimises resource allocation required to measure overall performance and distribute benefits among partners using an appropriate incentive scheme (Simatupang & Sridharan 2001:8).

In addition, information sharing among supply chain partners can create a mutual competitive advantage through increasing customers' derived benefits (value) and reducing supply chain costs. More so, it helps lower inventory levels, improve product availability as well as shorten the product delivery lead times. Such benefits can best be explained by the Dell, an example of a computer manufacturing company. Dell has an online information sharing system through which it leverages its logistics capability to create excellent customer service. According to Simatupang and Sridharan (2001:1), Dell manages to satisfy its online customers as well as provide its suppliers with a customer order visibility. As such, its suppliers such as Akustka, Logitech, American Power Conversion and Microsoft Corporation among others are

able to view the parts that Dell needs today and in the following week. As a result, these suppliers can reduce their inventory on hand and shorten their product delivery lead times.

Nevertheless, the practice of strategic information sharing regularly involves risks and costs. Some of these include the stimulation of information hoarding and opportunistic behaviour among supply chain partners. Information hoarding is one of the major risks that make partners reluctant or unwilling to share their firm's strategic information (Nogues 2014:27). It occurs when a partner, after receiving information from the other supply chain partner, uses that information to the disadvantage of the information disclosing partner. Information hoarding can lead to a decline in the profitability of the informant partner due to a bad reputation. Partners in a supply chain need to guard against such a behaviour amongst each other (Dittmann 2013:48)

Opportunistic behaviour as asserted by Piderit *et al*. (2011:7) is one that emanates from a partner's self interest which makes the partner to seek maximisation of benefits while avoiding costs by all means. Information sharing can encourage opportunistic behaviour in supply chain partners before or after signing the contract. On the one hand, pre-contractual opportunism occurs in the form of adverse selection. This involves a partner misrepresenting or concealing the truthful information about its resource capability and market conditions that need to be shared with other supply chain partners before signing the contract (Piderit *et al*., 2011:7). On the other hand, post-contractual opportunism occurs in the form of moral hazard. Moral hazard involves a partner providing misleading information about its performance status and lowers its service level efforts as well as minimising its level of resource allocation commitment to the supply chain activities (Piderit *et al*., 2011:7).

Previous studies have revealed that many supply chain partnering firms are hesitant to share strategic information (Chu & Lee 2006:1570; Prajogo & Olhager 2012:516). This is quite common, especially where the risk and cost of sharing strategic information is solely a burden of the disclosing supply chain partner. More so, this is also common where there is no mechanism defined prior to allocating some of the resultant additional profit as well as risks and costs to the disclosing supply chain partner (Chu & Lee 2006:1570). As such, partners in a supply chain might find the

issue of sharing their strategic information with their partners under the above mentioned conditions as a costly practice without even considering the benefits. Therefore, there is a need for a mechanism through which partners can consider the benefits, risks and costs of sharing information amongst each other.

Simatupang and Sridharan (2001:18) suggest that partners can use productive behaviour-based incentives, such as paying for performance and equitable compensation. For instance, the pay for performance schemes such as transfer pricing, consignment and additional backlog penalties can be introduced to help supply chain partners to share inventory costs that may result from information sharing (Simatupang & Sridharan 2001:18). This will ensure effective sharing of strategic information among all the involved supply chain partners. The next section provides previous evidence on strategic information sharing.

3.7.1. Review of Previous Studies on Strategic Information Sharing

This section provides previous evidence on strategic information sharing. It then focuses on the two types of information sharing applied in this study: strategic information sharing with customers, and suppliers.

Piderit *et al*. (2011) explored the cyclical relationship between trust and information sharing in South Africa's Eastern Cape Province automotive supplier in a supply chain. Their study followed a case study method which employed a document survey as well as participant observation to gather data. The findings revealed that trust and information sharing in supply chains are cyclically related.

Yang and Maxwell (2011) in their study reviewed previous research on information sharing and discussed the factors that affect information sharing in public organisations at three levels (interpersonal, intra- and interorganisational). Using a comprehensive literature analysis, their study found that factors such as incentives and rewards, trust, power games, information technology capability, organisational structures and bureaucracy, organisational culture, values as well as norms, self interest and cost-benefit analysis significantly affect both the intra- and inter-organisational information sharing in public organisations. Their findings also revealed that legislation and policy factors have a direct effect on interorganisational information sharing in public organisations.

A study by Rashed, Azeem and Halim (2010) examined the combined effect of information and knowledge sharing on a supplier's operational performance in supplier-buyer relationships of Bangladesh. Their study employed a questionnaire-based survey to collect data from 30 firms in Bangladesh's readymade garments' industry. Using ANOVA to analyse the data, the findings showed that information sharing with key suppliers do not affect the supplier's operational performance. In addition, the findings revealed that knowledge sharing with key suppliers has a weaker positive effect on the supplier's operational performance. Furthermore, it found that information sharing promotes knowledge sharing.

Zhou and Benton (2007) investigated the integration of information sharing and supply chain practice in supply chain management. Their study focused on three aspects of information sharing, which are: information sharing; supply technology; and information context and quality. In addition, the study categorised information sharing into information sharing with customers, suppliers, inter functional and interorganisational. They conducted a survey on 125 North American firms to collect data. Zhou and Benton (2007) performed a structural equation model that used the RAMONA program to test their research hypotheses. Their findings revealed that effective information sharing significantly enhances effective supply chain practice. In addition, the results showed that both effective information sharing and supply chain practice are important factors in achieving good supply chain performance.

This study categorises information sharing into strategic information sharing with customers and suppliers, which involves the focal firm sharing key and strategic firm information with its key customers. Strategic information sharing with suppliers occurs when the focal firm shares essential and strategic information of the firm with its key suppliers. The next section provides a detailed discussion on supply chain competence.

3.8. SUPPLY CHAIN COMPETENCE

Supply chain management in accordance with Handfield and Nicholas (1999), cited in Spekman, Spear and Kamauff (2002:41), has grown to encompass a competitive reality. This is because competition has shifted from being between individual firms to being between supply chains. In other words firms prefer collaborating in their supply chains where each supply chain partner contributes value and combines with the partner their unique skills, capabilities as well as experience to achieve goals that

they could not easily accomplish as individual firms (Spekman *et al*., 2002:41). The ability to leverage each supply chain partner's capabilities beyond tangible assets and explicit knowledge is the key strategic issue in each supply chain (Spekman *et al*., 2002:41).

Hall (1999) cited in Spekman *et al*. (2002:41) argues that within a supply chain there are more central (core) skills/assets that remain tacit and are less easily transferred among supply chain partners. The examples of such skills/assets are: the employee know-how, reputation and culture that are found in the structure of the firm. According to Spekman *et al*. (2002:41), these core skills/assets are not easily codified and often not immediately recognised, yet they provide a relative competitive advantage to the firm. Spekman *et al*. (2002:41) add that it is the ability of a firm to crack the code of these core skills/assets that makes the firm gain insight of its core competencies.

A competence, as defined by De Wit and Meyer (2010:113) using the Resource-based view, is an intangible resource that shows the fitness of a firm to perform in a particular field. In other words, a firm is said to have a competence if it has knowledge, capabilities and the attitude required to successfully operate in a specific area. Knowledge refers to all the rules (know-how, know-what, know-where and know-when) and insights (the know-why) that can be extracted from and help make sense of information (De Wit & Meyer 2010:114). This means that knowledge flows from and influences the interpretation of information. The knowledge that a firm can possess ranges from market insights, competitive intelligence, technological expertise as well as an understanding of the political and economic developments (De Wit & Meyer 2010:114).

A capability is the organisation's potential for carrying out a specific activity or a set of activities (Ackdilli & Ayhan 2013:145). It refers to the quality of combining a number of skills, where a skill means the ability of a firm to carry out a narrow functional task or activity (De Wit & Meyer 2010:114). The examples of a firm's capabilities include narrower abilities such as market research, advertising and production skills, that if coordinated could generate a capability for a new product development. Attitude is the third element of a competence, which De Wit and Meyer (2010:114) refer to as the mindset prevalent within a firm. Also used interchangeably with attitude are the terms 'disposition and will', which are used to reveal how a firm perceives and relates to the world (Sandberg & Abrahamsson 2011:5).

Some attitudes may bring rapid change to the firm, while, others may be entrenched within the cultural structure of the firm. The attitudes entrenched to the firm's cultural structure particularly can be important resources of the firm (De Wit & Meyer 2010:114). The examples of a firm's attitude can include being quality driven, internationally oriented, innovation-minded and competitively aggressive. Therefore, a firm's core competencies, essential for its sustainable competitive advantage against its rivals, emanates from its ability to attach the firm's cultural structure (firm's attitude) to the most suitable physical carrier/person, capture capabilities in computer programs and codify the tacit knowledge provides. De Almeida, Lisboa, Augusto and Batista (2013:356) in support of this emphasise that the competitiveness of a firm in the long run derives from its ability to build more speedily and at a lower cost than its competitors the core competencies that spawn unanticipated, unique and inimitable products.

Core competencies have been defined by De Wit and Meyer (2010:356) as the collective learning in the organisation, especially how to coordinate diverse production skills and integrate multiple streams of technologies. In addition, core competencies refer to the communication, involvement and a deep commitment of many levels of people from all functions working across firm boundaries (Rosenzweig & Roth 2007:1312). According to De Wit and Meyer (2010:357), the skills that together constitute core competencies must coalesce around individuals whose efforts are not so narrowly focused that they cannot recognise the opportunities for blending their functional expertise with those of others in new and interesting ways.

Core competencies are the glue that bind existing businesses and can be enhanced when these existing firms apply and share them (Wieland & Wallenburg 2013:302). They are an engine for new business development as they guide the patterns of diversification as well as market entry and often lead to new product development (De Wit & Meyer 2010:357). Firms, however, need to nurture and protect their core competencies in order to capture all the benefits that a firm can derive from them. More importantly, these core competencies are the essential ingredient of the relationships that unleash the unique and inimitable value creating abilities of a supply chain known as supply chain competencies (Wieland & Wallenburg 2013:302).

Supply chain competencies in this study refer to the collective learning of the entire supply chain; learning that emanates from the e-collaboration relationships between the supply chain partners, which unleash unique and inimitable value creating abilities by combining the core competencies of the individual partners. Collective learning is the source of competitive advantage for the entire supply chain and it stems from the communication, involvement and a deep commitment of the supply chain partners working across their firms' boundaries (Akbar, Muzaffar & Rehman 2011:41). Such learning is facilitated by a supply chain as a system that forms learning entities and transforms itself through the collective learning of all its individual supply chain partners (Breite & Koskinen 2014:11). The idea is that a supply chain learns from its individual supply chain collaborating firms through their sharing and transferring of an individual firm's core competencies such as tacit knowledge. This will in turn improve the supply chain activities thereby improving the performance of the entire supply chain of those collaborating firms.

Supply chain collective learning as a supply chain competence enables the supply chain collaborating firms (partners) to collectively respond to market uncertainties and outperform their rivals in supply chain operations (Stratman & Roth 2002:609). However, to capture the above mentioned benefits, supply chain competence requires the ability of the entire supply chain to take full control of its operations regardless of the environmental turmoil (Spekman *et al*., 2002:44). It is imperative to note that the core supply chain competencies that result from collective learning of the partnering firms must create a sustainable competitive advantage for the entire supply chain.

A supply chain's competitive advantage is sustainable if it cannot be copied, substituted or eroded by the actions of the rival supply chains and is not made redundant by the developments in the environment (Nieman & Bennett 2006:109). This implies that the sustainability of a supply chain's competitive advantage depends on its competitive defendability and environmental consonance. Supply chain competitive defendability refers to the intrinsic easiness or difficulty to defend a supply chain's competitive advantage (Nieman & Bennett 2006:109; De Wit & Meyer 2010:115). In other words, a supply chain's competitive advantage is said to be defendable if the other competing supply chains or even individual competing firms find it difficult or rather next to impossible to imitate its products and activities or find alternative routes to attack (De Wit & Meyer 2010:115). Such kinds of supply chain

defendability can only occur where the collaborating partners share their knowledge and use it for the benefit of the entire supply chain.

Environmental consonance refers to a situation where the sustainability of a supply chain's competitive advantage is threatened or stimulated by the developments in the market (Shen 2014:6239). The environmental developments encompass the changes in consumer needs, wants, tastes and preferences, the changes in distribution channels, alterations in government regulations, introduction of new technologies and the new competition entrants in the market (Shen 2014:6239). All such environmental developments can undermine the fit between a supply chain's competitive advantage and the environment, thereby weakening its position in the market. Supply chain collaborating firms therefore need to genuinely share and transfer their tacit knowledge with each other in order to learn collectively and sustain their supply chain competitive edge over their rivals. The next section provides previous evidence on supply chain competence.

3.8.1. Review of Previous Studies on Supply Chain Competence

This section provides previous evidence on supply chain competence. It also gives a brief explanation of the supply chain competence categories used in this study: quality and service; operations and distribution, as well as design effectiveness competencies.

A study by Kuei, Madu, Chow and Lu (2005) investigated the association between supply chain quality management and supply chain competence. Supply chain competence was classified into design and response capabilities as well as the levels of product quality. Their study used mail surveys to collect data from a sample of 250 respondents in Hong Kong. A stepwise discriminant analysis was used to test the research hypotheses. Its findings revealed that supply chain competencies, particularly the ability to make high quality products, are positively associated with supplier partnership. In addition, the results showed that supplier partnership initiative is significantly associated with higher levels of product quality. The findings also indicated that design and response capabilities as supply chain competencies are essential in the supply chain quality management.

Barnes and Liao (2012) examined the effect of individual, network and collaborative competencies on a supply chain management system. Electronic surveys were

conducted from a sample of 5707 United States of American based company CEOs, presidents, managers and directors. The study performed structural equation modelling to asses and test the links between individual, network and interorganisational competencies, investment in strategic partnerships and firm performance. The results showed that both organisational awareness (individual competence) and supply network (firm competence) have positive and significant effects on collaborative awareness (interorganisational competence). The findings also revealed that collaborative awareness (interorganisational competence) have a positive and significant effect on investment in strategic planning.

Chow *et al*. (2008) examined the associations between supply chain components (supply chain practices, concerns and competences) and organisational performance in the United States of America and Taiwan. Their study classified supply chain competence into quality and service, operations and distribution as well as design effectiveness. An empirical survey on middle level managers was used to collect data. Structural equation modelling was performed to test the research hypotheses. The findings of the study showed that supply chain competencies have positive effects on organisational performance in both US and Taiwan. In addition, the results revealed that supply chain practices and competencies are significantly associated in both US and Taiwan. The next paragraph focuses on the types of supply chain competence used in this study.

Supply chain competence in this study is classified in accordance with Chow *et al*. (2008:676) into: quality and service, operations and distribution as well as design effectiveness. Quality and service supply chain competence refers to the ability of the entire supply chain to: respond to key customer demands and needs in a timely manner, produce high quality products, deliver high quality services, work with key suppliers and have a better asset utilisation (Chow *et al*., 2008:676). Operations and distribution supply chain competence refers to the ability of the supply chain as a whole to manage its inventory, meet promised delivery dates, fill customer orders with improved accuracy, forecast sales with greater accuracy and issue advanced notice on shipping delays (Chow e*t al*., 2008:676). Design effectiveness supply chain competence is the ability of the entire supply chain to design low pollution production processes, delivery processes and enhance the supply chain's position in social responsibility (Chow *et al*., 2008:676). The next section focuses on supply chain performance.

3.9. SUPPLY CHAIN PERFORMANCE

Supply chain performance is increasingly recognised as an important factor in achieving a firm's competitive advantage (Sezen 2008:233). As such, firms in today's business world are constantly in search of new ways to improve the performance of their supply chains (Sezen 2008:233). Such an organisational change and source of competitive advantage require firms to strengthen their coordination and collaboration mechanisms such as information sharing (Kocoglu *et al*., 2011:1634). Supply chain performance has been defined by Ambe and Badenhurst-Weiss (2012:11006) as a monitoring process, undertaking a demonstrative analysis of whether the proper processes have been followed and the desired objectives were attained. In this study, supply chain performance refers to the supply chain's ability to respond timeously to customers' needs, deliver the right quantities and minimise production and inventory costs (Sezen 2008:234). Thus, in this study supply chain performance is assessed by flexibility, resource and output of the supply chain. The next section provides previous evidence on supply chain performance.

3.9.1. Review of Previous Studies on Supply Chain Performance

This section provides previous evidence on supply chain performance. It also gives a brief explanation of the performance categories used in this study: flexibility, resource and output performance.

A study by Jie, Parton and Cox (2007) analysed the concepts of supply chain practice, supply chain performance and competitive advantage in Australian beef enterprises with an aim of proposing a conceptual framework.

Fawcett, Osterhaus, Magnan, Brau and McCarter (2007) examined the impact of information sharing on operational supply chain performance. Their study conducted a large scale survey using semi-structured interviews to collect industry data in USA.

Sezen (2008) conducted a study on the relative effects of design, integration and information sharing on supply chain performance in Turkey. Supply chain performance was measured using flexibility, resource and output performance.

A study by Liu (2009) investigated the effect of implementing a quality management system (specifically the quality standard of ISO/TS 16949) on supply chain

performance. It categorised performance into expenses of cost, asset utilisation, and supply chain reliability as well as flexibility and responsiveness.

Although previous studies have explored the antecedents of supply chain performance, none of these studies have combined supply chain practices, supply chain e-collaboration, strategic information sharing and supply chain competence as its antecedents. It is against this backdrop that this study investigates the impact of supply chain practices on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. The study also examines the impact of strategic information sharing and supply chain competence on supply chain performance. In addition, the mediating impact of strategic information sharing and supply chain competence on the relationship between supply chain e-collaboration and supply chain performance is ascertained.

This study adopts Sezen's (2008) categorisation of supply chain performance measures or indicators of flexibility, resource and output. Flexibility supply chain performance refers to the ability of a supply chain to adapt and respond to its changing environment (Jie *et al*., 2007:8; Sezen 2008:234). Chopra and Miendl (2007) cited in Jie *et al*. (2007:7) classified flexibility performance into four dimensions which are: customer service, order, location, and delivery time. Customer service flexibility is the firms' ability to provide special customer orders or inquiries. Order flexibility refers to the firm's ability to adjust customers' order sizes, volume or composition during logistics operations. Location flexibility is described as the firms' ability to service customers from alternative wholesaler locations or supermarket outlets. Delivery time flexibility is the supply chain's ability to adapt lead times to changing customers' requirements (Jie *et al*., 2007:7-8). Delivery flexibility performance involves the implementation of the just-in-time supply chain practice, for example, in which suppliers deliver products to the customer at the right time, quantity and place. This study adapts Sezen's (2008) categorisation of supply chain flexibility performance which are: new product, delivery and volume flexibility. Volume flexibility refers to the firms' ability to effectively increase or decrease their supply chain's aggregate production in response to their customers' demand (Jie *et al*., 2007:19). According to Jie *et al*. (2007:19), volume flexibility has a direct impact on the performance of a supply chain as it prevents stock out conditions of products that are suddenly in high demand.

Resource supply chain performance is the second dimension used in this study. It is concerned with the efficient use of the resources in a supply chain system (Sezen 2008:234). The indicators for resource supply chain performance include the costs of using several resources, supply chain inventory levels and return on investment. Output supply chain performance constitutes customer satisfaction (as measured by the on-time deliveries, order fill rate and response time), sales quantities and profit (Sezen 2008:234).

3.10. CHAPTER SUMMARY

This chapter discussed the five research variables of this study, which are: intra-firm supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence, and supply chain performance. It first defined and discussed the concepts of supply chain and supply chain management to lay a strong foundation for all the research variables. It also discussed a previous theoretical supply chain management framework. Intra-firm supply chain practices were then defined, and the relevant previous evidence was also provided. The chapter then defined supply chain collaboration and e-collaboration. Previous evidence on supply chain e-collaboration was provided. The chapter also defined strategic information sharing and supply chain competence. Previous evidence on strategic information sharing and supply chain competence was provided respectively. Lastly, the chapter discussed supply chain performance and provided its relevant previous evidence. The next chapter (Chapter 4) focuses on the conceptual framework and hypotheses development.

CHAPTER 4

CONCEPTUAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

4.1. INTRODUCTION

The previous chapter reviewed literature on intra-firm supply chain practice, e-collaboration, strategic information sharing, supply chain competence and performance.The current chapter draws from the supply chain management variables to build the research conceptual framework. This chapter further develops research hypotheses from the research objectives using the two theories and empirical evidence on the research constructs.

4.2. THE RESEARCH CONCEPTUAL FRAMEWORK

In this study, previous research conceptual models on intra-firm supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance are used to construct the current study's research conceptual framework. The next section provides some of the relevant previous research conceptual models.

4.2.1. Previous Research Frameworks

This section provides some of the research conceptual models from previous studies relevant in this study. These studies include Zhou and Benton (2007), Rosenzweig (2009), Sezen (2008), Kocoglu *et al*. (2011) and Chow *et al*. (2008).

a. Zhou and Benton's conceptual model

Zhou and Benton (2007) in their study developed a conceptual model for supply chain dynamism, information sharing and intra-firm supply chain practice as shown in Figure 4.1. Figure 4.1 reveals information sharing as the mediator variable, in the relationship between supply chain dynamism and supply chain practice. Supply chain dynamism is the predictor variable while supply chain practice is the outcome variable as depicted in Figure 4.1. On the one hand, information sharing is defined by four items which are: information sharing support technology, customer information, manufacturer information and information quality. On the other hand, supply chain

practice is defined using three items which are: supply chain planning, Just-In-Time production and delivery practice. The current study's research conceptual framework follows Zhou and Benton (2007)'s conceptualisation of supply chain practice.

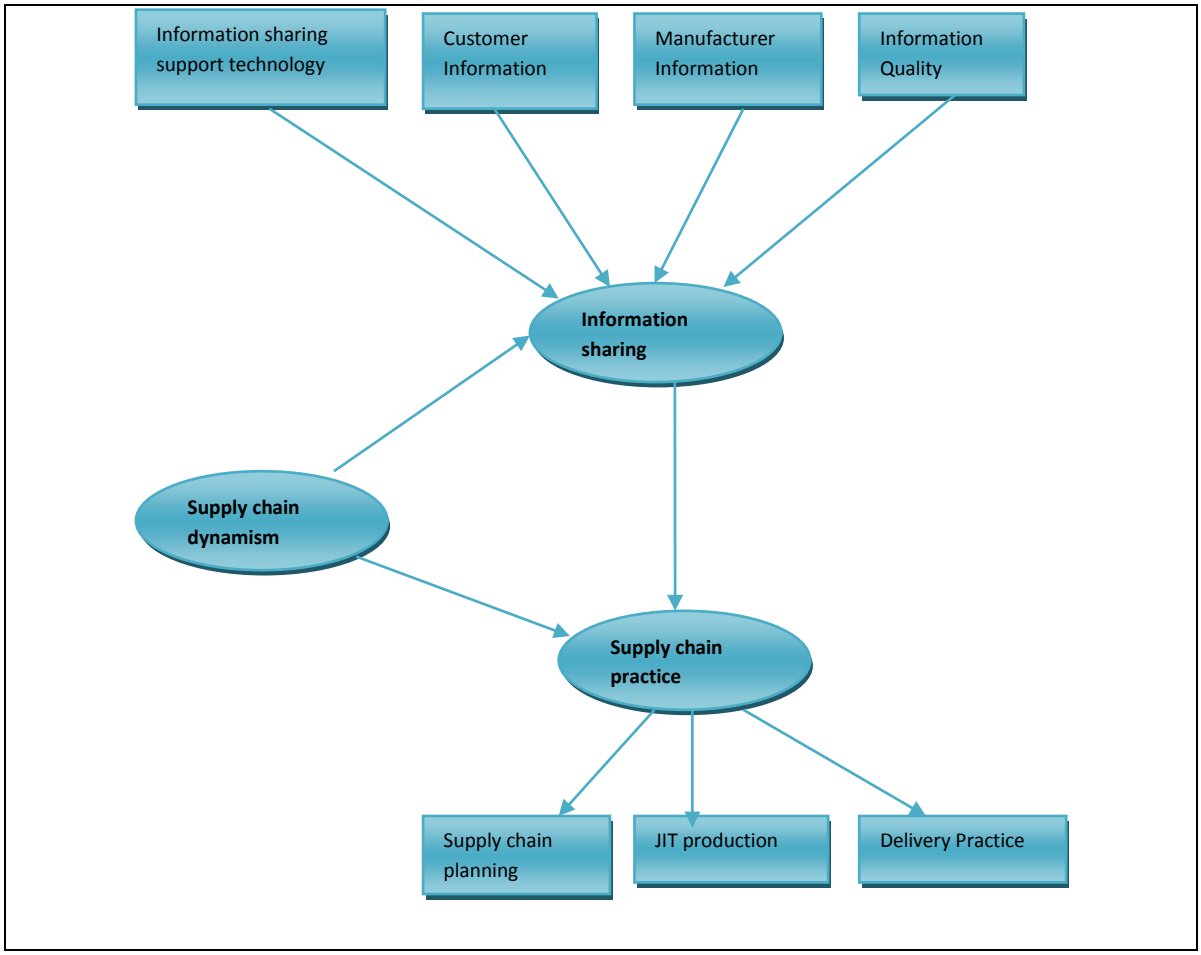


Fig 4.1: Supply Chain Practice, Information Sharing and Supply Chain Dynamism Model.

Source: Zhou and Benton (2007:1352)

b. Chow et al 's conceptual model

A study by Chow *et al*. (2008) developed a conceptual model for supply chain practices, supply chain concerns, supply chain competence and overall performance as depicted in Figure 4.2. The model as shown in Figure 4.2 shows supply chain concerns and supply chain competence as the mediator variables in the relationship between supply chain practice and overall performance. As revealed in Figure 4.2, supply chain practices are the predictor variable while overall performance is the outcome variable. The current study's research conceptual framework adopts supply

chain competence as a mediator variable in the relationship between supply chain practices, supply chain e-collaboration and supply chain performance, following the Chow *et al*. (2008)'s conceptualisation.

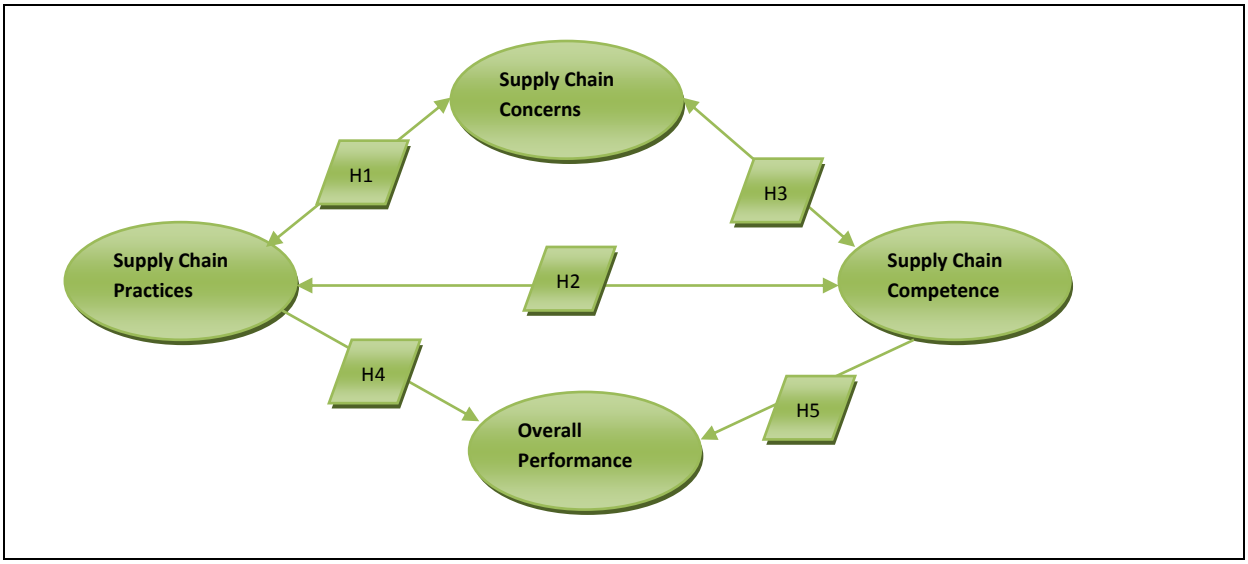


Figure 4.2: Supply Chain Practices, Concerns, Competence and Overall Performance Conceptual Model.

Source: Chow *et al*. (2008:671)

c. Rosenzweig 's conceptual model

Rosenzweig (2009) developed a conceptual model shown in Figure 4.3, on the relationship between e-collaboration and performance. As depicted in Figure 4.3, e-collaboration is the predictor variable while performance is the outcome variable. More so, three contextual factors (product complexity, environmental munificence and market variability) are shown as the moderator variables while size and e-transactions are the control variables for the e-collaboration-performance relationship. The current study adopts Rosenzweig (2008)'s model to hypothesise the indirect relationship between supply chain e-collaboration and supply chain performance, mediated by information sharing along with supply chain competence.

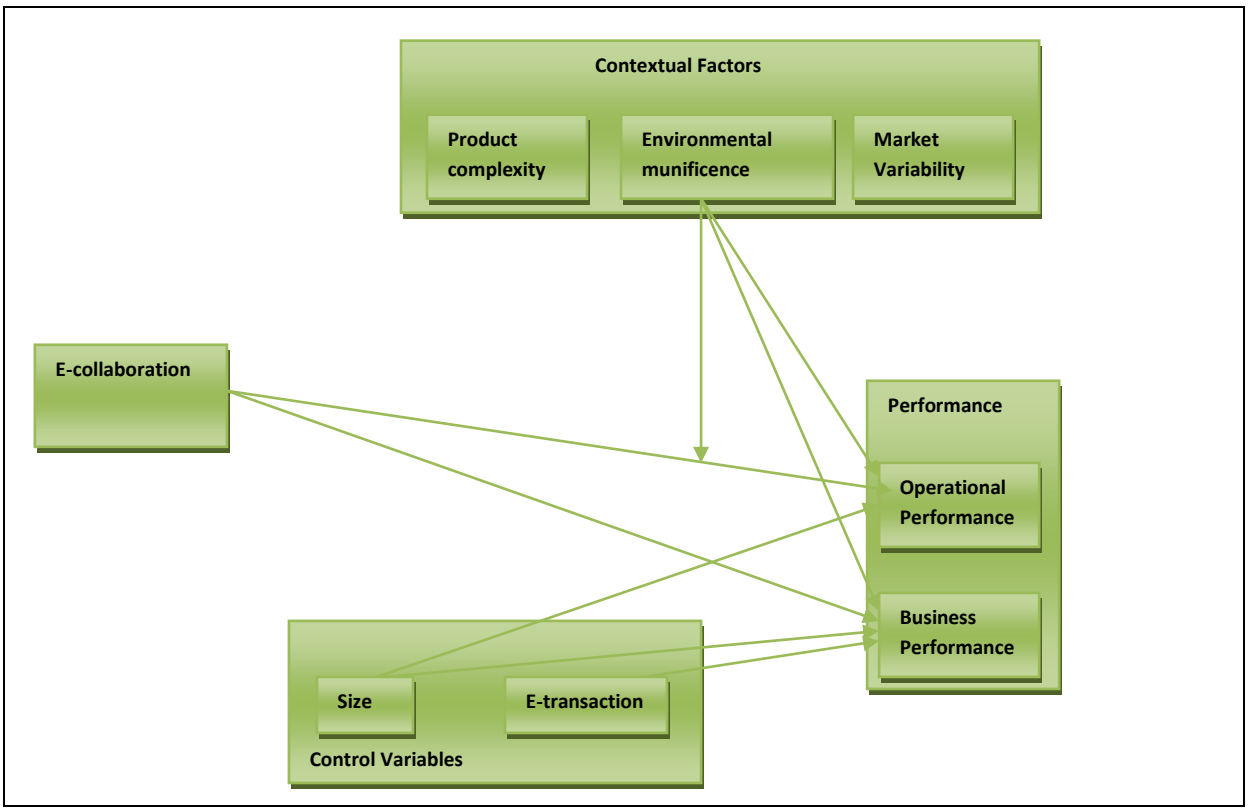


Figure 4.3: E-collaboration and Performance Conceptual Model.

Source: Rosenzweig (2009:469)

d. Kocoglu et al 's Conceptual Model

Kocoglu *et al*. (2011) developed a conceptual model (presented in Figure 4.4) on the relationship between supply chain integration, information sharing and supply chain performance. As shown in Figure 4.4, information sharing is the mediator variable in the relationship between supply chain integration and supply chain performance. From Figure 4.4, information sharing is defined using four items (and these are: information sharing with suppliers, information sharing with customers, inter-functional information sharing and intra-organisational information sharing). Figure 4.4, further depicts supply chain integration as the predictor variable measured by three items which are integration with suppliers, customers and intra-organisational integration. Supply chain performance in Figure 4.4 is shown as the outcome variable measured using expense of costs, asset utilization, supply chain reliability and supply chain flexibility. The conceptual model by Kocoglu *et al*. (2011) informed the conceptualisation of strategic information sharing as well as its mediating effect on the relationship between supply chain e-collaboration and supply chain performance in this study.

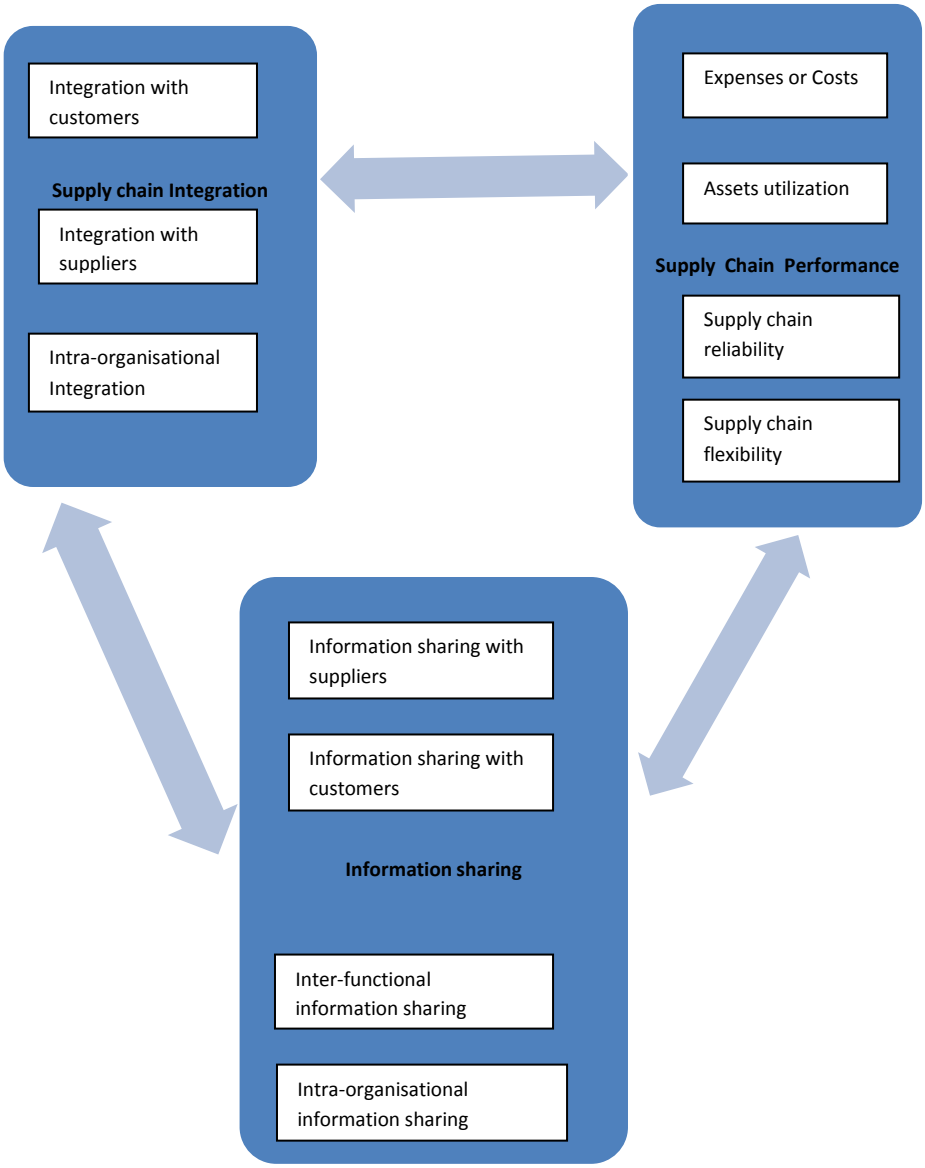


Figure 4.4: Supply Chain Integration, Information Sharing and Supply chain Performance Conceptual Model.

Source: Kocoglu *et al*. (2011:1637)

e. Sezen 's conceptual model

A study by Sezen (2008) developed a conceptual model depicted in Figure 4.5, on the effect of supply chain integration, supply chain information sharing and supply chain design on supply chain performance. Figure 4.5 shows supply chain performance as the outcome of supply chain integration, supply chain information sharing and supply chain design. In addition, supply chain performance as revealed in Figure 4.5 is defined by three items which are: flexibility performance, resource

performance and output performance. The current study adopts the conceptualisation of supply chain performance from Sezen (2008)'s model.

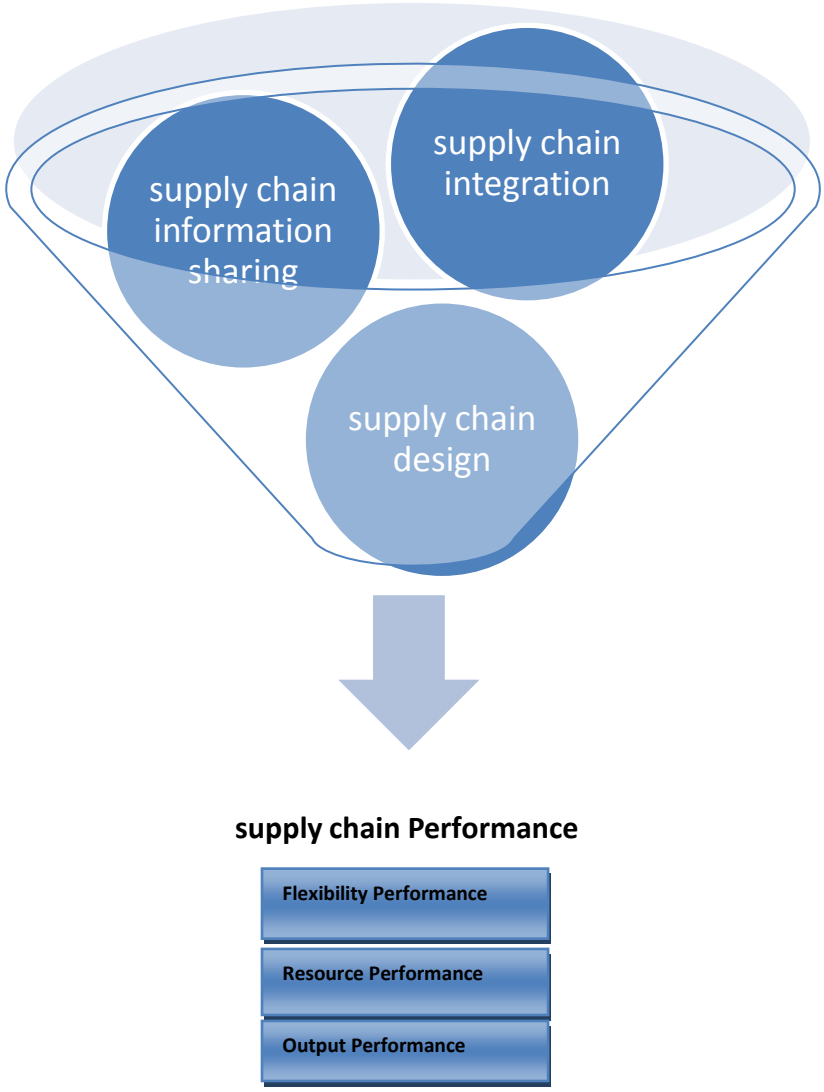


Figure 4.5: Supply Chain Integration, Supply Chain Information Sharing, Supply Chain Design and Supply Chain Performance Conceptual Model.

Source: Sezen (2008:235)

4.2.2. The Research Conceptual Framework

The research conceptual framework in this study conceptually portrays the research variables as shown in Figure 4.6.

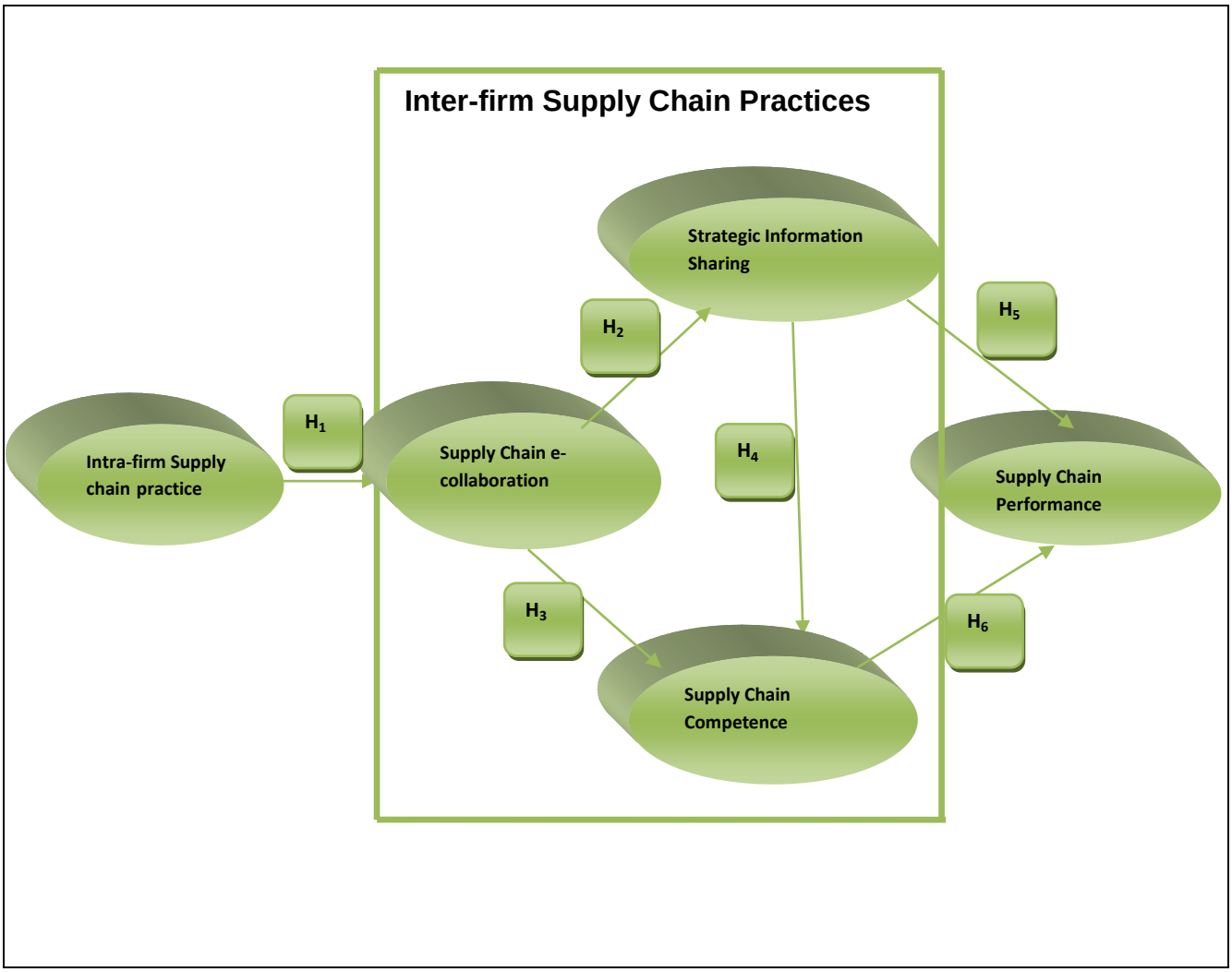


Figure 4.6: The Research Conceptual Framework. Source: own

The framework in Figure 4.6 shows the hypothesised links between intra-firm supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. From the conceptual framework depicted in Figure 4.6, intra-firm supply chain practice is the predictor variable, while the inter-firm supply chain practices of supply chain e-collaboration, strategic information sharing and supply chain competence are the mediating variables. Supply chain performance is the outcome variable for this study. The links posited between the research variables are depicted in Figure 4.6 as hypotheses (H1, H2, H3, H4, H5 and H6) and are further explained in the next sections.

4.3. RESEARCH HYPOTHESES DEVELOPMENT

This section focuses on the posited link between intra-firm supply chain practice and supply chain e-collaboration.

4.3.1. Supply Chain Practice and Supply Chain E-Collaboration

Intra-firm supply chain practice in this study is defined (as earlier noted in Chapter 3) as a set of intra-firm tangible activities, technologies or initiatives which encompass the supply chain planning, the JIT production and inventory control systems as well as the delivery practices, implemented by supply chain members ranging from the focal firm, suppliers to customers. The RV theory has been used in this study to explain the intra-firm supply chain practices of supply chain planning, JIT production system as well as delivery practices and their influence on supply chain e-collaboration.

Embedded in strategic management literature, the RV theory as earlier noted posits that the critical resources of a firm may extend beyond the firm boundaries and may be rooted in inter-firm resources as well as routines. The theory categorises inter-firm resources or assets into site, human and physical specific assets. These types of inter-firm assets were used to explain the supply chain practices of supply chain planning, JIT production systems and delivery practices as well as supply chain e-collaboration. More so, the RV theory's effective governance (a source of relational rents) was considered as a factor that enhances supply chain practices such as the JIT production system because it minimises costs and waste. Furthermore, three of the RV theory sources of relational rents (interorganisational relation specific assets, complementary resources/capabilities and self-governance) were applied and used to explain supply chain e-collaboration in this study. As noted in the previous chapter (Chapter 3), supply chain e-collaboration in this study is defined as 'a technology mediated process in which dislocated firms (suppliers, focal firm and customers) work interdependently, sharing resources with a common goal or purpose to develop long term relationships along with interorganisational learning, and ultimately improve their supply chain performance in a common context'.

The supply chain management framework by Lambert and Cooper (2000) has helped lay a theoretical foundation to this study's posited influence of supply chain practice on supply chain e-collaboration. The argument is that firms in a supply chain network

need to understand their positions in the supply chain and identify their primary supply chain members before investing in any intra-firm supply chain practices that may lead to links which facilitate partnerships and collaborations. For example, a firm needs to know if it is located near its suppliers, customers or between the customer and supplier before deciding on their supply chain planning, JIT production along with the delivery practices. More so, identifying a firm's primary customers and suppliers enables the firm to properly invest in the collaboration technologies that helps link its business processes with those of its primary suppliers/customers.

Empirical evidence has linked supply chain practices to various factors either as a predictor or outcome variable. For instance, a study by Zhou and Benton (2007) linked supply chain practice to supply chain dynamism and information sharing as an effect or outcome variable. Zhou and Benton (2007) suggest that information sharing causes firms to implement supply chain practices such as the supply chain planning, JIT production and delivery under different supply chain dynamics. For instance, sharing important information with customers and suppliers enables a firm to properly forecast the demand and supply customer needs just in time. It also helps the firm to use production methods that minimises waste, as well as delivery methods that reduce costs (Mbanje & Lunga 2015:162).

A study by Chow *et al*. (2008) linked supply chain practices to supply chain concerns, supply chain competence and overall performance. Their study revealed supply chain practices as having direct relationships with supply chain concerns, supply chain competence and overall performance. Li *et al*. (2006) in support proposed that supply chain management practices have both a direct and indirect impact on organisational performance through competitive advantage. In other words, the supply chain management practices (such as strategic supplier partnership, customer relationship, level of information sharing, quality of information and postponement) creates unique capabilities for a supply chain which in turn improves the overall performance of the firm.

Rosenzweig (2009) linked e-collaboration to performance, where size along with e-transaction were the control variables while environmental munificence was the only significant contextual factor to moderate the relationship. As can be seen from the above noted studies on supply chain practices and e-collaboration, rarely can one find studies that have so far linked intra-firm supply chain practice to supply chain e-

collaboration. The absence of such a link between intra-firm supply chain practices and supply chain e-collaboration from previous studies does not entail the insignificance of the link or that the two variables cannot be linked. Rather it shows a gap and opportunity in literature that needs to be exploited.

The current study's research framework proposes that intra-firm supply chain practices of supply chain planning, JIT production and inventory, as well as delivery can positively influence the supply chain member firms' technology mediated collaborations. This proposition is informed by both the RV theory along with the Lambert and Cooper's (2000) supply chain management framework. The argument is that after understanding their positions in the supply chain, identified and selected their primary suppliers as well as customers, firms can invest in the linkages and connections of their business processes to enhance supply chain planning, JIT production and delivery practices. With time, these supply chain firms will then invest in collaboration technologies that can help them share resources and strengthen their long term relations within their supply chain. Thus, firms that effectively implement their intra-firm supply chain practices increase the chances of collaborating with their key supply chain members using technologies in an attempt to control and minimise supply chain costs. In light of the RV theory, supply chain framework as well as the above reasoning, this study hypothesises that:

H_1: intra-firm supply chain practice has a positive influence on supply chain e-collaboration.

4.3.2. Supply Chain E-Collaboration and Strategic Information Sharing

Supply chain e-collaboration as earlier noted is a new way of doing business, competing with each other and a strategic tool with a lot of potential to transform traditional business relationships. Lambert and Cooper's supply chain management framework emphasised the need for firms to identify their primary suppliers and customers with whom to collaborate and coordinate their business processes with. This implies that a firm can effectively and profitably collaborate with few and primary selected supply chain members.

In support, the RV theory through its interorganisational relation specific assets requires firms in a supply chain to invest in collaboration technologies and other resources that are specific to their relations. These collaboration technologies and

other resources/assets of a firm specific to, say, the supply chain collaboration relations, should be well connected to those of its supply chain collaboration member firms. More so, the RV theory through its complementary resources/ capabilities requires collaborating supply chain member firms to buy all their needed resources among each other. These resources are indivisible and cannot be accessed elsewhere in the secondary markets. This would help create some information sharing routes among the firm and its primary customers or suppliers which it is collaborating with. According to the RV theory, the self governance source of relational rents also promotes the creation of strategic information sharing routes among collaborating firms. This is because it is a source of relational rents that promotes trust and commitment among supply chain collaboration partners. The factors of trust and commitment are essential in any relationship that requires the exchange and sharing of important information especially the tacit information.

Information sharing has been defined in this study as the communication or sharing of a firm's long term important and sensitive proprietary information among supply chain partners. As mentioned earlier in Chapter 3, the sharing of strategic information greatly depends on commitment and trust among the supply chain collaboration partners. Previous studies have, however, linked information sharing to various factors either as a predictor, mediator or outcome variable. For instance, Zhou and Benton (2007) in their research model linked information sharing to supply chain dynamism and intra-firm supply chain practice as a mediator variable. Using four items (information sharing technology, customer information, manufacturing information and information quality) to measure information sharing, the findings revealed that 'effective information sharing significantly enhances effective supply chain practice'.

Sheu, Yen and Chae (2006) linked trust and interdependence with collaboration, as well as information sharing. In their study, Sheu *et al*. (2006:40) found that high levels of trust and interdependence were the pushing factors of managers to engage a firm in further collaborations. Furthermore, their study suggested that relatively low trust and interdependence levels impede collaboration and information sharing. In other words, successful supply chain e-collaborations are highly dependent on the collaborating firms' trust and interdependence on each other. This will in turn encourage these firms to communicate and share with each other their strategic and even important tacit information.

Kocoglu *et al*. (2011) linked supply chain integration (as a predictor variable) to information sharing. Important to note is the fact that supply chain integration enhances the degree of a firm's e-collaborations with its primary supply chain suppliers and customers. According to Kocoglu *et al*. (2011:1633), supply chain integration 'structures the firm-level strategies, processes and practices into aligned and synchronised collaboration activities' aimed at achieving inter-firm information sharing. In addition, supply chain collaborations that uphold supply chain integration directs their supply chain collaboration member firms towards an expanded resource base. In these expanded resource bases, core elements are combined from heterogeneous information sources into a common information platform that encourages information sharing (Kocoglu *et al*., 2011:1633). Supply chain integration in supply chain e-collaboration relationships results in increased visibility of the e-collaborating partners' operational activities (Mbanje & Lunga 2015:6). Higher visibility in these supply chain e-collaboration relationships in turn improves transparency and engenders trust. It is the transparency and trust which creates a platform conducive for effective sharing of strategic information among the supply chain e-collaborating firms (Chinomona & Hove 2015:65).

In light of the above, this study posits that supply chain e-collaboration has a positive influence on supply chain collaboration partners' sharing of strategic information. This is stated below as:

H_2: Supply chain e-collaboration has a positive influence on strategic information sharing.

4.3.3. Supply Chain E-Collaboration and Supply Chain Competence

Supply chain e-collaboration does not only influence the sharing of strategic information among the collaborating firms, but it also creates a competence for the entire supply chain (Breite & Koskinen 2014:11). A supply chain competence has been defined in this study as the collective learning of the entire supply chain, emanating from the e-collaboration relationships between the supply chain partners that unleash unique and inimitable value creating abilities, by combining the core competencies of the individual partners.

The RV along with the LKP theories have been used to explain a supply chain competence in Chapter 2. The RV theory suggests that firms in a supply chain e-

collaboration relationship can collectively learn as a supply chain (supply chain competence) through three sources of relational rents. Firstly, a sustainable supply chain competence can be created when the e-collaborating firms invest in inter-firm collaboration specific assets along with technologies and link them well with each other's assets. Secondly, e-collaborating firms can create a sustainable supply chain competence by investing in complementary resources/capabilities (in essence, indivisible resources that cannot be bought elsewhere), where the e-collaborating firms will be mandated to only buy all the resources or capabilities they need among each other. Lastly, based on the RV theory, e-collaborating firms can create a sustainable supply chain competence through the enforcing self governance which is based on trust when resolving conflicts among members.

The LKP theory in support of the RV theory postulates that supply chain member firms collaborate in order to exploit opportunities that reveal knowledge creation and organisational learning (Cao 2007:21). In other words, the main purpose for firms in a supply chain to collaborate traditionally or electronically is to create a supply chain competence.

From the supply chain management framework by Lambert and Cooper (2000), firms that link their business processes with their primary customers and suppliers through the management components can create a competence for the entire supply chain. This is because information would be created, flowing from the demand management process through to the returns processes, which facilitates collective learning of the collaborating firms.

Previous studies have linked supply chain competence to various factors as a predictor, mediator and or outcome variable. For instance, a study by Kuei *et al*. (2005) linked supply chain competence to supply chain quality management as an outcome variable, measured using two (2) items (design and response capability as well as levels of product quality). Their results revealed a positive effect of supply chain quality management on supply chain competence. This suggests that a supply chain that effectively manages its product/service quality has an ability to collectively learn and create a sustainable supply chain competence.

Chow *et al*. (2008) in their model linked supply chain competence to supply chain concerns and supply chain practice as a direct effect or outcome variable. Their study as noted in Chapter 3, used three items to measure supply chain competence (in

essence operations and distribution, quality and service as well as design effectiveness). Their findings report a significant effect of supply chain practices on supply chain competence. This implies that a supply chain that effectively implements practices such as supply chain planning, JIT systems and delivery is able to learn collectively and create a sustainable supply chain competence. Such supply chain competences might include the ability to effectively manage inventory, accurately forecast customer demands and fill their orders, producing quality products and designing low pollution production along with delivery processes (Lysons & Farrington 2012:339).

This study proposes that e-collaborating firms in a supply chain can use e-collaboration tools to create a supply chain competence. For instance, e-collaborating firms in a supply chain can invest in the message based system which transmits information from the focal firm to other e-collaboration member firms' applications using technology. This system can be complemented with the shared collaborative system. The shared collaborative system as noted in Chapter 3, involves supply chain planning and forecasting, capacity planning, direct procurement and replenishment. The electronic procurement hubs and market place system is another e-collaboration tool useful in the facilitation and promotion of buying and selling among collaborating firms across industries (Chong *et al*., 2009:152). These systems enable firms in a collaborating supply chain to learn collectively and accurately forecast their demand needs, timely respond to customer orders, produce quality products and deliver quality services (Chong *et al*., 2009:152). In other words the e-collaboration tools in supply chains help firms to create a supply chain competence such as product and service, operation and distribution as well as design effectiveness.

Based on the above, this study hypothesises that supply chain e-collaboration has a positive influence on supply chain competence. This is further stated below as:

H_3: Supply chain e-collaboration has a positive influence on supply chain competence.

4.3.4. Strategic Information Sharing and Supply Chain Competence

Information sharing and communication is a fundamental contributing factor towards any form of learning. The supply chain management framework by Lambert and

Cooper (2000) shows information flowing to all the supply chain member firms from across all the business processes. It reveals information flow through sharing and communication as a fundamental pillar for the integration of business processes in a supply chain. The framework also entails that firms in a supply chain can learn collectively and develop a sustainable supply chain competence through the effective flow of the accurate information among member firms.

The RV, as well as the LKP theories are used to also explain the influence of strategic information sharing on supply chain competence. The RV theory assumes that a regular pattern of inter-firm interactions result in the creation of interorganisational knowledge sharing routines that allow firms to transfer, recombine and or create new specialised knowledge. The knowledge routines as earlier noted allow collaborating firms in a supply chain to share even tacit knowledge with each other. This knowledge cannot be accessed by any individual firm outside the collaboration relations even from the markets. The RV theory linked information sharing to organisational learning and relational rents. The theory requires collaborating firms in a supply chain to share their important information both expressly and tacitly with each other in order to learn collectively and ultimately generate relational rents.

The LKP theory, as earlier noted, regard information as an effect of supply chain collaborations, which facilitates even the sharing of tacit knowledge among partners. The theory holds that firms can learn either through exploitation or exploration. For instance, when collaborating firms exploit new areas of capability improvements, they can learn collectively through the discovery of new business growth opportunities as well as the creation of new business knowledge. Sharing of such knowledge with the other collaborating firms in their supply chain can help these firms to develop a competence for both the individual firms as well as the entire supply chain. Also when firms explore areas of their already existing capability improvements, they can learn collectively and create a sustainable supply chain competence.

Previous evidence from a study by Ngai, Chau and Chan (2011) linked knowledge sharing to learning orientation, supply chain agility and strategic competitiveness. They argue that the ‘efficient flow or sharing of information and materials helps firms to keep track of market needs and allows the firm to relocate resources in a responsive manner’ (Ngai *et al*., 2011:237). In other words information sharing

among collaborating firms enhances the ability of firms to learn and develop supply chain agility, which requires firms to promptly respond to unexpected changes. Supply chain agility will in turn create a supply chain competence for the entire supply chain. Previous studies that have linked strategic information sharing to supply chain competence are scant. This study attempts to provide such evidence on the link between strategic information sharing and supply chain competence.

The current study proposes that sharing of strategic information among e-collaborating firms in a supply chain can create operational and distribution, product and service as well as design effectiveness supply chain competences. It assumes that e-collaborating firms in a supply chain can learn collectively from sharing their strategic information through the reciprocal as well as the hub-and-spoke information structures. For instance, when e-collaborating firms share their information through a reciprocal structure, information flows in a bidirectional manner. If shared effectively, the information can help the e-collaborating firms to generate the operational and distribution as well as the product and service supply chain competences. In other words, bidirectional information sharing among e-collaborating firms enables them to accurately forecast demand, promptly fulfil customer orders, produce quality products and deliver quality services. However, if done inappropriately, bidirectional information sharing can cause irregularities between the shared information of different supply chain partners (Liu & Kumar 2003:525). As such, Liu and Kumar (2003:525) emphasise the need for collaborating firms to synchronise and integrate their strategic information sharing interactive processes so as to augment coordination as well as reduce uncertainty and conflict among member firms.

The hubs and spokes are web based structures for information sharing among collaborating firms (Chong *et al*., 2009:152). These structures, as noted in Chapter 3, require a virtual market (such as Carpentercare.com, Carpenterdirect.com and Visional technology) which facilitates a full range of business processes and interaction among collaborating firms. Liu and Kumar (2003:525) argue that a 'centralised e-hub enhances the ability of firms to accurately forecast customer demand, promptly fulfil customer orders and even produce quality products'. This means that strategic information sharing among e-collaborating firms through e-hub structures like Carpenterdirect.com enables firms to develop supply chain competences. Based on the above, the hypothesis of this study is that strategic

information sharing among e-collaborating firms in a supply chain has a positive influence on supply chain competence. This is stated below as:

H_4: Strategic information sharing has a positive influence on supply chain competence.

4.3.5. Strategic Information Sharing and Supply Chain Performance

Information sharing is also a key determinant of both firm and supply chain performance. The RV theory refers to supply chain performance as relational rents. When collaborating, firms invest in assets and technologies that are specific to their supply chain e-collaboration relationships and connect them well with those of their collaborating partners they create new knowledge. The firm can then share new knowledge together with the other existing important information to encourage learning within the supply chain. The supply chain learning will in turn enhance the performance of the entire supply chain. In addition, interorganisational information sharing routines, by allowing effective information sharing among collaborating firms, generates supply chain e-collaboration rents in the form of supply chain competences, which in turn improve supply chain performance.

The supply chain management framework can also be used to explain the relationship between strategic information sharing and supply chain performance in this study. As noted earlier, information flows through all the firms in the supply chain and across all the business processes in a supply chain framework. As information is shared across the business processes in a supply chain, firms can improve their supply chain performance through effective business process integration with their primary customers and suppliers.

Previous studies have linked supply chain performance to strategic information sharing as an effect or outcome variable. For instance, Sezen's (2008) model proposed that there is a correlation between information sharing and supply chain performance. Using three items to measure supply chain performance (flexibility, resource and output), the findings reported a correlation between information sharing and supply chain performance.

Fawcett *et al*. (2007) also linked operational supply chain performance to information sharing as an outcome variable. Their study proposed that information sharing in terms of willingness and connectivity has an impact on operational supply chain

performance. The findings revealed that information sharing has a significant impact on operational supply chain performance.

More so, a study by Kocoglu *et al*. (2011) linked supply chain performance to information sharing. Their study empirically tested the impact of information sharing on supply chain performance. Their findings revealed that information sharing positively impact supply chain performance. Informed by the above, the current study posits that:

H_5: Strategic information sharing has a positive influence on supply chain performance.

4.3.6. Supply Chain Competence and Supply Chain Performance

Supply chain performance is also influenced by supply chain performance. As previously noted, the RV theory identifies four sources of relational rents or supply chain performance (in particular interorganisational relation specific assets, interorganisational knowledge sharing routines, complementary resources/ capabilities and effective governance), and links supply chain competence to relational rents (supply chain performance). The theory assumes that collaborating firms create a supply chain competence by investing in assets and technologies that are specific to their supply chain collaboration relationships and connect them well with those of their collaborating partners. This in turn enhances the performance of the entire supply chain.

Supply chain competences are also created by the effective sharing of information among collaborating firms through interorganisational information sharing routines (De Wit & Meyer 2010:357). The supply chain competence in turn enhances supply chain performance. Furthermore, supply chain competences that enhance supply chain performance can be generated when e-collaborating firms only trade complementary resources/capabilities with each other within their supply chain. These resources must be inaccessible to firms that are not part of their supply chain collaboration relations. Such an arrangement enables the e-collaborating firms to create a unique and inimitable supply chain competence, which in turn improves supply chain performance. Collaborating firms can also generate relational rents that improve supply chain performance by enforcing effective governance. This is

because effective governance enables collaborating firms to reduce costs and improve profits.

Based on the Lambert and Cooper (2000)'s supply chain management framework, supply chain competences can be created through the integration of a firm's business processes with those of its collaborating partners. The supply chain competences will in turn improve the performance of the entire supply chain.

A previous study by Jie *et al*. (2007) linked supply chain performance to competitive advantage as an outcome variable. The results of the study suggested flexibility, efficiency, food quality and responsiveness as the significant indicators of supply chain performance. All these indicators are examples of supply chain competences that generate a competitive advantage and ultimately improve supply chain performance.

Chow *et al*. (2008) linked organisational performance to supply chain competence as an effect or outcome variable. The findings of their study reported a positive effect of supply chain competence on organisational performance. Based on the above, this study posits that:

H_6: Supply chain competence has a positive influence on supply chain performance.

4.4. CHAPTER SUMMARY

This chapter discussed the previous research models by various authors relevant to the research constructs of this study and used them to construct the current study's research conceptual framework. The research conceptual framework was also explained.

The research hypotheses development was then discussed. Firstly, the hypothesised influence of intra-firm supply chain practice on supply chain e-collaboration was explained using the supply chain management framework, RV theory as well as the empirical evidence. Secondly, the posited influence of supply chain e-collaboration on strategic information sharing was explained using the supply chain management framework, RV, and LKP theories along with the empirical evidence. Thirdly, the hypothesised influence of supply chain e-collaboration on supply chain competence was discussed using supply chain management framework, the two theories as well

as the links from the empirical studies. Fourthly, the posited influence of strategic information sharing on supply chain competence was explained using the two theories, supply chain management framework and the empirical evidence. Fifthly, the hypothesised influence of strategic information on supply chain performance was explained using the supply chain management framework, the RV theory as well as empirical reasoning. Lastly, the posited influence of supply chain competence on supply chain performance was discussed using the supply chain management framework, RV theory and empirical evidence. The next chapter (Chapter 5) focuses on the research methodology and design.

CHAPTER 5

RESEARCH METHODOLOGY

5.1. INTRODUCTION

The advent of new technologies has significantly shifted the competition paradigm in the contemporary business world from between individual firms to supply chains (Lambert & Cooper 2000:18). As noted in the previous chapters, supply chain practices that enhance e-collaboration among supply chain members are augmenting in importance. The purpose of this study is to investigate the influence of supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance in South Africa. Chapters 2, 3 and 4 respectively discussed the theoretical and empirical literature of the current research variables, as well as the conceptual framework along with hypotheses developed, based on the research problem and its objectives. This chapter focuses on the research methodology, which results from translating the current study's research conceptual framework into varied research procedures.

According to Santhakumaran and Sargunamary (2008:2.1), a research methodology describes a plan of action to be carried out in connection with a proposed research work. It comprises the presentation of a research problem, procedures along with the techniques used for data collecting, the studied population as well as the data processing and analysis methods used (Santhakumaran & Sargunamary 2008:2.1). A synopsis of the philosophical underpinnings of research methodology along with the relevant types of research methods/ approaches used in this study is provided in this chapter. Subsequently, the chapter discusses the research design and methods, sampling design, as well as the data collection and analysis procedures used. The chapter concludes with a discussion of research constructs reliability and validity issues, ethical considerations, as well as the limitations.

5.2. RESEARCH PHILOSOPHIES AND PARADIGMS

A research philosophy or paradigm is linked to a researcher's views on knowledge development. Thus it is imperative for all researchers to have an understanding of research philosophy since it fundamentally influences the research approach decisions (Wilson 2010:9). Kuhn (1962:viii) refers to a research philosophy/paradigm

as a ‘universal standard scientific achievement that provides model problems and solutions to a community of practitioners or researchers for a given time’. Hussey and Hussey (1997:47) add that a research paradigm is a researcher’s beliefs about the world which are reflected in the way a research is designed, how data is gathered and analysed, as well as how the thesis or report is written. Hussey and Hussey (1997:47) single out two main research paradigms or philosophies, which they labelled as the positivist and the phenomenological (also referred to as interpretivist).

The positivist paradigm is premised on the belief that human behavioural studies should be conducted in similar methods as the natural science studies (Hussey & Hussey 1997:52). This paradigm assumes the independency of social reality from the researchers and exists regardless of the researcher’s awareness of it (Hussey & Hussey 1997:52). In support of this, Wilson (2010:10) asserts that the positivist paradigm follows empirical research methods with an objective view in which the researcher is independent of or is not influenced by what is being investigated. As argued by Hussey and Hussey (1997:52), positivists are of the view that laws provide the basis of explanation, permit the anticipation of phenomena, predict their occurrences and therefore allow them to be controlled.

The positivist paradigm seeks explanation which comprises the establishment of causal relationships between research variables. It establishes causal laws and links them to a deductive or integrated theory. According to Krauss (2005:760), the positivist paradigm uses deductive reasoning which applies a well known theory to develop research hypotheses that can be tested. More so, it applies logical reasoning to the research so that precision, objectivity and rigour replace hunches, experience and intuition as the means of investigating research problems (Hussey & Hussey 1997:52). This paradigm is thus considered as empirical research that follows a strict set of guidelines which should be carried out by appropriately trained researchers/scientists.

Generally, the positivism paradigm follows quantitative methods of data collection and analysis (Hussey & Hussey 1997:52). This paradigm is normally associated with higher levels of reliability since it is a highly structured approach (Hussey & Hussey 1997:52). As such, the positivism paradigm aims to apply or generalise its findings to the entire population (Wilson 2010:10; Sobh & Perry 2006:1196). For this reason, the

positivism paradigm has been widely accepted and used in most social science studies, especially business management, logistics and supply chain management.

Contrary to the positivist paradigm is the phenomenological (interpretivist) paradigm which is concerned with understanding human behaviour from the participant's own frame of reference. This paradigm assumes that social reality is within the researcher and that the researcher's act of investigating the reality has an effect on that reality (Hussey & Hussey 1997:53). In other words, the phenomenologist believes that social reality depends on the mind of the researcher and that there is no reality independent of the mind. More so, as stated by Van Maanen (1983:9), the phenomenological paradigm follows an array of qualitative methods and interpretative techniques which seek to describe, translate and interpret the meaning of social phenomena. According to Hussey and Hussey (1997:53), the qualitative approach emphasises the subjective aspects of human activity by focusing on the meaning rather than the measurement of social phenomena. Following Hussey and Hussey (1997:54), the main features of the positivist and phenomenological paradigms are tabulated in Table 1 below.

Table 5.1: Research Philosophies

Positivist Paradigm	**Phenomenological Paradigm**
Tends to produce quantitative data	Tends to produce qualitative data
Uses larger samples	Uses small samples
Concerned with hypotheses testing	Concerned with generating theories
Data is highly specific and precise	Data is rich and subjective
Reliability is high	Reliability is low
Validity is high	Validity is low
Generalises results from sample to population	Generalises results from one setting to another

Source: Hussey and Hussey (1997:54)

This study follows the positivist paradigm given the quantitative nature of the research methods and data analysis methods used. Moreover, the positivist paradigm befits this study mostly because of the causal relationships investigated between the five variables (which are supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply

chain performance). The positivist paradigm is also suitable in this study because it allows the measurement of research variables' reliability and validity levels. It also allows the testing of hypotheses. More so, the positivist paradigm is relevant and suitable in this study as it allows the generalisability of the research findings to a wider population setup like Southern African countries or Africa. The next section focuses on the research design employed in this study.

5.3. RESEARCH DESIGN

A research design is defined by Wilson (2010:102) as a detailed framework or plan that helps to guide the researcher through the research process, allowing a greater chance of achieving the research objectives. According to Sekeran and Bougie (2009:102), a research design fundamentally specifies issues related to decisions regarding the purpose of the study (exploratory, descriptive, hypothesis testing), its location (which is the study setting) and the research type it should conform to (type of investigation). It also shows the extent to which it is manipulated and controlled by the researcher (extent of researcher interference), its temporal aspects (time horizon) as well as the level at which the data is analysed (units of analysis) (Sekeran & Bougie 2009:102).

Research designs can suit three types of research, depending on the purpose of the study. Research studies can be either exploratory, descriptive or causal in nature (Sekeran & Bougie 2009:102). Wilson (2010:103) refers to exploratory research as a type of research in which a researcher conducts research into a research problem where there currently exists very little, if any, earlier work to refer to. In support, Sekeran and Bougie (2009:102) state that an exploratory study is undertaken when not much is known about the situation at hand, or no information is available on how similar research problems or issues were solved in the past. This means that exploratory research studies befit situations where there is a dearth of published research and a lack of knowledge about a given topic. As such this type of study requires extensive preliminary work to be done so as to gain familiarity with the research problem at hand. It aims to develop better and in-depth insight into a particular topic, which in turn leads to the development of a set of hypotheses (Wilson 2010:104). Exploratory research studies are primarily characterised by qualitative research methods which allow the use of focus groups, in depth interviews, historical analysis and observations (Wilson 2010:104).

Contrary to exploratory research is descriptive research, which is carried out to describe existing or past research problems or phenomena (Wilson 2010:104). More so, a descriptive study is conducted in order to ascertain and be able to describe the characteristics of the variables of interest in a situation (Sekeran & Bougie 2009:105). The goal of descriptive studies, in accordance with Sekeran and Bougie (2009:106), is to offer the researcher a profile or to describe the relevant aspects of the research problem at hand ranging from individual, organisational, to industrial. Integral to descriptive research studies is the quantitative nature of data in terms of frequencies, or mean and standard deviations. Wilson (2010:104) argues that descriptive studies tend to provide accurate information and help form the basis of simple decision making by setting out to provide answers to what, how and who questions. However, they do not determine the cause-effect relationships. In this study, descriptive research was used to build the profiles of the South African firms interviewed.

Contrasting descriptive research is causal research, which is solely concerned with learning why (Dick, Heras & Casadesus 2008:695). It helps determine the cause-effect relationships. Causality is usually accepted in empirical research and requires three conditions: that (i) there is an association between variables that logically might influence one another, (ii) the causal variable must produce its influence before the outcome occurs and (iii) other possible explanations must be eliminated, such as a third variable that influences both variables (Dick *et al*., 2008:695). This study uses causal research to determine the cause-effect relationships between supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. The next section focuses on the research methods.

5.4. RESEARCH METHODS

Creswell (2009:15) describes a research method as a means of outlining the data collection strategies used by the researcher. According to Wilson (2010:13), the two main research methods/strategies are quantitative and qualitative. Denzin and Lincoln (2000:8) refer to quantitative research methods as studies that emphasise the measurement and analysis of causal relationships between variables. This method primarily uses numerical and statistical techniques to attest such conclusions (Wilson 2010:13). The primary goal of quantitative research methods in accordance with

Malhotra (1999:148) is to develop and employ mathematical models, theories and/or hypotheses pertaining to a natural phenomenon.

A quantitative research method is advantageous in that it allows a large and representative sample to be drawn from the population of interest, measure the behaviour and characteristics of that sample, as well as attempt to construct generalisations regarding the whole population (Hyde 2000:84). The use of quantitative research methods helps the researcher to establish statistical corroboration on the strengths of relationships between variables (Shammout 2007:90). Shammout (2007:90) argues that despite the criticisms of quantitative research for its inadequacy in terms of generating a theory and providing an in depth explanation of qualitative enquiry, it is still useful in conducting the reliability and validity tests along with hypotheses verification.

Contrary to quantitative research is qualitative research, which is concerned with subjective assessment of attitudes, opinions and behaviours of categorical data (Santhakumaran & Sargunamary 2008:4.5). It adequately generates a theory and provides an in depth explanation of a qualitative enquiry (Shammout 2007:90). Santhakumaran & Sargunamary (2008:4.5) describe qualitative research as a function of a researcher's insights and impressions, which generates results either in non-quantitative form or in the form which is not subjected to rigorous quantitative analysis.

The current study used a quantitative research method to help establish the statistical evidence on the strengths of influence of supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. In addition, the quantitative research method was suitable for the current study because of its objectivity and usefulness in hypothesis, reliability and validity testing. More so, this method was befitting the study at hand because of its usefulness in quantifying data and applying some statistical data analysis method, particularly, the principal component analysis for factor reduction, confirmatory factor analysis (CFA) and structural equation modelling (SEM) and the regression analysis. The quantitative method also makes it possible to generalise the results of this study's sample of South Africa to a larger population setup like Southern Africa or Africa. Population and sampling design are discussed in the next section.

5.5. SAMPLING DESIGN

A sampling design is a process that involves six stages. It involves defining the target population, selecting a sample frame, choosing sampling techniques, determining a sample size, collection of data and assessing the response rate (Wilson 2010:190). Figure 5.1 below provides a pictorial presentation of a sampling design.

Figure 5.1: Sampling Design

Source: Wilson (2010:160)

5.5.1. Target Population

A population as defined by Berndt and Petzer (2011:347) is 'the collection of elements (people or objects) about which the researcher wants to make inferences and the total group of people who could be asked to participate in the research study'. The supply chain member firms' managers and owners who affiliate with SAPICS in South Africa are the target population of this study. The supply chain member firm managers ranging from demand planners, purchasing managers, procurement managers, logistics engineers, logistics managers and supply chain managers and owners or managers of the small and medium enterprises (SMEs) were the specific target population. This is because of their acquaintance and wider knowledge and experience base in terms of the supply chain management issues investigated in this study. The other prerequisite for these managers to qualify as

respondents was their SAPICS affiliation, since SAPICS is one of the biggest supply chain boards in South Africa. The nature of firms in the SAPICS data base range from manufacturing, retailing, construction, mining, tourism, agriculture, financial, logistics and marketing. The current SAPICS population is 1964. Target population is closely linked with the sampling frame.

5.5.2. Sampling Frame

Aaker *et al*. (2004:760) refer to a sampling frame as a listing of population members that is used to create a random sample and may include individuals, households or institutions. The list of supply chain member firm managers who are also SAPICS members was obtained from the SAPICS database. It consisted of 1964 members. The next section discusses the sampling techniques used to determine the sample size of 280 used in this study from the sampling frame.

5.5.3. Sampling Techniques

Choosing the most appropriate sampling techniques is one of the major decisions in a quantitative study. Generally, there are two broad types of sampling techniques, which are probability and non-probability sampling. According to Wilson (2010:194), probability sampling is a sampling technique in which every item in the population has an equal and known chance of being selected and included in the sample. Non-probability sampling is the alternative to probability sampling and includes any method in which the elements have an unequal chance of being selected and included in a study sample (Santhakumaran & Sargunamary 2008:3.3). The current study employs probability sampling techniques due to its quantitative nature. More so, as advocated for by Kumar, Aaker and Day (2002:306), probability sampling allows the researcher to statistically demonstrate the representativeness of a sample, an explicit statement as to how much variation is introduced, and identification of possible biases. In other words, probability sampling techniques are useful in this study because of their ability to eliminate or minimise bias by providing an equal chance of selection to the target population individuals.

Some of the most popular probability sampling techniques include: simple random, systematic, stratified and multi-stage sampling. This study, however, only employs the simple random probability sampling technique. According to Wilson (2010:194), the simple random sample means that every case of the population has an equal

probability of inclusion in the study sample. This sampling technique provides the following benefits: ease of use, and minimisation or elimination of selection bias, which enhances the variables' reliability levels.

5.5.4. Sample Size

A sample size is a function of change in the population parameters under study and the estimation of the quantity that is needed by the researcher (Wegner 2012:86-87). According to Sekaran and Bougie (2009:268), the decision of determining a sample size is governed by the research objectives; the extent of the desired precision (confidence interval); the acceptable risk in predicting the level of precision (confidence level); the amount of variability in the population itself; the cost and time constraints as well as, in some cases, the size of the population. Precision denotes how close the population parameter estimation is based on the sample statistics. Confidence denotes how certain the researcher is that the estimates will hold true for the population (Sekaran & Bougie 2009:288). Precision and confidence are among the most important factors in determining a sample size because they have a direct effect on the sample data used to draw inferences about the population and provide an estimate of the extent of the possible error (Sekaran & Bougie 2009:289). According to Terre Blanche, Durrheim and Painter (2006:236), generally, larger sample sizes result in more precise and robust statistical findings, while smaller samples result in less precise and unreliable findings.

The determination of the final sample size also involves judgment, especially where convenience sampling is employed, and calculation where random sampling is used by the researcher. Effective judgement when it comes to sample size determination requires the use of a sample size similar to those of the previous studies, so as to provide the researcher with a comparison of other researchers' judgements (Kumar *et al*., 2002:318). In this study, however, since simple random sampling techniques were used, the sample size was then calculated using the Raosoft sample size calculator. An initial sample size of 500 firms was calculated using the Raosoft sample size calculator at a margin error of 3.975% and a confidence interval of 96.025%.

A sample size directly impact on the appropriateness and the statistical power of the structural equation modeling techniques (Ho 2008:77; Hair, Anderson, Tatham & Black 2006:25). This is especially relevant in the current study since the study used

structural equation modelling techniques for data analysis. Hair *et al*. (2006:25), in addition, advocate that while the technique does not use individual observation, sample size plays an important role in the estimation and interpretation of SEM results. According to Sekaran and Bougie (2009:296), researchers universally agree that larger samples provide much more stable parameter estimates. Nevertheless, there is no agreement as to what constitutes an adequately large sample size. Consequently, the question of sample size is a deceptively difficult one to answer. Sekaran and Bougie (2009:296) in an attempt to address this question, cites Roscoe (1975) who proposed some rules of thumb for determining an adequately large sample size.

The rules of thumb suggest that: (i) sample sizes larger than 30 and less than 500 are appropriate for most research; (ii) where samples are to be broken into subsamples (for example males/females, juniors/seniors) a minimum sample size of 30 for each category is necessary; and (iii) in multivariate research (including multiple regression analyses and structural equation models), the sample size should be several times (preferably ten times or more) as large as the number of variables (Sekaran & Bougie 2009:296).

The first and third rules of thumb are more relevant for the current study. Following these rules, and since the study has five research variables, a sample size of 500 was initially calculated using the Raosoft sample size calculator. However, after the data collection process, a total of 320 usable questionnaires were gathered. This number further reduced to 280 questionnaires due to the mahalanobis which necessitated the deletion of 40 responses shown as extreme outliers. Thus, the final sample size of this study is 280 SAPICS members who are supply chain/logistics/procurement/purchasing managers and selected using simple random sampling techniques. These respondents are all registered on the SAPICS database as members. The final sample size of 280 used in this study falls within the recommended sample sizes of below 500. More importantly, the sample size of 280 respondents improved all the goodness of fit indices as advocated for by Hair *et al*. (2006:25). The next section focuses on the data collection procedures.

5.6. DATA COLLECTION PROCEDURES

This section focuses on the primary methods used by the researcher in order to physically collect the requisite data. The next section focuses on the research instrument cover letter.

5.6.1. Research Instrument Cover Letter

Cover letters play a significant role in most questionnaire surveys as they seek informed consent and participation from the targeted respondents. Dillman (2007:6) reveals that the contents or messages in a self-administered questionnaire's cover letter enhance the response rate. Consequently, questionnaires usually have a cover letter attached to them, which serves to briefly introduce and clearly define the purpose of the study. This letter also serves as a request for informed consent to the respondents and that they will participate voluntarily. Furthermore, the significance of the study, the importance of the respondents' assistance, and the assurance of confidentiality along with anonymity of the response are highlighted in the cover letter. Dillman's (2007:6) guidance on cover letter contents was followed and a cover letter was designed and accompanied the research questionnaire (refer to Appendix A). The cover letter was provided to all the respondents. The researcher was available to explain further the purpose of the current research study to the managers in demand planning, procurement, purchasing, logistics and supply chain (who are the respondents).

5.6.2. Questionnaire Design

A questionnaire protocol served as the primary means for data collection from the supply chain member firm managers. Shammout (2007:107) refers to a questionnaire as a 'reformulated written set of questions to which respondents record their answers, and is usually within the closely defined alternatives'. According to Martins, Loubser and Van Wyk (2002:216), there are three main reasons for designing a questionnaire, which are: (i) to maximise the relevance and accuracy of the data collected; (ii) to maximise the participation and cooperation of the target respondents and (iii) to facilitate the collection as well as analysis of the data.

As earlier noted, the questionnaire in this study was developed primarily on the basis of instruments used in other studies (operationalisation and item measurement section; Appendix B). Multi-item scaled questions (particularly Likert scales) were

used to test the research hypotheses. Thus, most of the questions contained in the questionnaire were 5-point Likert scale questions. Following arguments of Wegner (2012:86-87), most of the questions contained in the questionnaire were Likert scale questions for the following reasons: (i) they reduce the development of response bias amongst the respondents; (ii) they evaluate attitudes, beliefs, opinions and perceptions; (iii) Likert scale makes the response items standard comparable amongst the respondents; and (iv) the Likert scale statements answers are easy to code and analyse directly from the questionnaires.

A questionnaire containing 76 items was designed, based on previous works which are relevant to this study. The questionnaire items contain five constructs, namely, supply chain practice (16 items); supply chain e-collaboration (19 items), strategic information sharing (10 items), supply chain competence (14 items) and supply chain performance (17 items). All the measurement items were measured on a 5-point Likert-type scale that used 1=strongly disagree to 5=strongly agree to express the degree of agreement or 1=not implemented to 5=extensively implemented. Detailed operationalisation and measurement procedures for each research construct in the proposed model are provided in the next sections.

The scope of this study covered all the nine provinces in South Africa since SAPICS members are in all the nine provinces. In addition, it covers all the nine official sectors (retailing, manufacturing, wholesaling, construction, tourism, agriculture, financial, mining and transport), since supply chains cut across all sectors. As earlier noted, self-administered questionnaires were used for data collection. However, given the distance involved between the nine provinces in South Africa, these questionnaires were turned into monk Internet based surveys to reduce costs. With the help of SAPICS, a majority of the questionnaires were distributed to SAPICS members during the SAPICS annual conference held from 1-3 June 2014 at Sun City, South Africa. This conference had a total attendance of almost 1500 SAPICS members. A total of 300 usable completed questionnaires were collected at this conference. From the monk survey, a total of 20 usable and completed questionnaires were retrieved, summing up to a total of 320 responses.

5.6.3. Operationalisation and Measurement

A measurement can be defined as a standardised process of assigning numbers or other symbols to certain characteristics of the objects of interest, according to some specified rules, in order to predict or gauge some underlying scale which can only be partially measured by a single item or variable (Aaker *et al*., 2004:283). For the purposes of this study and as noted earlier, the research measurements were adopted and operationalised primarily on the basis of previous works along with consultation with field and academic experts. A review of the relevant literature resulted in five main constructs, and these are: supply chain practices, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. The study made some minor modifications to the adapted measures in order to suit the purpose and context of the current research. The questionnaire had six sections ranging from Section A to F. Section A incorporated 8 statements on personal information of the supply chain member firms as well as of the owners/managers. The Sections B to F of the questionnaire are discussed in the next sections.

5.6.3.1. Intra-firm supply chain practice

Intra-firm supply chain practice was measured from three dimensions - supply chain planning practices, just-in time production practices, and delivery practices. The study adopted and adapted 16-items employed by Zhou and Benton (2007:1358). Section B of the questionnaire (see Appendix B) incorporated 16 statements on the implementation of supply chain practices. The statements together with their data analysis codes are given on Appendix B.

5.6.3.2. Supply chain e-collaboration

Supply chain e-collaboration was measured from three dimensions: e-collaboration with suppliers, internal e-collaboration and e-collaboration with customers. It was measured using adopted and adapted 19 items from Hosseini, Azizi and Sheikhi (2012:86-87) and Rosenzweig (2009:475-6). Section C in the questionnaire (see Appendix B) incorporated the 19 items on supply chain e-collaboration. The 19 statements together with their data analysis codes are presented in Appendix B.

5.6.3.3. Strategic information sharing

Strategic Information sharing in this study was categorised into two dimensions: strategic information sharing with suppliers, and strategic information sharing with customers. It was measured using 10 items adopted and adapted from the instruments used by Sezen (2008:236), Eng (2006:771) and Kocoglu *et al*. (2011:1639). The questions on strategic information sharing are presented under Section D of the questionnaire in Appendix B. The 10 statements on strategic information sharing together with their data analysis codes are presented in Appendix B.

5.6.3.4. Supply chain competence

This study categorised supply chain competence into three main classes: quality and service, operations and distribution as well as design effectiveness. Fourteen (14) items were adopted and adapted from Chow *et al*. (2008:677) and used to measure supply chain competence. Section E of the questionnaire shown in Appendix B presents the 14 items used to measure supply chain competence in this study. The statements and data analysis codes used for supply chain competence are shown in Appendix B.

5.6.3.5. Supply chain performance

Finally, supply chain performance was measured from three dimensions: flexibility performance, resource performance, and output performance. It was measured using 17 items adopted and adapted from Sezen (2008:235), Liu (2009:286) and Kocoglu *et al*. (2011:1639). These items are shown in Section F of the questionnaire presented in Appendix B. The questionnaire statements as well as their data analysis codes are provided in Appendix B.

5.7. DATA ANALYSIS

Malhotra (1996:469) refers to data analysis as a statistical process that includes modeling and transforming data using a wide range of statistical techniques, which are notably classified as inferential and descriptive statistics. Descriptive statistics describe and summarise data, while inferential statistics are used to make inferences in relation to a wider population (Wilson 2010:213). Hypothesis testing is one of the main methods used in inferential statistics. Wilson (2010:237) describes hypothesis

testing as a method that ‘involves making a statement about some aspects of the population, then generating a sample to see if the hypothesis can or cannot be rejected’. This study used both the descriptive statistics to summarise and describe the respondents and firm profiles; and inferential statistics to test the research hypotheses. The primary hypothesis of this study broadly claims that: supply chain practices have a positive influence on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance.

The quantitative research data gathered for the purposes of this study was analysed using a four-step procedure which include: principal component analysis (PCA), confirmatory factor analysis (CFA), structural equation modeling (SEM) and multiple regression analysis respectively. Firstly, the principal factor analysis was used to reduce items by extracting factors or components that highly correlated with each of the research variables in this study. Secondly, the CFA was used to test the probability that the hypothesised factor structure is supported or confirmed by the sample data. Thirdly, SEM through the path analysis was used to test the research model and hypotheses. Lastly, the regression analysis which served the same purpose as the path analysis in SEM was used to confirm the associations and influences that variables have on each other. Analysis of Moments of Structure (Amos, version 21) was employed as the computational SEM software; while Statistical Package for Social Sciences (SPSS, version 21) was used for PCA and regression analysis. SEM, in this study, relates to three types of models, which are the measurement model of confirmatory factor analysis, the path models and the full latent variable model. The next section focuses on these statistical techniques, as well as the computer applications utilised in this study.

5.7.1. Principal Component Analysis

Principal component analysis was applied to condense the 76 questionnaire measurement items used for the five research variables of supply chain practices, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. Thus, the use of principal component analysis which was performed using the SPSS 21 statistical software packages reduced the 76 items contained in the questionnaire for all the research variables into a smaller number of 16 principal components/factors. This was done by finding the linear combinations of the original questionnaire items for each of the five research

variables that accounted for as much variation in the original data set as possible (Amman, Oesch & Schmid 2011:41).

The 16 principal components or factors were extracted on the basis of eigen values of greater than one and factor loadings exceeding 0.5 (Cramer 2006:21). These 16 factors were further rotated using the varimax rotation method, in which the items are assumed to be unrelated or orthogonal to one another, in the sense that the scores in one item are not correlated with the scores of the other item. According to Cramer (2006:20), the varimax rotation method attempts to maximise the variance explained by the questionnaire items by increasing the correlation of items that highly correlate with them; and decreasing the correlation of items that lowly correlate with them.

The 16 extracted varimax rotated principal components or factors were further linked to the five research variables (supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance). This was done on the basis of the component/factor among the extracted, to which most of the research variable's measurement items loaded highest in. The extracted items were further used for the performance of structural equation modelling for confirmatory factor analysis and hypothesis testing. The next section focuses on the structural equation modelling.

5.7.2. Structural Equation Modeling (SEM)

Structural Equation Modeling as defined by Sweeney (2009:186) is a very powerful multivariate technique that merges multiple regression aspects with factor analysis to simultaneously estimate a series of inter-correlated dependent relationships. It is a multivariate data analysis method that applies either an exploratory or a confirmatory factor analysis as well as the testing of hypotheses to analyse the structural theory bearing on some phenomena (Byrne 2001:53). Gunzler, Chen, Wu and Zhang (2013:390) in support, add that SEM employs a 'conceptual model, path diagram and system of linked regression-style equations to estimate complex and dynamic relationships within a web of observed and unobserved variables'.

The basic goal of SEM is to provide a quantitative test of a theoretical model hypothesised by the researcher using different types of models to predict relationships among observed variables. In other words, SEM analysis seeks to determine the extent to which the theoretical model is supported by sample data. So,

if the sample data supports the theoretical model, then the researcher can posit more complex theoretical models. On the contrary, if the sample data fail to adequately support the theoretical model, then there is a need to either modify the original model and re-test it or develop and test other theoretical models (Schumacher 2006:3).

According to Hair *et al*. (2010:17), SEM comprises two main components, namely, the measurement and structural model. The measurement model enabled this study to use several indicators for a single independent variable (supply chain practice). The structural model, which is a path, enabled this study to connect and test the hypothesised relationships between the independent (supply chain practice) and dependent variables (supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance). In addition, this study identified supply chain practice, supply chain e-collaboration, strategic information sharing and supply chain competence as having an influence on supply chain performance. The SEM technique initially requires the performance of a measurement model which is discussed below.

5.7.2.1. Measurement model

Reisinger and Mavondo (2007:43) describe the measurement model as a 'theoretical model that reveals the structural relationships among latent variables (in essence the independent and dependent) and their observed variables; along with the arcs that directly link them as well as the error terms for their observed variables.' Its main purpose is to provide the overall fit of the factor model, which shows the undimensionality of the measurement items (Reisinger & Mavondo 2007:43). The measurement model can be performed either as an exploratory factor analysis or confirmatory factor analysis. Exploratory factor analysis seeks to determine and develop the likely factor structure (new measures) for studies where there is a dearth of literature and previous measures for the latent variables investigated (Cramer 2006:28). Confirmatory factor analysis is a technique that confirms that the existent measurement items load themselves into latent variables, which depends on how the researcher links the measurement items to the latent variables (Lei & Wu 2007:34; Reisinger & Mavondo 2007:43). This study applies the confirmatory factor analysis as the measurement model since previous measures of the latent variables (supply chain practice, supply chain e-collaboration, strategic information sharing, supply

chain competence and supply chain performance) exist. The next section focuses on confirmatory factor analysis.

(a) Confirmatory factor analysis

A confirmatory factor analysis (CFA) is a measurement model that focuses exclusively on the link between factors and their measurement variables (Cramer 2006:28). It seeks to statistically test the probability that a hypothesised factor structure is supported or confirmed (Cramer 2006:28). In other words, CFA aims to test the significance of a posited factor model developed by the researcher. Thus, if the data supports the factor model, then the data will not significantly differ from the model. On the contrary, if the data do not support or fit the posited factor model, the data will then differ significantly from the assumed factor model (Schumacher 2006:3; Cramer 2006:28).

CFA is premised on the assumption that commonalities are originally one, entailing that the total variance of the variables can be accounted for by means of its components (or factors) and that there is thus no error variance (Byrne 2001:54). Its application is most appropriate where the researcher is knowledgeable of the underlying latent variable structure. Byrne (2001:54) further argues that the researcher can apply the theoretical and/or empirical research knowledge to statistically hypothesise a structure of relationships between the observed measures and underlying factors. Accordingly, CFA requires that the researcher specifies a certain number of factors which are correlated, and for which observed variables measure each factor (Reisinger & Mavondo 2007:44). In this study, CFA is used for two main reasons: that there is some previous literature on some of the variables and that CFA has previously been widely used by various researchers in the field of supply chain management. CFA, thus, allowed the specification of supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance as correlated variables in this study.

Effective performance of CFA recommends that data be screened. This entails analysing the correlation matrix with an aim of eliminating items that are not correlated with any other items or that highly correlate with other items (Field 2005:6). Furthermore, as suggested by Tabachnick and Fidell (2007:17), effective performance of CFA requires that the sample size be assessed to ensure that it is sufficiently large. The final sample size of this study of 280 is in line with most

recommendations of what constitutes a sufficiently large sample size that can provide a good factor model fit (Kline 2005:93).

This study performed a confirmatory factor analysis to establish the factor model fit; in other words, to test if the sample data fits or supports the hypothesised research factor model. Using Amos 21, the model fit indices tested in CFA to assess the factor model fit include: the Chi-square/degrees of freedom, Goodness of Fit Index (GFI), Augmented Goodness of Fit Index (AGFI), Normed Fit Index (NFI), Incremental Fit Index (IFI), Tucker-Lewis Index (TLI), Composite Fit Index (CFI), Root mean square residual (RMR) and Root mean square error of approximation (RMSEA). All these model fit indices are discussed in detail in Chapter 6 (under Confirmatory Factor Analysis Model Fit/Acceptability section). The Confirmatory factor analysis leads to the performance of a path analysis which is discussed in the next section.

5.7.2.2. Structural model

A structural model is a theoretical model that indicates structural relationships among the latent or unobserved variables (both dependent and independent) and their observed variables (measurement items); along with the direct arcs linking them as well as the error terms for the observed variables (Reisinger & Mavondo 2007:43). The linear connections between the unobserved variables reflect the proposed research hypotheses. In this study there are six linear connections between the five variables and these are shown in Table 5.2 below.

Table 5.2: Theorised Variable Paths

Hypothesis	Theorised Variables Paths
H_1	supply chain practices ⟶ supply chain e-collaboration
H_2	supply chain e-collaboration ⟶ strategic information sharing
H_3	supply chain e-collaboration ⟶ supply chain competence
H_4	strategic information sharing ⟶ supply chain competence
H_5	strategic information sharing ⟶ supply chain performance
H_6	supply chain competence ⟶ supply chain performance.

The structural model combines the measurement model and path model. This means that the structural model provides both the overall model fit of the factor model and tests the research hypothesis. The path analysis is discussed in the next section.

a. Path analysis

A path model or analysis describes the linear dependency or causal relationships between the unobserved variables (Reisinger & Mavondo 2007:45). It is an extension of the multiple regressions and comprises various regression models or equations that are simultaneously estimated (Lei & Wu 2007:34). Kline (2005:94), in addition, asserts that path analysis involves the specification of a model by researchers in an attempt to explain the reasons for the correlations between variables X and Y. In other words, the path analysis may involve estimating the presumed causal relations among the unobserved variables (for example X causes Y); or presumed non-causal relationships, such as a spurious association between X and Y. The path analysis ultimately aims at measuring how well the factor model accounts for the sample data, that is, the observed correlations or covariance.

In path analysis, the structural relationships are the research hypotheses that reveal the directional influences or causal relationships among multiple variables (Lei & Wu 2007:34). In simpler terms, the structural relationships show how the independent variables (for example supply chain practice) affect the dependent variables (for example supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance). As contended by Lei and Wu (2007:34), the path analysis provides a more ‘effective and direct way of modelling mediation, indirect effects and other complex relationships among the variables’.

For better understanding of the path analysis, two major types of variables are explained in this study, which are latent and observed variables. On the one hand, latent variables are used to refer to the research factors or variables that are observed or measured indirectly through the measurement items (observed variables). They are also referred as the unobserved variables and are inferred from a set of items or questionnaire questions used by the researcher to measure latent variables using statistical techniques. This implies the need for operational definition of the latent variables of interest in terms of the behaviour assumed to represent it by the researcher (Byrne 2001:7). Therefore, the latent variable is connected to the measurement items or observed variables, which makes the measurement of latent

variables possible. In SEM's path analysis, these latent variables are depicted by a circle (or an ellipse).

On the other hand, observed or manifest variables are defined by Schumacher (2006:5) as a set of variables or questionnaire items used by researchers to define or infer latent variables. These questionnaire or measurement items serve to reveal the underlying latent constructs that they are presumed to represent. In SEM's path analysis, these measurement items or observed variables are diagrammatically depicted by a square (or a rectangle). More so, these two types of variables can be defined as either independent variables (exogenous) or dependent variables (endogenous). Schumacher (2006:3) defines the independent variable is a variable that is not influenced by any other variable in the model, while the dependent variable is influenced by other variables.

Multiple regression analysis was also performed to test the research hypotheses of this study and compares them with the path analysis' hypotheses test results. Chapter 6 on research findings and interpretations provides the multiple regression analysis results. Above all, the issues of reliability and validity are of paramount importance in SEM models as well as the multiple regression analysis and these are discussed in the next sections.

5.8. RELIABILITY AND VALIDITY OF RESULTS

Various precautions were applied during the research process to enhance the validity and reliability of the sample data gathered. The item-to-total correlation values were used to measure the reliability of multi-item construct measures in this study. In addition, the Cronbach's coefficient alpha, Composite Reliability (CR) values and Average Variance Extracted (AVE) values were also used to measure the reliability of the research variables. Specifically, the item-to-total correlation values were used to measure the correlation of each item to the sum of the remaining items. On the contrary, the Cronbach's coefficient alpha was used to measure the squared correlation between observed scores and true scores. The Composite Reliability values were employed to measure the internal reliability of each construct (which are: supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance) in this research. Lastly, the Average Variance Extracted values were used to show the total amount of variance in the measurement items that explain by the latent construct (Hair *et al*., 2010:18). A

more detailed discussion of these measures of reliability used in this study is provided in the next chapter (Chapter 6).

Construct validity was measured using both convergent and discriminant validity. According to Cooper and Schindler (2011:281), convergent validity is concerned with the degree to which the measurement items show homogeneity within the same latent variable measured. It is established when the scores obtained with two or more different measurement items measuring the same latent variable are highly correlated (Sekaran & Bougie 2009:160). Thus, for convergent validity to exist and be validated, a measurement item is expected to correlate highly with the other measurement items that measure the same latent variable. This study measures convergent validity by assessing whether individual measurement's factor loadings for each corresponding research construct are above the minimum threshold value of 0.5 (Anderson & Gerbing 1988:55).

Saunders *et al*. (2009:319) refer to discriminant validity as an assessment performed to measure the degree to which the measurement items for different latent variables show heterogeneity (or load separately) between different latent variables. For instance, discriminant validity requires that the questionnaire/measurement items for, say, supply chain practice, load distinctly and separately from the measurement items loading into supply chain e-collaboration. Discriminant validity is established when, based on theory, two or more latent variables are predicted to be uncorrelated, and the scores obtained by measuring them are indeed empirically found to be so (Sekaran & Bougie 2009:160). The current study measured discriminant validity using the correlation matrix coefficients of less than 1 and the AVE values of less than 1. The study also measured discriminant validity by comparing the Average Variance Extracted estimates of the latent variables with the highest shared variance (square of the parameter estimate between these measures). Thus, discriminant validity was established where the AVE values were greater than the highest shared variance between variables (Fornell & Larcker 1992:45). The next section focuses on the ethical considerations of the study.

5.9. ETHICAL CONSIDERATIONS

Ethics are concerned with the development of moral standards by which situations can be judged, which applies to all situations in which there can be actual or potential harm of any kind to an individual or group (Churchill 1991:1039). Therefore, the respondents who completed the questionnaires for this study willingly participated in the survey. In addition, the respondents were informed about the 'potential impact of the investigation' and that the study is a Doctoral degree research project conducted for academic purposes. This was done by means of a covering letter which was attached to the front of the measuring instrument (Strydom 1998:25). More so, the respondents' information would be kept in strict confidence and they would remain anonymous (Churchill 1991:54). The ensuing discussion offers a summary of this chapter.

5.10. SUMMARY

This chapter delineated the research methodology (which covered the research philosophies and paradigms, the research design and methods, sampling design, data collection methods, data analysis procedures, reliability, validity, ethical consideration together with the limitations) that the researcher pursued in this study. The study followed a positivist paradigm, which requires the use of a quantitative research model. The SAPICS professional member database comprised the sampling for this study in South Africa. Simple random probability sampling was used to select the sample. Using the Raosoft sample size calculator, an initial sample size of 500 SAPICS professional members was calculated. After data collection, a total of 320 usable questionnaires were collected. The final sample size reduced to 280 after the deletion of the extreme outliers as required by the mahalanobis.

Data analysis was performed fourfold. Firstly, the principal component analysis was performed to reduce the questionnaire items which were too many. Secondly, the SEM models of confirmatory factor analysis and the path analysis were performed using Amos software packages (version 21). The confirmatory factor analysis measured the overall model fit, while the path analysis performed the testing of this study's hypotheses. Multiple regression analysis was also performed using SPSS 21 for comparison reasons with the path analysis' hypotheses test results. The chapter also provided a brief discussion of reliability and validity issues concerning data collection and analysis for the study. Ethical considerations as well as the limitations

of the study were also provided. The next chapter (Chapter 6) covers the detailed findings and data analysis of the study.

CHAPTER 6

EMPIRICAL RESULTS OF THE STUDY

6.1. INTRODUCTION

The previous chapter (Chapter 5) provided the research philosophies, methods and design along with the sampling design, data collection methods as well as data analysis methods. This chapter presents the findings and their interpretation from the data analysis performed. As noted in the previous chapters, SPSS Version 21 was used to statistically analyse and provide the descriptive analysis results (in the form of graphs and tables) of the respondents and firm profiles (see section 6.2) in this study. SPSS Version 21 was also used to perform principal component analysis utilised to reduce the measurement items for the research latent variables (see section 6.3). The study employed Amos Version 21 to perform structural equation models of confirmatory factor analysis for assessing the overall model fit as well as the path analysis for hypotheses testing. SPSS was used to conduct multiple regression analysis for hypotheses tests, which served as a comparison measure particularly for Hypothesis 5 and 6 with weaker influences in SEM. The descriptive analysis results for the sample profile are discussed below.

6.2. DESCRIPTIVE ANALYSIS RESULTS

A descriptive analysis was performed to build a sample profile for both the respondents and their firms. This section constitutes eight aspects, which are addressed individually and separately in the next sections. These include respondents' gender, education level, race, the firm's number of employees, turnover, age, type of business and technologies owned and utilised. The performance of the descriptive analysis of the sample personal data was crucial as it enhanced the researcher's understanding of the fundamentals of key personnel and the firm itself, especially in relation to supply chain practices and performance. These fundamentals have a strong bearing on the supply chain practices adopted and implemented in firms individually as well as the supply chain collectively. They also affect the performance of the individual firms through the performance of the entire supply chain. The next section focuses on the gender of the respondents

(logistics/supply chain/procurement/purchasing managers/demand planners) and how it affects supply chain practices and performance.

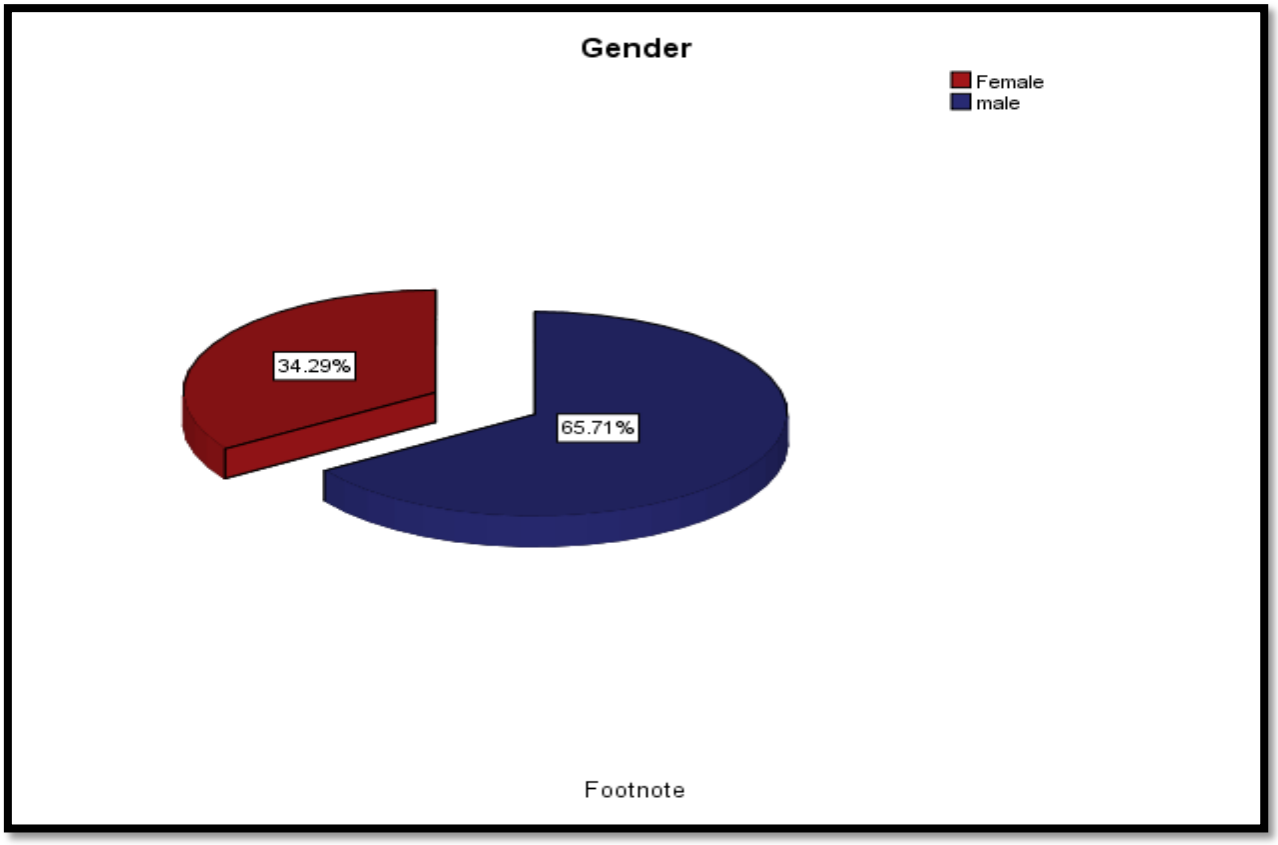
6.2.1. Gender Representation

The gender of the top supply chain officers such as the supply chain/logistics/procurement/purchasing managers is one of the factors that can influence the adoption and extent of implementation of supply chain practices such as supply chain e-collaboration and sharing of strategic information with major supply chain partners. The first question, thus, enquired about the gender of the respondents (in particular firm owners and logistics/supply chain/procurement/purchasing managers/demand planners) and the outcome appears in Table 6.1 and Figure 6.1 below.

Table 6.1: Gender Representation

Gender		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	96	34.3	34.3	34.3
	Male	184	65.7	65.7	100.0
	Total	280	100.0	100.0	

Figure 6.1: Gender Representation



From Table 6.1 and Figure 6.1, above, 65.7% of the respondents were males while 34.3% were females. The findings reveal that women still lag behind men in supply chain carriers. Subsequently, a smaller percentage of women occupy the top supply chain positions such as the supply chain managers, procurement and logistics. This is consistent with previous literature which claim that women account for about 5% of top supply chain positions at the fortune 500 firms (Eshkenazi 2014). Eshkenazi (2014) further associates the women lagging behind in supply chain carriers to education levels and experience. The next section focuses on the education levels of the sample.

6.2.2. Education Levels

The education levels of the top supply chain officers such as the supply chain/logistics/procurement/purchasing managers can influence the quality and nature of decisions they make for the firms. As such, the respondents were requested to provide their levels of education.The outcome appears in Table 6.2 and Figure 6.2 below.

Table 6.2: Education Levels

Education Level		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High school	27	9.6	9.6	9.6
	Diploma	31	11.1	11.1	20.7
	Degree	222	79.3	79.3	100.0
	Total	280	100.0	100.0	

Figure 6.2: Education Levels

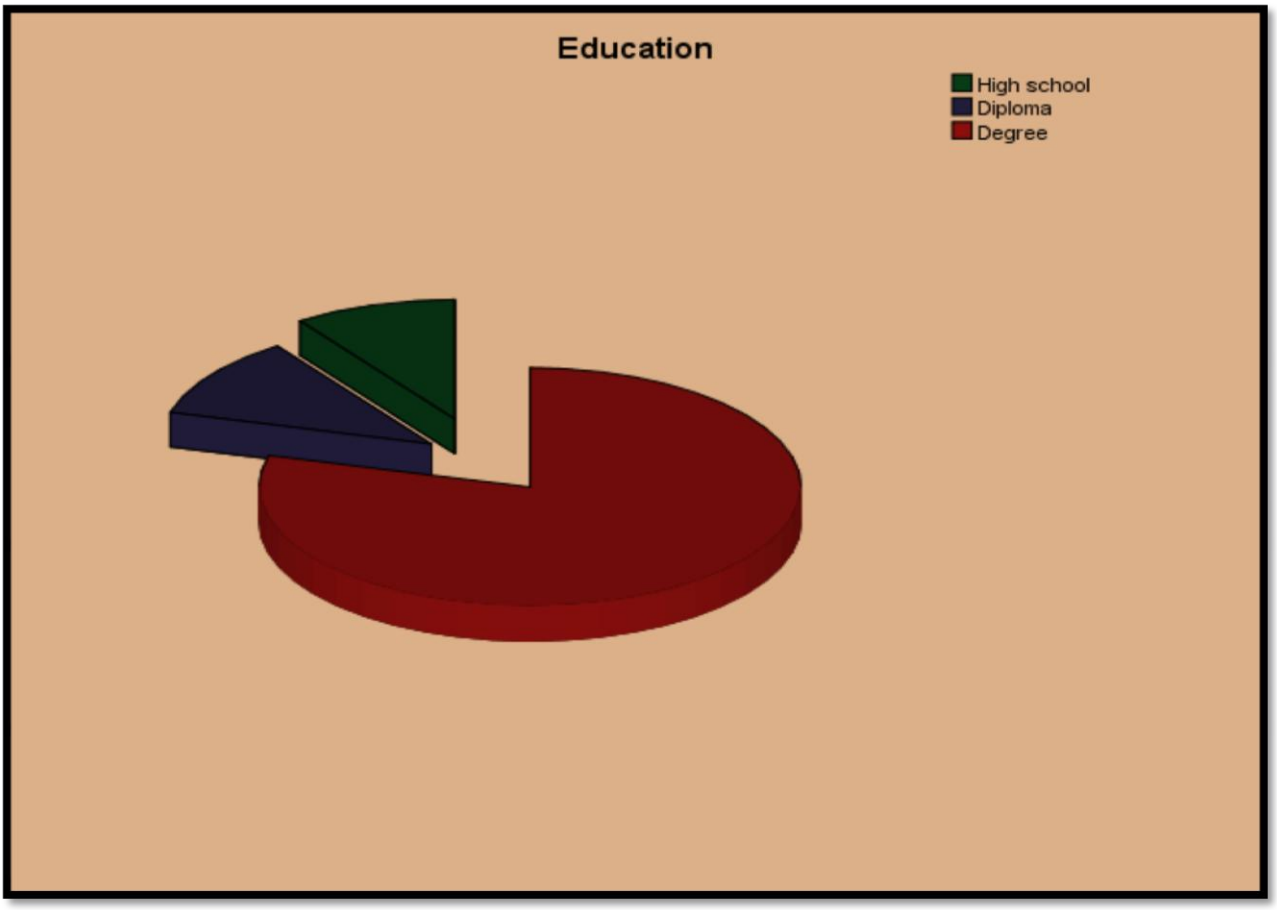


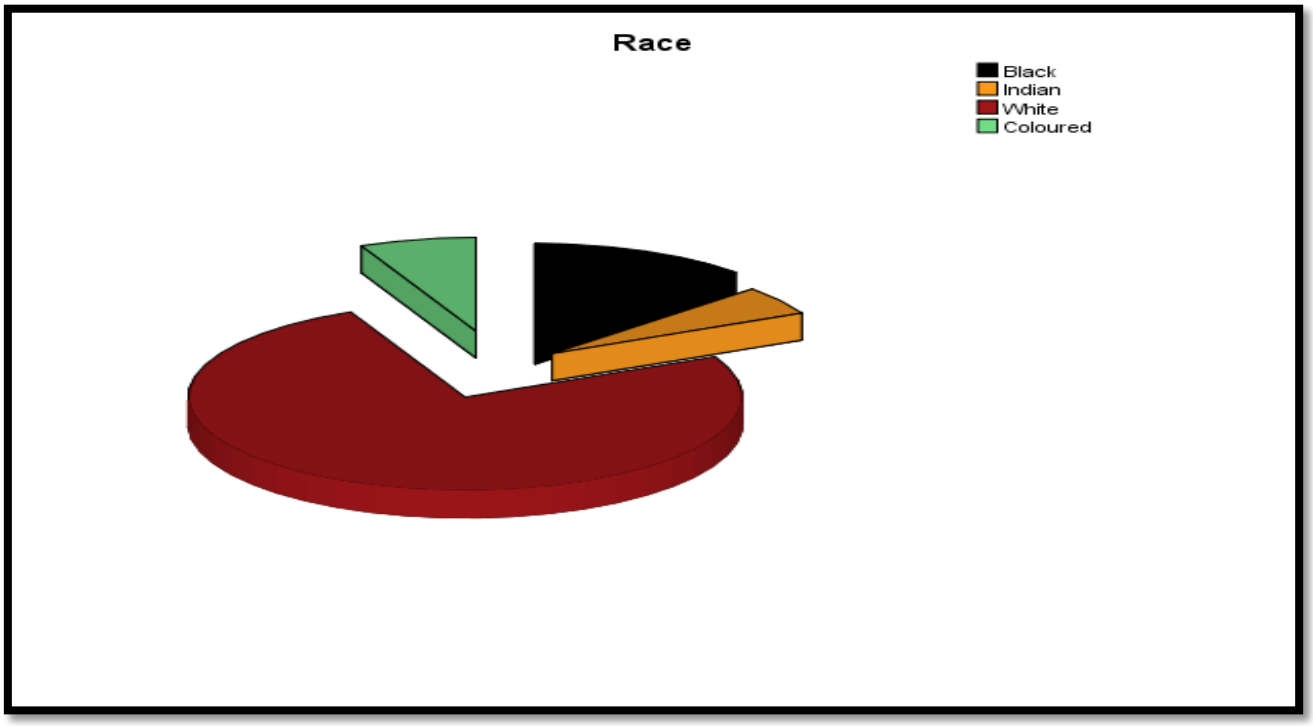
Table 6.2 and Figure 6.2 reveal that most (79.3%) of the respondents (supply chain/logistics/procurement/purchasing managers and firm owners) are degree holders, while 11.1% are diploma holders. 9.6% of the respondents have high school certificates. These findings are consistent with the previous studies of Walker, Di Sisto and Mc Bain (2008:82), which advocate that the level of education and training affects the mindsets of the purchasing managers, particularly when it comes to the quality of supply chain related decisions. The next section discusses the racial distribution of the respondents.

6.2.3. Racial Distribution

The racial distribution of the respondents is depicted in Table 6.3 and Figure 6.3, below. This section inquired about the race of the firm owners and supply chain/logistics/procurement/purchasing managers based on four categories, namely, black, Indian, white and coloured.

Table 6.3: Racial Distribution					
Racial Distribution		**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Black	36	12.9	12.9	12.9
	Indian	14	5.0	5.0	17.9
	White	211	75.4	75.4	93.2
	Coloured	19	6.8	6.8	100.0
	Total	280	100.0	100.0	

Figure 6.3: Racial Distribution



From Table 6.3 and Figure 6.3, it can be seen that a majority of the firm owners and the supply chain/logistics/purchasing/procurement managers are white people accounting for 75.4%; followed by blacks accounting for 12.9%; 6.8% coloureds and 5% Indians. These findings contradict the population statistics of South Africa (2014), which reveal that black people constitute the majority in South Africa's composite population. The main reason why blacks are not the dominating owners/managers in supply chains might be because of the challenges they face in pursuing the supply chain and logistics' careers.

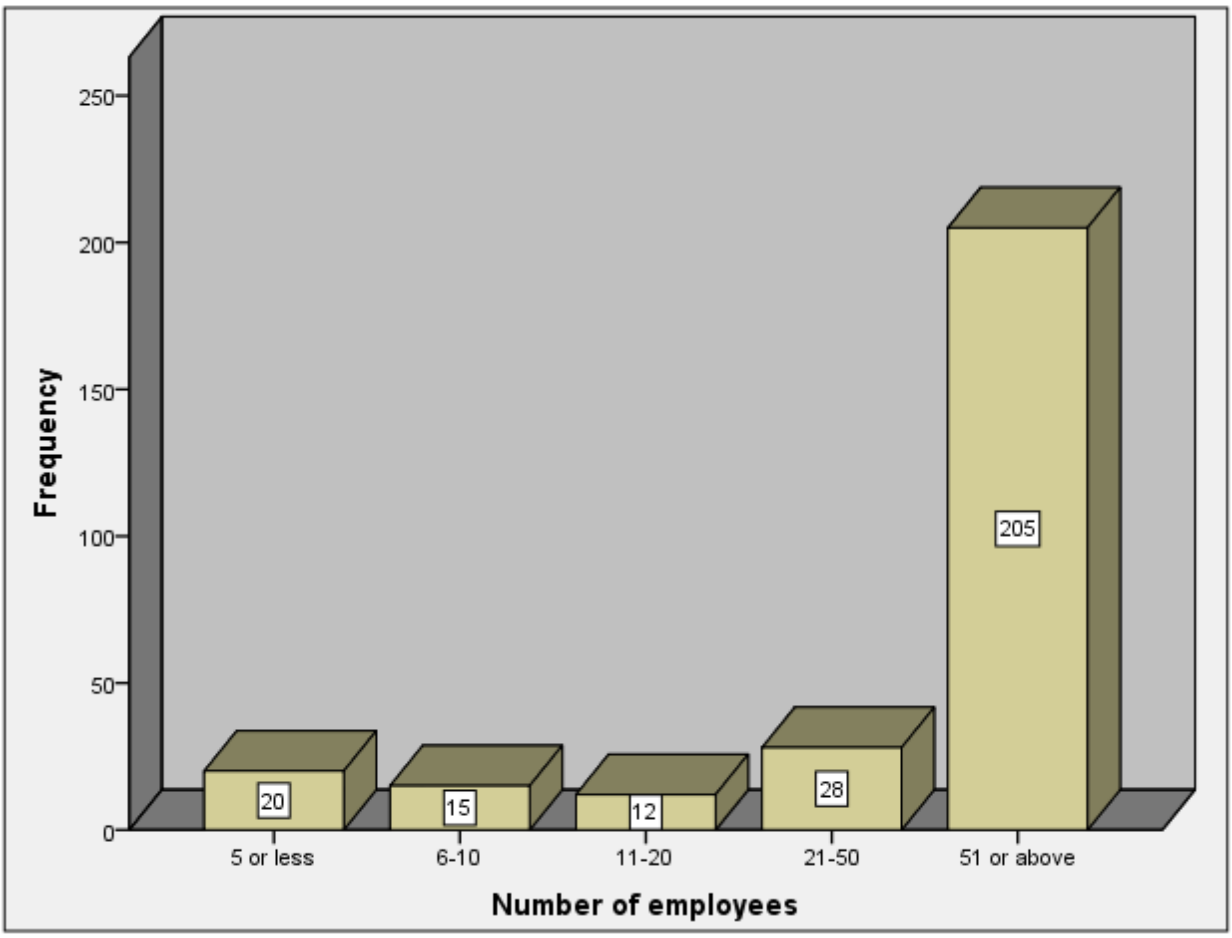
6.2.4. Employment

The size of a firm is normally determined by factors such as the size of workforce and turnover levels. Table 6.4 and Figure 6.4 show the results of the question that inquired about the number of employees that each firm employs. The respondents chose from five categories, namely: 5 or less; 6-10; 11-20; 21-50 and 51 employees and above.

Table 6.4: Number of Employees

Employment		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5 or less	20	7.1	7.1	7.1
	6-10	15	5.4	5.4	12.5
	11-20	12	4.3	4.3	16.8
	21-50	28	10.0	10.0	26.8
	51 or above	205	73.2	73.2	100.0
	Total	280	100.0	100.0	

Figure 6.4: Number of Employees



As indicated in Table 6.4 and Figure 6.4 above, 73.2% of the surveyed firms employ more than 51 employees, while 10% employ between 21 to 50 employees. 7.1% of these firms employ at least five workers or less, while 5.4% employ between 6 to 10 workers. Only 4.3% of the sample employ between 11 to 20 workers in their firms. Furthermore, Table 6.4 and Figure 6.4 show that a majority (73.2%) of the sample firms are larger firms while 26.8% are small and medium firms based on the number of workers they employ. The next section focuses on the turnover levels of the sample firms.

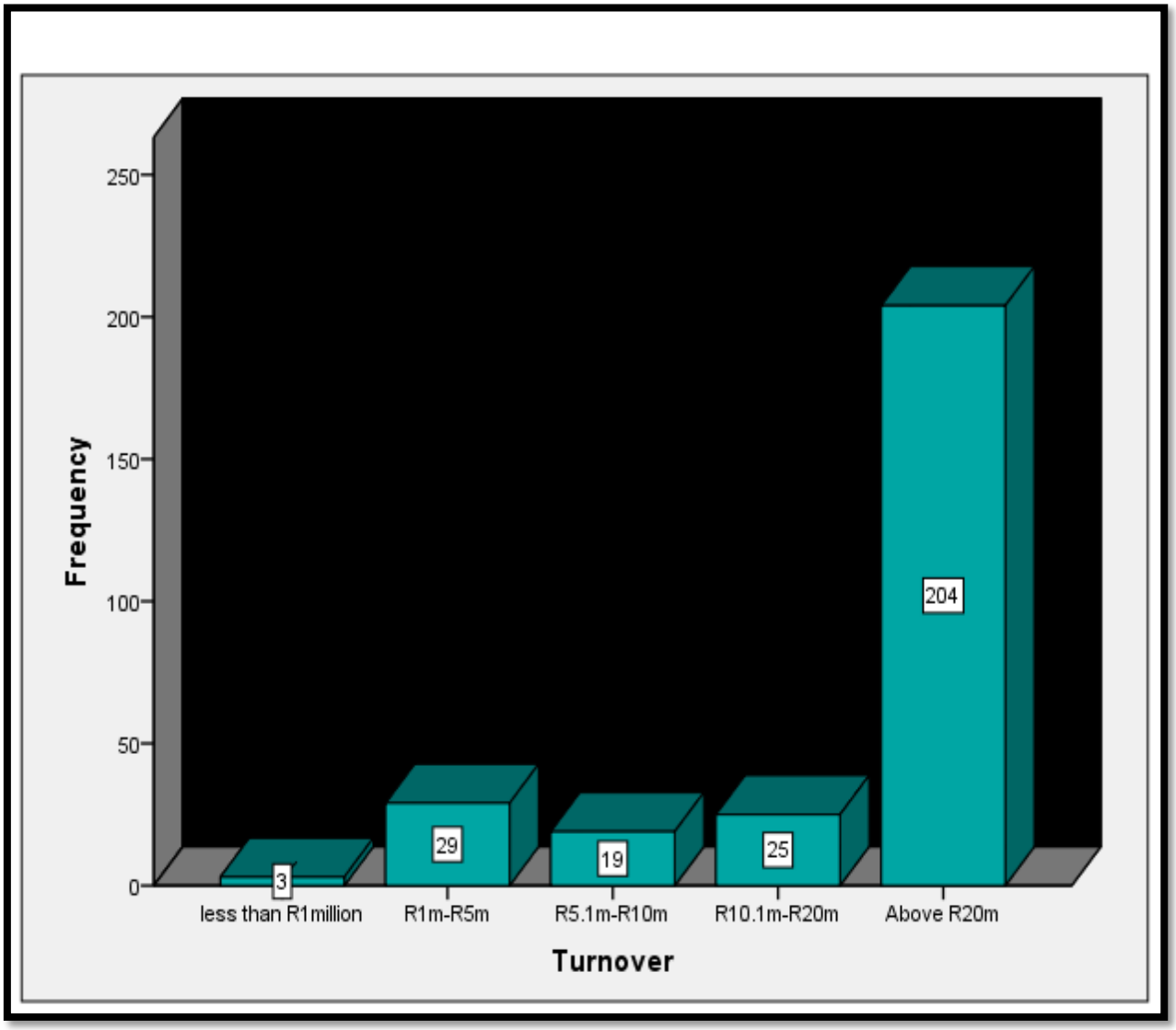
6.2.5. Turnover

As noted earlier, turnover is one of the factors that determine the size of a firm. In addition, a firm's turnover levels can influence the type of communication technologies and technology infrastructure that a firm can invest in. The respondents (in essence the firm owners and the supply chain/logistics/purchasing/procurement managers) were asked to choose their annual turnover range from five categories, namely: less than R1million; R1million-R5million, R5.1million-R10million, R10.1million-R20million and above R20million. The findings are shown in Table 6.5 and Figure 6.5, below.

Table 6.5: Turnover

Sales Turnover		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than R1million	3	1.1	1.1	1.1
	R1m-R5m	29	10.4	10.4	11.4
	R5.1m-R10m	19	6.8	6.8	18.2
	R10.1m-R20m	25	8.9	8.9	27.1
	Above R20m	204	72.9	72.9	100.0
	Total	280	100.0	100.0	

Figure 6.5: Turnover



The bar graph (Figure 6.5) and Table 6.5 depict that 72.9% of the sample firms have a sales turnover of above R20million, while 10.4% have a sales turnover of between R1million to R5million. The findings further reveal that 8.9% have a turnover between R10.1million to R20million, while 6.8% of the firms have a turnover of between R5.1million to R10million. The least sales turnover is recorded at 1.1% for firms earning less than R1million. These findings further confirm that most (72.9%) of the sample firms in this study were large firms.

6.2.6. Firm Age

The firm's age can depict the learning curve of the firm owners and the top supply chain officers in using modern technologies that promote supply chain practices such as supply chain e-collaboration along with strategic information sharing. The respondents were asked about the age of their firms, which they chose from five categories, as follows: 2years or less; 3-5years; 6-10years; 11-20years, 21years or above. The findings are shown in Table 6.6 and Figure 6.6 below.

Table 6.6: Firm Age

Firm Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2years or less	20	7.1	7.1	7.1
	3-5years	3	1.1	1.1	8.2
	6-10years	33	11.8	11.8	20.0
	11-20years	48	17.1	17.1	37.1
	21years or above	176	62.9	62.9	100.0
	Total	280	100.0	100.0	

Figure 6.6: Firm Age

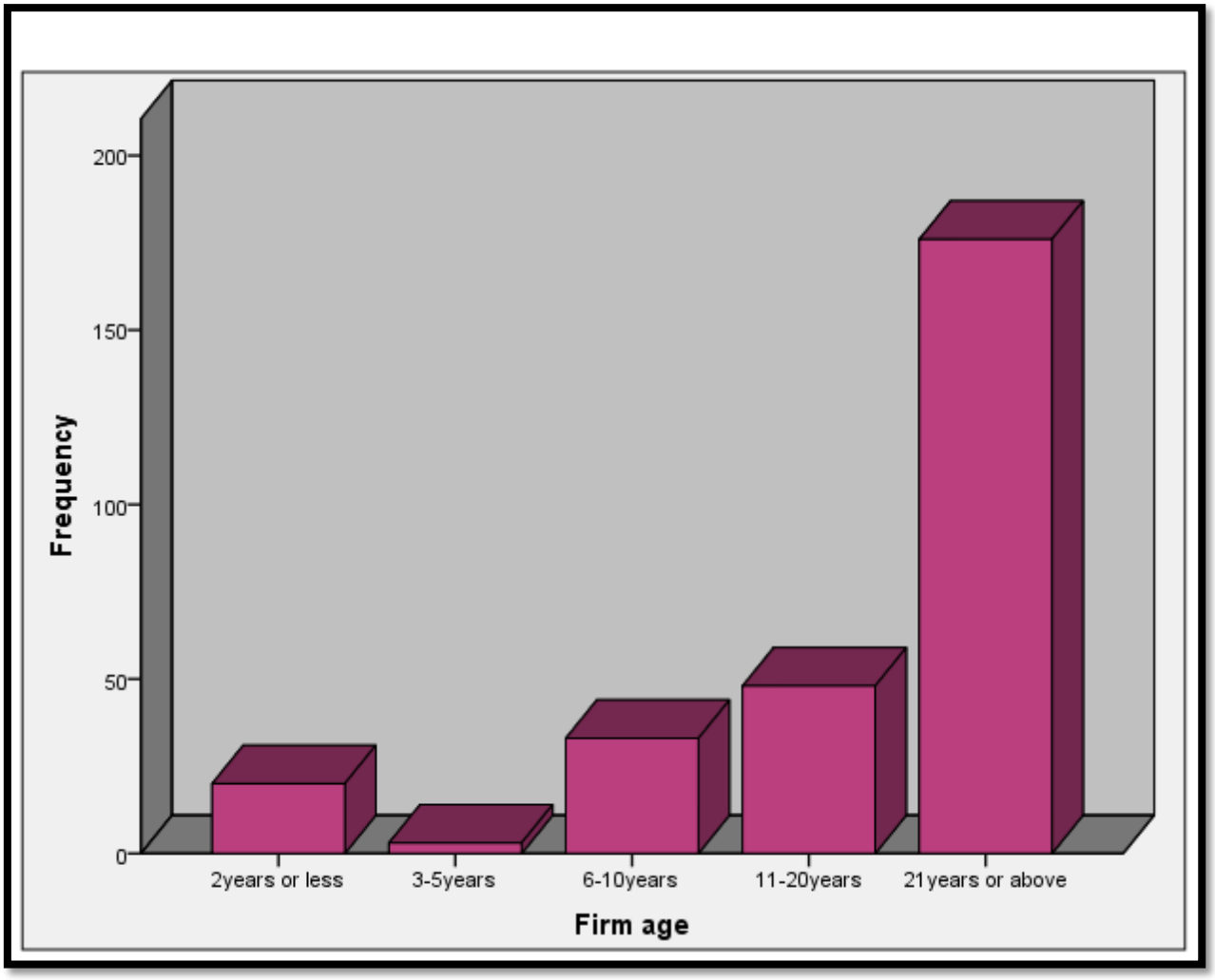


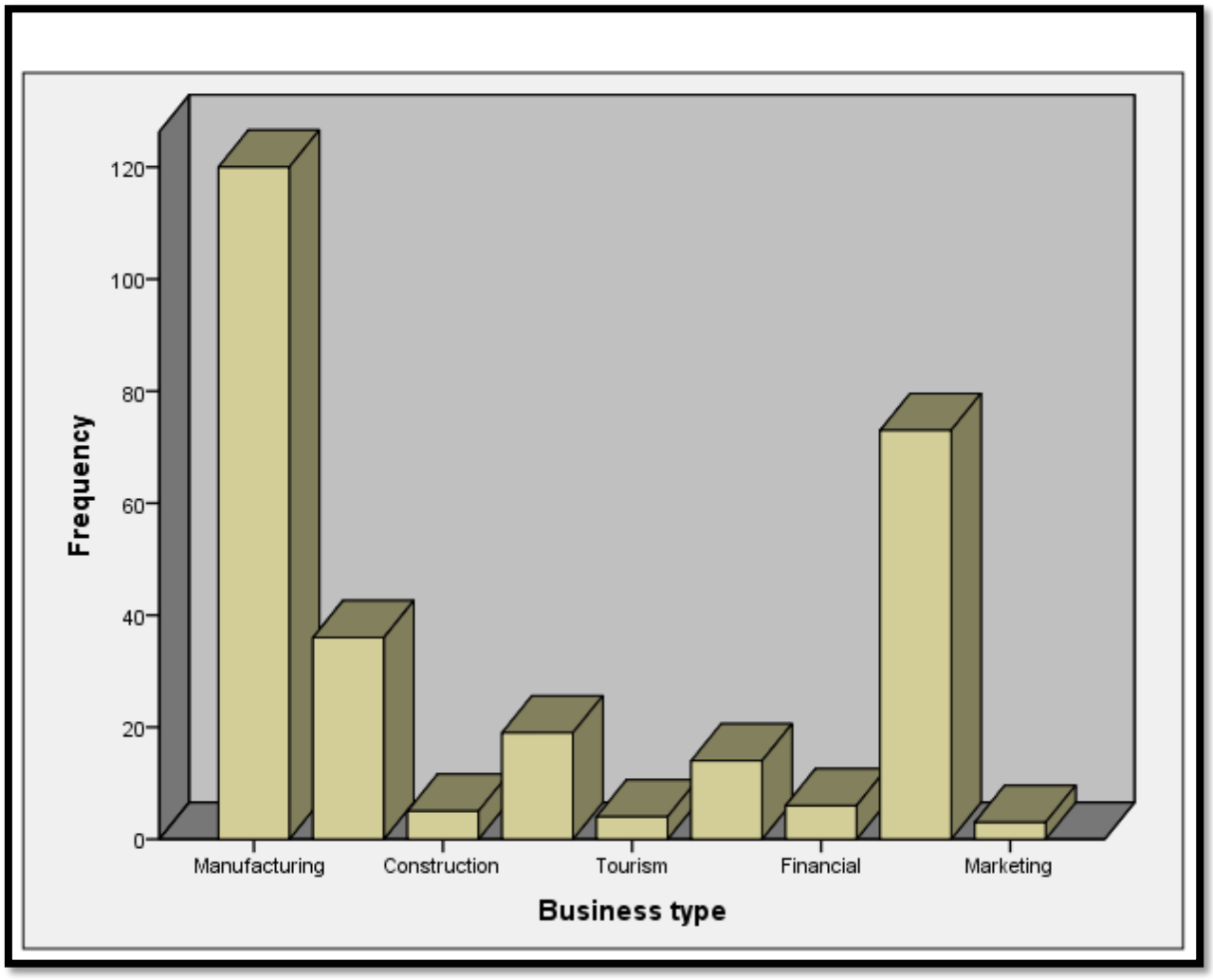
Table 6.6 and Figure 6.6, above, show that 62.9% of the firms are aged 21 and above, while 17.1% of the firms are aged between 11 to 20. 11.8% of the sample firms are aged between 6 to 10, 7.1% are less than 2years, while 1.1% of these firms are between 3 to 5. The business types are discussed in the next session.

6.2.7. Business Type

All business types belong to at least a supply chain if not supply chains as there is always need for a firm, a customer and a supplier, for a business to continue in operation. As such, the respondents were asked to choose the type of business into which their firms slot. They could choose from nine options, which included: manufacturing, retailing, construction, mining, tourism, agriculture, financial, logistics and marketing. The responses are shown in Table 6.7 and Figure 6.7, below.

Table 6.7: Business Type					
Business Type		**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Manufacturing	120	42.9	42.9	42.9
	Retailing	36	12.9	12.9	55.7
	Construction	5	1.8	1.8	57.5
	Mining	19	6.8	6.8	64.3
	Tourism	4	1.4	1.4	65.7
	Agriculture	14	5.0	5.0	70.7
	Financial	6	2.1	2.1	72.9
	Logistics	73	26.1	26.1	98.9
	Marketing	3	1.1	1.1	100.0
	Total	280	100.0	100.0	

Figure 6.7: Business Type



The findings in Table 6.7 and Figure 6.7, above, indicate that 42.9% of the sample firms are in the manufacturing sector; 26.1% in logistics; 12.9% in retailing; 6.8% in mining; 5% in agriculture; 2.1% in the financial services; 1.8% in construction; 1.4% in tourism and 1.1% in marketing services. The next section focuses on the marketing and communication technologies owned by the sample firms.

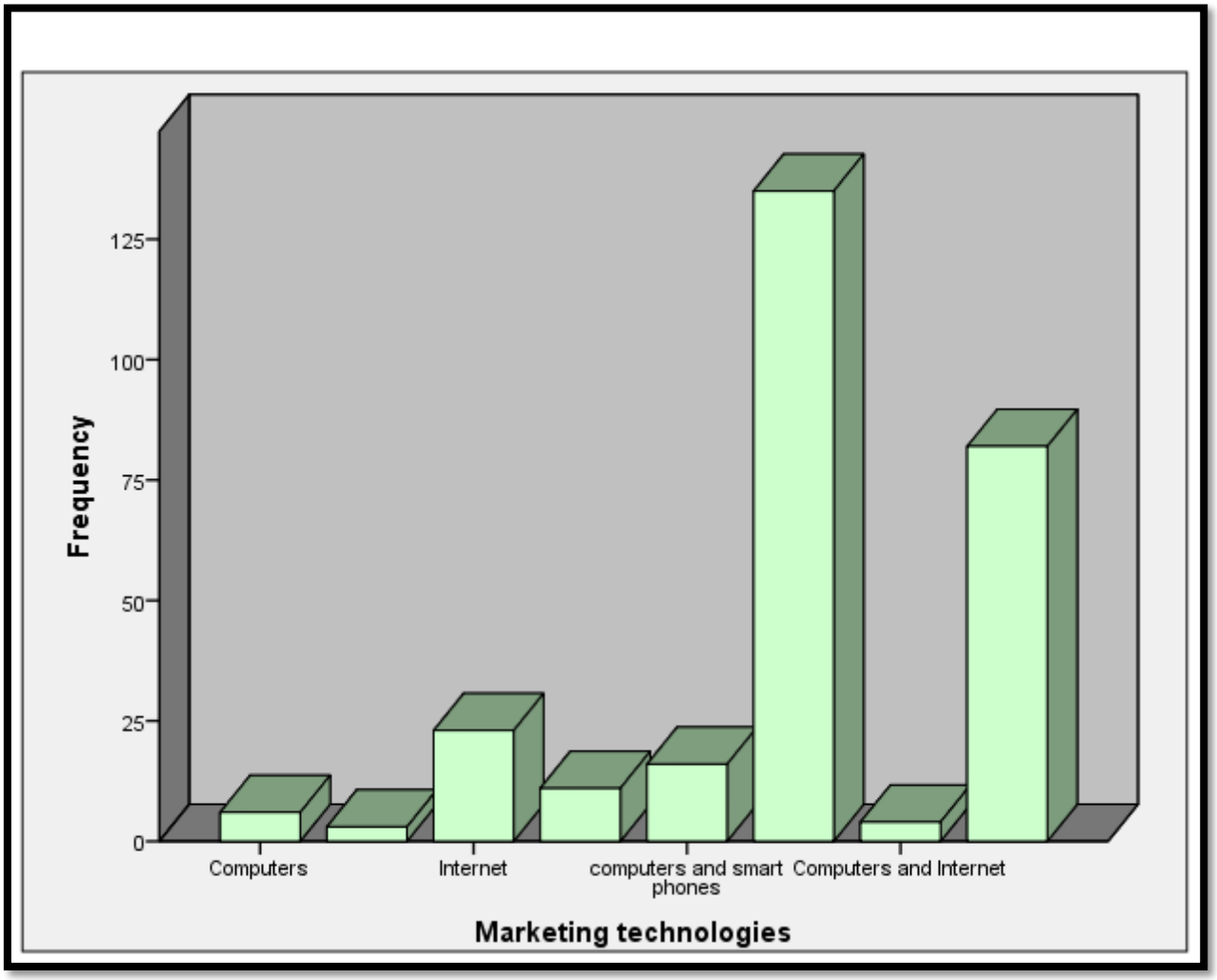
6.2.8. Marketing and Communication Technologies

The type of marketing and communication technologies that firms own reveal the extent of development and commitment a firm has towards supply chain practices. This is especially true for supply chain practices that require investments in technology such as supply chain e-collaboration and sharing of strategic information. The respondents were, therefore, asked about the marketing and communication technologies that their businesses own. They were supposed to choose from computers, smart phones, Internet, satellites and others, which they needed to specify (as shown in Table 6.8 and Figure 6.8).

Table 6.8: Marketing and Communication Technology

Marketing and Communication Technology		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Computers	6	2.1	2.1	2.1
	Smart phones	3	1.1	1.1	3.2
	Internet	23	8.2	8.2	11.4
	Other (extranets)	11	3.9	3.9	15.4
	computers and smart phones	16	5.7	5.7	21.1
	Computers, Smart phones and Internet	135	48.2	48.2	69.3
	Computers and Internet	4	1.4	1.4	70.7
	Computers, Smart phones, Internet and Satellite	82	29.3	29.3	100.0
	Total	280	100.0	100.0	

Figure 6.8: Marketing Technologies



The results in Table 6.8 and Figure 6.8, above, indicate that a majority (48.2%) of the sample firms own a combination of computers, smart phones and the Internet; while 29.3% own a combination of computers, smart phones, the Internet and satellite. In addition, the findings reveal that 8.2% of the sample firms own Internet; 5.7% own a combination of computers and smart phones; 3.9% own other forms of marketing and communication technologies, particularly, extranets; 2.1% own computers; 1.4% own a combination of computers and Internet, while, 1.1% own smart phones only. For firms with smart phones only, the implication is that they fail to capture the likely benefits posited by using computers, Internet and satellite in their collaborations with the major supply chain members. However, most of the sample firms (77.5%) own a combination of the four marketing and communication technologies (in particular computers, smart phones, Internet and satellite). Likewise, this implies that a majority of these sample firms are able to collaborate with their primary supply chain

members in technology-enabled environments and share their important and strategic information effectively.

The marketing and communication technology representation was the last aspect addressed under the descriptive demographic analysis section. The study proceeded to discuss the principal component analysis results as well as the measurement accuracy assessment sections, where sections B, C, D, E and F of the questionnaire were addressed. Unlike the descriptive analysis section where the eight questions in section (A) of the questionnaire were addressed individually, the other five sections (B, C, D, E and F) were treated as composite constructs because of the statistical package (Amos 21) used to analyse the data. In other words, all the questions that addressed supply chain practice (as shown in section B of the questionnaire) were assessed under the supply chain practice construct; while questions addressing supply chain e-collaboration in section C, were assessed under supply chain e-collaboration construct. Questions addressing strategic information sharing in section D, were assessed under the strategic information sharing construct; questions addressing supply chain competence in section E, were assessed under the supply chain competence construct and lastly, questions measuring supply chain performance in section F were assessed under the supply chain performance construct. The next section provides a discussion on the principal component analysis of the measurement items for all the five research variables.

6.3. THE PRINCIPAL COMPONENT ANALYSIS RESULTS

Principal component analysis is a factor reduction method that involves replacing large data sets by smaller data sets (Rotaru, Pop, Vatca & Cioban 2012:504). According to Yong and Pearce (2013:84), it is a factor reduction method used to reduce a large number of observed variables (measurement items) into a smaller number of principal factors or dimensions of the latent variables, through the extraction of maximum variances. As previously noted in chapter 5, this method was applied in this study to reduce the 76 questionnaire measurement items (observed variables) used for the five latent research variables and confirm their dimensional groupings. Principal component analysis in this study was also performed to confirm the groupings of the measurement items for the five latent variables in the survey questionnaire (see Appendix B).

The maximum likelihood, Kaiser criterion (eigen values >1), an evaluation of the scree plots along with the varimax rotation methods were employed to extract the principal components or dimensions of the five latent variables in this study. More importantly, the primary condition for performing PCA, which requires a Kaiser-Meyer-Olkin (KMO) measure of sample adequacy to be at least 0.5 or more was met for all the five research latent variables. The KMO values were 0.856 for supply chain practice; 0.814 for supply chain e-collaboration, 0.865 for strategic information sharing, 0.884 for supply chain competence and 0.794 for supply chain performance. All these KMO values for sample adequacy were significant at less than 0.001 (tha is 0.000). The satisfaction of KMO values of above 0.5 at higher significance levels necessitated the continuation of PCA for factor reduction. The Kaiser Normalisation criteria which requires that all the measurement items have an Eigen value greater than 1, was the next procedure followed. Tables 6.9, 6.10, 6.11, 6.12 and 6.13 present the initial Eigen values for all the research latent variables.

Table 6.9: Eigen Values for Supply Chain Practice

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.127	38.293	38.293	6.127	38.293	38.293	4.140	25.875	25.875
2	2.181	13.634	51.926	2.181	13.634	51.926	2.656	16.597	42.472
3	1.129	7.056	58.982	1.129	7.056	58.982	2.202	13.763	56.235
4	1.091	6.819	65.801	1.091	6.819	65.801	1.531	9.567	65.801
5	.826	5.166	70.967						
6	.760	4.751	75.718						
7	.705	4.405	80.123						
8	.518	3.239	83.362						
9	.463	2.893	86.255						
10	.442	2.766	89.021						
11	.394	2.463	91.483						
12	.357	2.229	93.712						
13	.321	2.008	95.721						
14	.294	1.836	97.557						
15	.211	1.319	98.876						
16	.180	1.124	100.000						

Extraction Method: Principal Component Analysis.

Table 6.9 above depicts the initial Eigen values calculated in the SPSS 21 statistical software package, revealing that the first four (component 1, 2, 3,and 4) components have Eigen values of greater than 1. The first component with an Eigen value of 6.127 explains 38.29% of the variance of the supply chain practice data set. The second component with an Eigen value of 2.181 accounts for 13.63% of the variance. The third and fourth components with Eigen values of 1.129 and 1.091 respectively jointly explain 13.88% of the supply chain practice data set variance.

Table 6.10: Eigen Values of the Supply Chain E-Collaboration

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.068	37.199	37.199	7.068	37.199	37.199	3.662	19.271	19.271
2	2.973	15.647	52.846	2.973	15.647	52.846	3.395	17.866	37.138
3	1.329	6.993	59.839	1.329	6.993	59.839	2.805	14.765	51.903
4	1.218	6.409	66.248	1.218	6.409	66.248	2.726	14.346	66.248
5	.985	5.183	71.432						
6	.785	4.132	75.564						
7	.698	3.671	79.235						
8	.673	3.544	82.779						
9	.562	2.957	85.736						
10	.486	2.559	88.295						
11	.472	2.484	90.778						
12	.371	1.953	92.732						
13	.319	1.677	94.408						
14	.295	1.552	95.960						
15	.231	1.213	97.173						
16	.216	1.136	98.309						
17	.168	.885	99.195						
18	.114	.600	99.795						
19	.039	.205	100.000						

Extraction Method: Principal Component Analysis.

As shown in Table 6.10 above, four components (component 1, 2, 3 and 4) have initial Eigen values of greater than 1 as calculated in the SPSS 21 statistical software package. Component one (1) has an Eigen value of 7.068 and accounts for 37.20% of the supply chain e-collaboration data set variance. Component two (2) with an Eigen value of 2.973 explains 15.65% of the variance. Component three (3) and four (4) with Eigen values of 1.329 and 1.218 respectively, jointly explain for 13.40% of the variance.

Table 6.11: Eigen Values for Strategic Information Sharing

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.038	50.378	50.378	5.038	50.378	50.378	3.592	35.921	35.921
2	1.206	12.063	62.441	1.206	12.063	62.441	2.652	26.519	62.441
3	.924	9.237	71.677						
4	.635	6.345	78.023						
5	.539	5.389	83.411						
6	.458	4.578	87.990						
7	.400	4.001	91.990						
8	.353	3.534	95.524						
9	.235	2.350	97.875						
10	.213	2.125	100.000						

Extraction Method: Principal Component Analysis.

Table 6.11 presents the Eigen values calculated in the SPSS software package and shows that only component one (1) and two (2) have the initial Eigen values greater than one. Component 1 with an initial Eigen value of 5.038 accounts for 50.38% of the strategic information sharing data set variance. Component 2 with an Eigen value of 1.206 explains 12.06% of the data set variance.

Table 6.12: Eigen Values for Supply Chain Competence

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.826	48.758	48.758	6.826	48.758	48.758	5.381	38.433	38.433
2	1.947	13.908	62.666	1.947	13.908	62.666	3.393	24.233	62.666
3	.933	6.666	69.332						
4	.848	6.059	75.391						
5	.660	4.711	80.102						
6	.565	4.035	84.137						
7	.424	3.031	87.168						
8	.397	2.836	90.004						
9	.349	2.496	92.500						
10	.305	2.182	94.682						
11	.279	1.990	96.673						
12	.199	1.420	98.093						
13	.141	1.010	99.103						
14	.126	.897	100.000						

Extraction Method: Principal Component Analysis.

As shown in Table 6.12 above, only two components (component 1 and 2) have the initial Eigen values exceeding one, the recommended and acceptable threshold value. Component 1 with an initial Eigen value of 6.826 explains 48.76% of the supply chain competence data set variance. Component 2 with an Eigen value of 1.947 accounts for 13.91% of the data set variance.

Table 6.13: Eigen Values for Supply Chain Performance

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.544	44.376	44.376	7.544	44.376	44.376	3.651	21.475	21.475
2	1.931	11.358	55.735	1.931	11.358	55.735	3.503	20.603	42.078
3	1.323	7.780	63.514	1.323	7.780	63.514	2.650	15.590	57.668
4	1.145	6.738	70.252	1.145	6.738	70.252	2.139	12.584	70.252
5	.958	5.637	75.889						
6	.723	4.255	80.144						
7	.645	3.797	83.940						
8	.553	3.250	87.191						
9	.442	2.602	89.793						
10	.380	2.238	92.031						
11	.365	2.147	94.177						
12	.287	1.689	95.866						
13	.231	1.360	97.226						
14	.200	1.178	98.404						
15	.183	1.075	99.479						
16	.062	.365	99.843						
17	.027	.157	100.000						

Extraction Method: Principal Component Analysis.

Table 6.13 above shows that only four components (component 1, 2, 3 and 4) have initial Eigen values of greater than one as calculated in the SPSS 21 statistical software package. Component one (1) has an Eigen value of 7.544 and explains 44.38% of the supply chain performance data set variance. Component two (2) with an Eigen value of 1.931 accounts for 11.36% of the variance. Component three (3) and four (4) with Eigen values of 1.323 and 1.145 respectively, jointly explain 14.52% of the variance. The next sections discuss the grouping of the dimensions for all the latent variables together with the measurement items that highly load into each dimension.

After establishing the components with the initial Eigen values that exceed the recommended threshold of one, the next step is to select the measurement items that load above 0.5 into a principal component. The principal component analysis results that reveal these high factor loadings are shown as the component plots (see Appendix C) as well as the varimax rotated component matrix in the tables below. According to Cu, Charrette, Dieu, Hai and Toan (2009:68), varimax rotation is necessary in factor reduction because it makes it easier to clearly distinguish between the factor loadings of each measurement item using their principal components/dimensions. Table 6.14 below depicts the rotated component matrix results for the supply chain practice variable.

Table 6.14: Rotated Component Matrix for Supply Chain Practice

	Component			
	1	2	3	4
SCP1		.752		
SCP2		.826		
SCP3				.671
SCP4		.688		
SCP5		.566		
SCP6			.591	
SCP7				.806
SCP8			.687	
SCP9	.701			
SCP10	.708			
SCP11	.769			
SCP12	.782			
SCP13	.790			
SCP14	.716			
SCP15	.716			
SCP16			.752	

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization.[a]; a. Rotation converged in 6 iterations.

Table 6.14 depicts the varimax rotation results for the principal components or dimensions along with the measurement items that highly load into these dimensions of supply chain practice. As shown in Table 6.14 above, three principal dimensions of supply chain practice were extracted, which are planning, production and delivery practice. These three principal components confirm the three dimensions suggested

in the questionnaire (see Appendix B). The first component highly loaded seven measurement items mostly related to the supply chain delivery practice dimension. These measurement items range from SCP9 to SCP 15 with factor loadings between 0.701 and 0.790. The second component highly loaded four measurement items (SCP1, 2, 4 and 5) with factor loadings of between 0.566 and 0.826. These four measurement items highly load into the supply chain planning practice dimension. The third component had three measurement items (SCP6, 8 and 16) with high factor loading ranging from 0.591 to 0.752. These three measurement items are highly related to the production practice dimension. Table 6.15 below depicts the rotated component matrix results for the supply chain e-collaboration variable.

Table 6.15: Rotated Component Matrix for Supply Chain E-Collaboration

	Component			
	1	2	3	4
SCE1		.765		
SCE2		.640		
SCE3			.753	
SCE4			.549	
SCE5			.672	
SCE6			.618	
SCE7			.590	
SCE8				.733
SCE9				.614
SCE10				.749
SCE11				.759
SCE12	.730			
SCE13	.807			
SCE14	.825			
SCE15	.822			
SCE16	.788			
SCE17		.666		
SCE18		.803		
SCE19		.622		

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization.[a]; a. Rotation converged in 8 iterations.

As shown in Table 6.15, a varimax rotation converged in eight iterations and reveals the presence of four meaningful dimensions or components of supply chain e-collaboration. The factor analysis empirically grouped the measurement items of supply chain e-collaboration as predicted, and confirms the original dimensional groupings provided in the questionnaire (see Appendix B). The first component comprised five measurement items (SCE12 to SCE16) with higher factor loading between 0.730 and 0.825. These measurement items highly relate to the supply chain e-collaboration with customers dimension.

The second component consists of five measurement items (SCE1, 2, 17, 18 and 19) with factor loadings ranging from 0.622 to 0.803. All these five measurement items highly load into the intra-organisational supply chain e-collaboration dimension. The third component also comprised five measurement items (SCE3, 4, 5, 6 and 7) with

factor loadings between 0.549 and 0.753. The five measurement items highly loaded into the dimension of supply chain e-collaboration with suppliers. The last component included four measurement items (SCE8, 9, 10 and 11) with factor loadings between 0.614 and 0.759. All the four measurement items highly relate to the internal e-collaboration dimension. Table 6.16 tabulates the rotation component matrix of the strategic information sharing variable.

Table 6.16: Rotated Component Matrix for Strategic Information Sharing

	Component	
	1	2
SIS1		.796
SIS2	.512	.559
SIS3		.716
SIS4		.688
SIS5		.645
SIS6	.731	
SIS7	.832	
SIS8	.847	
SIS9	.811	
SIS10	.588	

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization.[a]; a. Rotation converged in 3 iterations.

Table 6.16 presents the varimax rotation results for the principal dimensions along with the measurement items that highly load into these dimensions of strategic information sharing. As shown in Table 6.16 above, two principal dimensions of strategic information sharing were extracted, which are strategic information sharing with suppliers and customers. Five measurement items (SIS 6 to SIS 10) highly loaded into the first component with factor loadings of between 0.588 and 0.847. All the five measurement items related highly to the dimension of sharing strategic information with customers. The second component constitutes four measurement items (SIS 1, 3, 4 and 5) with factor loadings of between 0.645 and 0.796. All the four measurement items highly loads into the dimension of sharing strategic information with suppliers. Measurement item SIS 2, which appeared on both component 1 and 2 was deleted because it showed multicolinearity problems by loading above 0.35 in

the two components. Table 6.17 below presents the rotated component matrix results for the supply chain competence variable.

Table 6.17: A Rotated Component Matrix for Supply Chain Competence

	Component	
	1	2
SCC1		.786
SCC2		.638
SCC3		.702
SCC4		.663
SCC5	.540	
SCC6		.589
SCC7		.731
SCC8	.814	
SCC9	.823	
SCC10	.814	
SCC11	.861	
SCC12	.858	
SCC13	.850	
SCC14	.811	

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization.[a]; a. Rotation converged in 3 iterations.

Table 6.17 shows that a varimax rotation converged in three iterations and extracted two meaningful dimensions of supply chain competence. These two dimensional groupings of the measurement items of supply chain competence are less than the predicted three in the original groupings provided in the questionnaire (see Appendix B). The first component consists of eight measurement items (SCC5, SCC8 to SCC14) with higher factor loading, ranging from 0.540 and 0.861. All these measurement items highly load into the design, operational and distributional effectiveness dimension. The second component comprised six measurement items (SCC1 to SCC4 and SCC6 to SCC7) with factor loadings of between 0.589 to 0.786. All these six measurement items are highly related with the quality and service dimension. Table 6.18 tabulates the rotation component matrix of the supply chain performance variable.

Table 6.18: The Rotated Component Matrix for Supply Chain Performance

	Component			
	1	2	3	4
CP1				.872
CP2	.713			
CP3	.650			
CP4	.802			
CP5	.737			
CP6	.557			
CP7			.696	
CP8				
CP9		.609		
CP10		.658		
CP11		.759		
CP12		.848		
CP13			.846	
CP14			.832	
CP15				.853
CP16	.559			
CP17		.648		

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization.[a]; a. Rotation converged in 6 iterations.

As shown in Table 6.18, a varimax rotation converged in six iterations and extracted three meaningful dimensions of supply chain performance. The first component has six measurement items (CP2 to CP6 and CP 16) with factor loading of between 0.557 and 0.802. These six measurement items are all related to the flexibility supply chain performance dimension. The second component consists of five measurement items (CP9 to CP12 and CP17) with factor loadings ranging from 0.609 to 0.848. All these six measurement items highly load into the output supply chain performance dimension. The third component has three measurement items (CP7, 13 and 14) with factor loadings of between 0.696 and 0.846. All the three dimensions of supply chain performance extracted by the factor analysis confirm the original dimensional groupings in the questionnaire (Appendix B). The next sections focus on the measurement accuracy assessment of the measures (which are the reliability and validity tests).

6.4. MEASUREMENT ACCURACY ASSESSMENT

The measurement accuracy assessment includes the reliability and validity tests of the measurement items used in this study. These tests were particularly necessary for the current study since most of the measurement items for the five research variables were adopted and modified to fit the current research context. The performance of the principal component analysis for factor reduction and dimensional grouping resulted in the deletion of items SCP 3 and SCP7 in the supply chain practice variable. It also led to the deletion of item SIS2 in the strategic information sharing variable for multiple co-linearity problems. The reliability and validity tests performed in this study are discussed in the following section.

6.4.1. Reliability Tests

Reliability refers to the degree to which a independent but comparable measures of the same object or latent variable yield the same scores across different times, groups of people, or versions of the instrument (Vanderstoep & Johnston 2009:62). Huck (2004:76) sums up the basic idea of reliability to consistency of measurement items across different times and instruments. In other words, reliability is concerned with the extent to which the measurement items work together and measure the same thing. There are several approaches and tests that can be used to measure the reliability of measures. Some of the examples include split-half reliability coefficient, the Kuder-Richardson #20 (K-R 20), the Cronbach's alpha and the Item-Total correlations (Huck 2004:80). The current study employed the Item-Total correlation values, Cronbach's coefficient alpha (α), Composite Reliability (CR) and Average Variance Extracted (AVE) to test the measurement reliability.

6.4.1.1. Cronbach's coefficient alpha

The Cronbach's coefficient alpha also known as the coefficient alpha is an internal consistence measurement index used to evaluate the extent to which a number of measurement items measure the same latent variable (Baarda, De Goede & Van Dijkum 2004:71). According to Iacobucci and Churchill (2010:259), the Cronbach's coefficient α is one of the most common internal consistency techniques used to establish the mean reliability coefficient for all possible ways of splitting a set of items in half. Huck (2004:80) in addition contends that the Cronbach's alpha is a more versatile technique used with instruments comprising measurement items that can be

scored with three or more possible values such as the four-question essay test and the Likert-type questionnaires.

The Cronbach's alpha values can range from 0.00 to 1.00 and signify the level of internal homogeneity in the measurement items. On the one hand, an α value of 0.00 indicates a complete lack of homogeneity among the measurement items used to measure a particular latent variable. On the other hand, an α value of 1.00 means that there is total homogeneity among the latent variable's measurement items. In other words, the closer the α value is to 1, the higher the level of reliability. Where the α value is low, there may be little homogeneity among the measurement items due to too few measurement items. It is, however, important to note that there are no fixed rules for assessing the magnitude of reliability coefficients and that it depends mostly on the purpose of the study in question (Iacobucci & Churchill 2010:259). This study computed the coefficient α values for the five latent variables using the reliability procedure in the SPSS (version 21) software.

The standardised Cronbach's coefficient alpha was used to assess the internal reliability of each latent variable in this study. A higher level of Cronbach's coefficient alpha (particularly closer to 1) indicates a higher level of measurement item reliability. The current study also used the higher Item-Total correlations to complement the Cronbach's coefficient alpha in showing statistical agreement among the measured items. Table 6.19 on the next pages presents the results of the reliability tests.

Table 6.19: Accuracy Analysis Statistics: Reliability Tests

Research Constructs		Descriptive Statistics*		Cronbach's Test		C.R.	AVE	Factor Loading	Highest S.V.
		Mean	SD	Item-total	α Value				
Supply chain practice	SCP_{-1}	3.78	1.23	0.53	0.89	0.92	0.47	0.78^{c}	0.38
	SCP_{-2}			0.49				0.38^{c}	
	SCP_{-4}			0.56				0.43^{c}	
	SCP_{-5}			0.42				0.39^{c}	
	SCP_{-6}			0.59				0.71^{c}	
	SCP_{-8}			0.63				0.58^{c}	
	SCP_{-9}			0.75				0.90^{c}	
	SCP_{-10}			0.61				0.89^{c}	
	SCP_{-11}			0.70				0.85^{c}	
	SCP_{-12}			0.58				0.73^{c}	
	SCP_{-13}			0.54				0.70^{c}	
	SCP_{-14}			0.58				0.74^{c}	
	SCP_{-15}			0.50				0.73^{c}	
	SCP_{-16}			0.45				0.46^{c}	
Supply chain e-collaboration	SCE_{-1}	3.70	1.19	0.65	0.90	0.89	0.46	0.56^{c}	0.32
	SCE_{-2}			0.58				0.52^{c}	
	SCE_{-3}			0.62				0.65^{c}	
	SCE_{-4}			0.74				0.79^{c}	
	SCE_{-5}			0.59				0.62^{c}	
	SCE_{-6}			0.36				0.42^{c}	
	SCE_{-7}			0.58				0.60^{c}	
	SCE_{-8}			0.46				0.52^{c}	
	SCE_{-9}			0.68				0.73^{c}	
	SCE_{-10}			0.58				0.62^{c}	
	SCE_{-11}			0.47				0.50^{c}	
	SCE_{-12}			0.47				0.38^{c}	
	SCE_{-13}			0.55				0.54^{c}	
	SCE_{-14}			0.48				0.43^{c}	
	SCE_{-15}			0.46				0.48^{c}	
	SCE_{-16}			0.43				0.33^{c}	
	SCE_{-17}			0.44				0.42^{c}	
	SCE_{-18}			0.66				0.56^{c}	
	SCE_{-19}			0.55				0.52^{c}	

Strategic information sharing	**SIS$_{-1}$**	3.58	1.26	0.50	0.87	0.88	0.50	0.68[c]	0.14
	SIS$_{-3}$			0.63				0.62[c]	
	SIS$_{-4}$			0.39				0.32[c]	
	SIS$_{-5}$			0.70				0.66	
	SIS$_{-6}$			0.62				0.59	
	SIS$_{-7}$			0.75				0.79	
	SIS$_{-8}$			0.69				0.72	
	SIS$_{-9}$			0.63				0.64	
	SIS$_{-10}$			0.61				0.49	
Supply chain competence	**SCC$_{-1}$**	3.69	1.25	0.53	0.91	0.93	0.51	0.65[c]	0.32
	SCC$_{-2}$			0.42				0.39[c]	
	SCC$_{-3}$			0.57				0.51[c]	
	SCC$_{-4}$			0.55				0.46[c]	
	SCC$_{-5}$			0.68				0.75[c]	
	SCC$_{-6}$			0.39				0.33[c]	
	SCC$_{-7}$			0.60				0.52[c]	
	SCC$_{-8}$			0.75				0.88[c]	
	SCC$_{-9}$			0.75				0.91[c]	
	SCC$_{-10}$			0.69				0.85[c]	
	SCC$_{-11}$			0.75				0.89[c]	
	SCC$_{-12}$			0.71				0.87[c]	
	SCC$_{-13}$			0.71				0.66[c]	
	SCC$_{-14}$			0.65				0.81[c]	
Supply chain performance	**CP$_{-1}$**	3.66	1.27	0.57	0.92	0.93	0.45	0.61[c]	0.39
	CP$_{-2}$			0.68				0.76[c]	
	CP$_{-3}$			0.66				0.69[c]	
	CP$_{-4}$			0.64				0.67[c]	
	CP$_{-5}$			0.72				0.79[c]	
	CP$_{-6}$			0.62				0.65[c]	
	CP$_{-7}$			0.35				0.46[c]	
	CP$_{-8}$			0.63				0.71[c]	
	CP$_{-9}$			0.58				0.63[c]	
	CP$_{-10}$			0.74				0.83[c]	
	CP$_{-11}$			0.68				0.76[c]	
	CP$_{-12}$			0.52				0.63[c]	
	CP$_{-13}$			0.47				0.53[c]	
	CP$_{-14}$			0.45				0.46[c]	
	CP$_{-15}$			0.63				0.68[c]	
	CP$_{-16}$			0.72				0.77[c]	
	CP$_{-17}$			0.63				0.70[c]	

Note: SCP=supply chain performance, SCE=supply chain e-collaboration, SIS=strategic information sharing, SCC=supply chain competence, CP=supply chain performance.

As shown in Table 6.19 above, the item-to-total values ranged from 0.42 to 0.75 for supply chain practice; 0.36 to 0.73 for supply chain e-collaboration; 0.39 to 0.75 for strategic information sharing; 0.39 to 0.75 for supply chain competence and 0.35 to 0.74 for supply chain performance. All the measurement items for the five latent variables had item-to-total values greater than the acceptable threshold value of 0.3 or above (often ≦0.3) (Dunn, Seaker & Waller 1994:145). Moreover, Table 6.19 reveals that the Cronbach's alpha coefficients were between 0.87 and 0.92 for all the five research latent variables. Thus, all the Cronbach's alpha values for all the research variables used in this study were above the acceptable threshold value of 0.7 used in the study of Nunnally and Bernstein (1994:24). All in all, the measurement items used in this study were highly reliable since all the item-to-total values were above the recommended value of 3 and all the Cronbach's alpha coefficients were closer to 1. The study further used composite reliability checks as shown in Table 6.19 to complement the item-to-total correlations and the Cronbach's coefficient alpha values.

6.4.1.2. Composite reliability

The internal reliability of a measurement model (besides the item-to-total values and the Cronbach's alpha) can also be measured using a Composite Reliability (CR) index. The index is manually calculated using a formula from Hair *et al*. (2010:22) as follows: (CR): $CR\eta=(\Sigma\lambda yi)^2/[(\Sigma\lambda yi)^2+(\Sigma\varepsilon i)]$, where CRη = Composite Reliability, $(\Sigma\lambda yi)^2$= square of the summation of the factor loadings; (Σεi)= summation of error variances. The calculated composite reliability coefficient is then compared with the Cronbach's α and must show some similarities with it. The recommended threshold value for Composite Reliability should be 0.7 or above (Hair *et al*., 2010:22).

As earlier noted, the current study performed composite reliability tests to assess the internal reliability of each research latent variable. Previous evidence (Nunnally & Bernstein 1994:23; Hair *et al*., 2006:55) contends that a Composite Reliability coefficient exceeding 0.7 indicates a satisfactory level of internal reliability of a variable. Table 6.19 in the previous pages presents the results of the calculated Composite Reliability values for all the five research latent variables.

Table 6.19 shows that the Composite Reliability coefficients were between 0.88 and 0.93. All the Composite Reliability values for all the variables exceed the recommended estimate criteria used in previous studies by Hair *et al*. (2006:55) and

Kline (2005:45). More so, the Composite Reliability coefficients are similar to the Cronbach's alpha coefficients. Thus, all the Composite Reliability coefficients confirm that all the measures for the five variables used in this study were highly reliable. The next section discusses the Average Variance Extracted (AVE).

6.4.1.3. Average Variance Extracted (AVE)

The Average Variance Extracted is described by Kline (2005:47) as an estimate that shows the total amount of variance in the measurement items used to measure a latent variable. Thus, higher AVE values of greater than 0.4 are said to show an adequate representation of a latent variable by its measurement items. The AVE values in this study were manually calculated using a formula suggested by Hair *et al*. (2010:17) as follows: $V\eta=(\Sigma\lambda y^2 i)/[(\Sigma\lambda y^2 i)+(\Sigma\varepsilon i)]$; where $V\eta$= Average Variance Extracted (AVE); $\Sigma\lambda y^2 i$= Summation of the squared factor loadings; $\Sigma\varepsilon i$= Summation of error variances. Table 6.19 in the previous pages depicts the calculated AVE values for all the five research latent variables.

As shown in Table 6.19, the AVE values for all the research variables in this study range from 0.45 to 0.51. Thus, all the AVE values for all the variables were above the recommended threshold value of 0.4. Thus, as previously noted, these AVE values exceeding 0.4 showed that the measurement items used in this study adequately represent their respective latent variables. Therefore, the AVE values, Composite Reliability coefficients, Cronbach's alpha and the total-to-item values for the five latent variables in this study suggest that the measurement items were internally reliable. The next section focuses on the validity of the research variables.

6.4.2. Validity Tests

Vanderstoep and Johnston (2009:59) describe validity as a measure of truthfulness and accuracy, which is shown if a measurement item actually measures the latent variable that it is intended to measure in a given context. It is concerned with the accuracy of the items used to measure a latent variable and is mainly categorised as construct, content and predictive validity. However, in this study construct validity was the only form of validity tested and discussed because it befits the purpose of the study.

6.4.2.1. Construct validity

Construct validity refers to the degree at which a measurement item is accurate when measuring the latent variable being studied (Vanderstoep & Johnston 2009:60). Drost (2011:116) describes it as an accuracy measure concerned with how well a concept or idea or behaviour (in essence the latent variable) is translated or transformed into a functioning and operational reality (or operationalised). There are two ways to determine construct validity, which are: convergent and discriminant validity. The next section discusses convergent validity.

a) Convergent Validity

Convergent validity refers to the degree at which the measurement items reveal homogeneity within the same latent variable being measured (Vanderstoep & Johnston 2009:60). It requires that a measurement item highly correlates with the other measurement items that measure the same latent variable. For instance, convergent validity in this study expects that measurement item SCP1 have a high correlation with the other measurement items that measure supply chain practice. In contrast, it is expected that these measurement items measuring supply chain practice, for instance, do not correlate highly with the measurement items which measure supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance (discriminant validity) (Iacobucci & Churchill 2010:258). Convergent validity in this study was measured by assessing whether the individual measurement item loadings for each corresponding research latent variable exceeded the recommended threshold value of 0.5. The measurement items with factor loadings of less 0.5 were deleted as they accounted for less than half (50%) of the measured latent variable. The results are shown in Table 6.19.

As shown in Table 6.19, 10 measurement items of supply chain practice (SCP1, 6, 8-15) had factor loadings greater than the recommended threshold value of 0.5 and all ranged from 0.58 to 0.90. Measurement items SCP2, 4, 5 and 16 had factor loadings less than 0.50 and were excluded in further statistical analysis. Table 6.19 further indicates that 13 measurement items of supply chain e-collaboration (SCE1-5, 7-11, 13 and 18-19) had factor loadings exceeding the acceptable threshold of 0.5 and were between 0.50 and 0.79. Six measurement items (SCE6, 12, 14, 15, 16 and 17) explained less than 50% of supply chain e-collaboration and were excluded in further statistical analysis. Table 6.19 also reports seven measurement items (SIS1, 3, and

5-9) of strategic information sharing with factor loadings greater than 0.5. Their factor loadings ranged from 0.59 to 0.79. The table also shows two items (SIS4 and 10) with less than 0.5, the recommended threshold value and were excluded in further analysis.

More so, Table 6.19 reveals 11 items of supply chain competence (SCC1, 3, 5 and 7-14) with factor loading above 0.5 and ranged from 0.51 to 0.91. Three items (SCC2, 4 and 6) explained less than 50% of supply chain competence and were excluded in further statistical analysis. Lastly, Table 6.19 reports 15 items of supply chain performance (CP1-6, 8-13 and 15-17) with higher factor loadings ranging from 0.53 to 0.83. Two items (CP7 and 14) failed to explain at least 50% of supply chain performance and were excluded in further statistical analysis. All in all, all the factor loadings of above 0.5 for all the five latent variables provide evidence of convergence validity in this study. The next section focuses on discriminant validity.

b) Discriminant Validity

Guo, Aveyard, Fielding and Sutton (2008:288) describe discriminant validity as a way of measuring construct validity which is concerned with the degree of distinctiveness or heterogeneity between different variables. It requires that measurement items of unrelated latent variables load differently. This study employed the AVE values of less than 1, the pair-wise correlation matrix coefficients of less than 1 as well as comparing the AVE values against the highest shared variance.

Discriminant validity requires that where the research variables are unrelated their pair-wise correlation values be less than one (1.0). Previous studies (Gatignon 2014:83; Nunnally & Bernstein 1994:10) suggest a correlation value between variables of less than 0.7 as adequate to confirm the existence of discriminant validity. As noted earlier, AVE values of less than 1 also indicate the existence of discriminant validity. Alternatively, a comparative assessment can be done to determine discriminant validity by checking whether the AVE values are greater than the highest shared variance of the variables. The discriminant validity of the research constructs in this study was checked using all the above mentioned ways. Table 6.20, below, provides examples of assessing discriminant validity using the pair-wise correlation coefficients less than one (1).

Table 6.20: Correlations Matrix

Research Variables		CP	SCP	SCE	SIS	SCC
	CP	1.000				
	SCP	.728	1.000			
	SCE	.908	.769	1.000		
	SIS	.851	.711	.902	1.000	
	SCC	.701	.945	.762	.730	1.000

Note: SCP=supply chain practice, SCE=supply chain e-collaboration, SIS=strategic information sharing, SCC=supply chain competence, CP=supply chain performance.

As indicated in Table 6.20, above, all the inter-correlation values for all paired latent variables are less than 1.0. They all range between 0.70 and 0.95, thus, confirming the existence of discriminant validity. However, since the correlation value of supply chain e-collaboration (SCE) and strategic information sharing is above 0.7 (in particular 0.90) and very close to 1.0, other tests for discriminant validity are necessary (Nunnally & Bernstein 1994:12). Therefore, further tests (particularly the AVE-SV test and the AVE values of less than 1) were performed to establish discriminant validity. As shown in Table 6.19, all the AVE values range from 0.45 to 0.51 and are all far below 1, which confirms the existence of discriminant validity. More so, Table 6.19 indicates that the highest shared variance values of all the variables are between 0.32 and 0.40. All these figures are less than the AVE values (ranging from 0.45 to 0.51) of their respective latent variables, thereby further confirming that the measures of all the five different variables were indeed distinct and heterogeneous (Fornell & Larcker 1992:40). The next section provides a discussion on the overall fit of the measurement model (CFA).

6.4.3. Confirmatory Factor Analysis Model Fit/Acceptability

Confirmatory factor analysis as earlier noted (in Chapter 5) is a technique that confirms that the existent measurement items load themselves into latent variables (Lei & Wu 2007:34; Reisinger & Mavondo 2007:43). CFA was performed to assess the consistence and accuracy (in other words the reliability, convergent and discriminant validity) of the measurement items, using AMOS Version 21. To provide an adequate model fit as well as the measurement items accuracy and consistence assessments; 40 responses were deleted due to the mahalanobis report, which showed them as the most extreme outliers. More so, measurement items (SCP2, 3, 4, 5, 7 and 16; SCE6, 12, 14, 16 and 17; SIS2, 4 and 10; SCC2, 4 and 6; CP7 and

14) were excluded in the performance of CFA tests because their factor loadings were below the recommended threshold of 0.5.

Several model fit guidelines were developed to improve the understanding of CFA and SEM assumptions for building a diverse and complex model. In other words, due to the existence of these various model fit criteria, the establishment of model fit for both CFA and SEM models is relatively easier compared to other multivariate statistical methods (such as the analysis of variance, multiple regression and discriminant analysis). According to Schumacher (2006:78), CFA and SEM fit indices are believed to have no single statistical check of significance that determines a correct model for the specified sample data. This is because of the possibility of existence of alternative models, which can provide the exact same data to model fit. As a result, this study used a different model fit criteria that combined the assessment of model fit indices (Hair *et al*., 2006:43). The study thus employed 10 model fit criteria to check the overall fit of the research model, starting with the chi-square index following the works of Kline (2005) as well as Cheung and Rensvold (2002:233-255). The other nine model fit indices used in this study are discussed in the next sections.

Some of the CFA model fit acceptability guidelines are provided in Table 6.21 on the next page. Table 6.21 shows that the value of chi-square over degrees of freedom ($\chi 2$/df) ranging between 1 and 3 provides an adequate model fit. More so, the table shows that the values of Goodness-of-Fit Index (GFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), and Tucker-Lewis Index (TLI) equal to or greater than 0.90, and the Root Mean Square Error of Approximation (RMSEA) value equal to or less than 0.08 provides a good model fit (see Table 6.21, on the next pages). Table 6.21 also indicates that the values of a Parsimonious Fit Index (PClose), Relative Non-Centrality Index (RNI) and McDonald's Centrality Index (CI) of 0.9 or higher reflects a good model fit. The next sections focus on the CFA results for the selected 10 model fit indices (see Table 6.22).

Table 6.21: Model Fit Indices and Acceptable Levels

Goodness of Fit Criterion	Acceptable Level	Level Interpretation
Absolute fit measures		
Chi-square (x^2)	Low x^2 value (relative to degrees of freedom) with significance level < .05	Value greater than .05 reflects acceptable fit Values between 0.05 and 0.20 indicate a good fit Non-significant & small values show good fit, Significant and large values show poor fit
Chi-square/df or CMIN	Ratio 2:1 or 3:1	Values close to 1 reflect good model fit, values < 3 reflect acceptable fit
Goodness of Fit Index (GFI)	.90 or higher	Values > .90 reflect good fit Shows the amount of variances explained by model. It is the equivalent of R2 in multiple regressions
GFI (AGFI)	.90 or higher	Adjusted for the degrees of freedom Values > .90 reflect a good fit Adjusts model fit for the degrees of freedom relative to the number of variables
Akaike Information Criterion (AIC)		Small positive values relative to independence model indicate model parsimony
Hoelter's Critical N (CN)		Gives a sample size below which the model is acceptable and above which the model becomes poorly fitting
Root Mean Square Residuals (RMSR) or RMS or RMR	.08 or lower	Values close to 0 reflect good fit, Marginal acceptance level is 0.08. Reflects the average amount of variances and covariances not accounted for by the model
Model Comparison and Relative fit measures		
Tucker- Lewis Index (TLI) or Bentler-Bonett Non-Normed Fit Index (BBNNFI)	Value close to 1	Values >.90 reflect a good fit, Values below .90 indicate the need to respecify the model Compares an absolute null model with the theoretical model of interest, penalizes for model complexity
Normed Fit Index (NFI) or Bentler-Bonett Normed Fit Index (BBNFI) or DELTA 1	Value close to 1	Values below .90 indicate the need to respecify model Reflects the proportion by which model improves fit compared to the null model, provides a measure of the proportion of total covariance accounted for by the model
Bentler-Bonnet Index (BBI)	.90 or higher	Values > .90 reflect a good fit
Incremental Fit Index (IFI) or BL89 or DELTA	2 .90 or higher	Values = or > .90 reflect a good fit
Relative Fit Index (RFI) or RH01	Values close to 1	Values > .90 reflect a good fit
Model Parsimony and Parsimonious fit measures		
Parsimony Ratio (PRATIO)	.90 or higher	Shows the extent to which good fit can be achieved by freeing constrained parameters
Parsimonious Fit Index (PCLOSE)	.90 or higher	Values close to 0 indicate no fit and values close to 1 indicate perfect fit; values > .90 reflect a good fit Takes into account the number of degrees of freedom; a high degree of fit with fewer degrees of freedom is desired Non centrality-based indices
Root Mean Square Error of Approximation (RMSEA) (measure of misfit), or RMS, RMSE, discrepancy per	< .08	Values < .05 reflect a good fit Values between .05 and .08 reflect reasonable fit Estimates how well the fitted model approximates the population covariance matrix

degree of freedom		per degree of freedom
Comparative Fit Index (CFI) or Bentler Comparative Fit Index	Value close to 1	Values > .90 reflect a good fit Penalizes for sample size, gives the best approximation of the population value for a single model
Relative Non-Centrality Index (RNI)	.90 or higher	Values > .90 reflect good fit Penalizes for sample size and model complexity
McDonald's Centrality Index (CI)	.90 or higher	Values > .90 reflect good fit

Source: Adapted from Reisinger and Mavondo (2008:57)

Table 6.22: CFA Model Fit Indices Results

FIT INDEX	Results
Chi-Square/ d. f.	3.69
GFI (Goodness of Fit Index)	0.95
AGFI (Adjusted Goodness of Fit Index)	0.90
RMR (Root Mean Square Residual)	0.06
CFI (Comparative Fit Index)	0.96
RMSEA (Root Mean Square Error of Approximation)	0.09
NFI (Normal Fit Index)	0.94
TLI (Tucker Lewis Index)	0.93
IFI (Incremental Fit index)	0.96
RFI (Relative Fit Index)	0.91

Table 6.22, above, indicates that the measurement model yielded a ratio of chi-square value to degree-of-freedom of 3.69. The recommended threshold range is between 1 and 3. Although the current study has a value of above 3, the difference of 0.69 is still tolerable. According to Reisinger and Mavondo (2008:57), chi-square to degrees-of-freedom values below 5 still provide a good model fit. As such, the chi-square to degrees-of-freedom value of 3.69 in this study is marginally accepted and reflects a good model fit. Table 6.22 also shows GFI, AGFI, NFI, RFI, IFI, CFI and TLI values (0.95, 0.90, 0.94, 0.91, 0.96, 0.96 and 0.93 respectively) that are above the recommended threshold of 0.9 or above. This further reflects a good model fit.

Table 6.22 further reports RMR value of 0.06 and is less than 0.08, thus it yields a reasonable model fit. The table also shows a RMSEA value of 0.09. Although this figure is above the range of between 0.05 and 0.08, which yields a reasonable fit, the value is still within the tolerable range of 0.09 or less. Based on the model fit

acceptability guidelines provided in Table 6.21, and the actual CFA model fit results in Table 6.22 above, all the 10 selected model fit indices provide an acceptable overall fitness of the measurement model to the specified sample data. The next section provides a discussion of the structural model, starting with the SEM model fit to the hypotheses testing.

6.4.4. SEM Conceptual Model Fit Assessments

This section focuses on the SEM model fit assessments and commences by establishing an acceptable model fit using the 10 selected model fit indices(see section 6.4.3 CFA model fit). These are discussed in detail below and the results are shown in Table 6.23 later in this chapter. The Chi-square is discussed in the next section.

6.4.4.1. Chi-square (x^2)

Chi-square is a conventional model fit index in SEM used to evaluate the degree of inconsistency between the observed sample and the fitted or estimated covariance matrices (Hooper, Coughlan & Mullen 2008:53). Schumacher (2006:83) describes the aim of chi-square as that of achieving a small discrepancy between the sample variance-covariance matrix and the reproduced implied covariance matrix at a non statistical significance level. These discrepancies are depicted in a residual matrix (see Appendix C).

A chi-square value of zero shows that there are no discrepancies between the values in the covariance matrix and the reproduced implied covariance matrix, which signifies a perfect model fit. In other words, the chi-square value is close to zero or not significant when the residual values shown in the residual matrix are close to zero. This indicates that the observed theoretically specified model perfectly fits the sample data (Schumacher 2006:83). The recommended threshold value for a chi-square should be less than three (3) with a larger p value of less than 0.05. The chi-square index needs to be applied with alternative model fit indices to minimise its limitations of sometimes rejecting a properly specified model due to its assumption of multivariate normality and severe deviations from normality (Hooper *et al*., 2008:54). The next section discusses the Goodness-of-fit index (GFI).

6.4.4.2. Goodness-of-fit Index (GFI) and (AGFI)

According to Hooper *et al*. (2008:54) GFI measures the percentage of variance explained by the estimated population covariance. It is an indication of the degree of closeness of the estimated model in terms of replicating the observed covariance matrix (Hooper *et al*., 2008:54). This indication of closeness is done through observing the variances and covariances accounted for by the model. GFI is, to a certain extent, the percentage of observed covariances accounted for by the model.

It is similar to R square in multiple regression except that it cannot be interpreted as the percentage of error explained by the model. This means that while on the one hand, R square in multiple regression is concerned with error variance, GFI, on the other hand, is concerned with the error in reproducing the variance-covariance matrix. The GFI statistic value normally ranges between 0 and 1, although in rare cases the index in theory can yield meaningless negative values. The index values increase when the sample grows larger and as the number of estimated parameters increase. Bollen (1990:446) suggests that in principle a good model fit is achieved where the GFI value is equal to or greater than 0.90.

GFI is, however, too sensitive, especially when it comes to sample size and the number of estimated parameters; such that it cannot be used alone to assess model fit. The GFI is closely associated with the AGFI index which adjusts the GFI using the degrees of freedom. The model fit in AGFI is reduced as the model becomes more saturated. In other words, the AGFI index prefers more parsimonious models and penalises complicated models. In light of the above, the AGFI value is always less than the GFI value. More so, just like the GFI, the AGFI value increases with the increases in the sample size. Its statistic value also ranges between 1 and 0. The generally recommended threshold value for AGFI to provide a good model fit is 0.90 or more. Neither the GFI nor the AGFI can be used as a stand-alone measure for overall model fit mostly due to their dependence on sample size. As such, alternative model fit indices are provided in the sections below.

6.4.4.3. Root mean square residual (RMR)

Tabachnick and Fidell (2007:748) describe the root mean square residual (RMR) as the average residual value between the sample variance (both variance and covariance) and the estimated population variance (both variance and covariance). It

is statistically estimated as the 'square root of two times the sum, over all the variables in the covariance matrix of the average squared differences between each of the sample covariances (or variances) and the estimated covariances (or variances)' (Tabachnick & Fidell 2007:748). A metric of correlation matrix is used to present the average residuals used for the RMR for easy interpretation. The matrix's outcome symbolises the average value across all the standardised residuals and ranges between 0 and 1. Thus, model fit improves as the RMR value moves closer to 0 (Hu & Bentler 1995:72). Reisinger and Mavondo (2008:57) suggest a recommended criteria where values close to 0 indicates a good model fit, while 0.08 or less reflects a marginally accepted model fit.

6.4.4.4. The normed fit index (NFI)

NFI also known as the Bentler-Bonnet Normed Fit Index (BBNFI) or Delta 1 is a comparative model fit index developed eccentrically to CFI. According to Reisinger and Mavondo (2008:57), NFI measures the percentage of the total covariance accounted for by the model. It assesses the amount by which the research model improves model fit compared to the null model (random variables). The NFI statistical values have a 0-1 range, where 1 represents a perfect fit, 0.9 or above indicative of a good fit and 0 reflecting no fit at all. Hu and Bentler (1995:76) suggest an NFI value of 0.9 or above as indicative of a good model fit, while values below 0.9 show a need to respecify the research model.

6.4.4.5. The comparative fit index (CFI)

CFI also known as the Bentler Comparative Fit Index (BCFI) is a revised form of NFI which takes sample size into consideration. Kline (2005:208) describes CFI as an incremental model fit index that assesses the relative improvements in the fit of the research model over the null or baseline model. It is premised on the assumption that all the latent variables are uncorrelated (null /baseline model) and compares the sample covariance matrix with the null model (Hooper *et al*., 2008:55). CFI assesses the null model with the observed covariance matrix in order to estimate the amount of lack of fit explained by moving from the null model to the research SEM model. Its statistical values ranges from 0 to 1, with values closer to 1 indicative of a very good model fit. Reisinger and Mavondo (2008:57) suggest that a good model fit is achieved by a threshold value of 0.9 or above, since it shows that 90 percent of the covariation in the data can be reproduced by the given model.

6.4.4.6. The incremental fit index (IFI)

IFI is an incremental model fit index that is basically calculated the same way as the NFI, except that it takes into account the degrees of freedom. This index was developed by Bollen (1990) with an aim of addressing the problems of the NFI related to limitations in the issues of parsimony and sample size. The statistical value of IFI has a 0-1 range, with 1 indicative of a perfect fit while 0 shows no fit at all. Nevertheless, the IFI value can also exceed 1, under certain circumstances (Hair *et a*l., 2006:39). The acceptable guideline threshold value for IFI that provides a good model fit should be 0.9 or above (Reisinger & Mavondo 2008:57).

6.4.4.7. Root mean square error of approximation (RMSEA)

Reisinger and Mavondo describe RMSEA as a parsimonious measure of model misfit that 'estimate how well the fitted model approximates the population covariance matrix per degree of freedom'. It takes into account the error of approximation in the population. RMSEA is mostly sensitised to the number of estimated parameters in the model. According to Hooper *et al*. (2008:54), the major benefit of RMSEA over other indices is its ability to allow for the calculation of the confidence interval around its value. There has been a downward shift in terms of the recommended threshold value of what yields a good model fit over time. As noted by Hooper *et al*. (2008:54), during the early nineties, a RMSEA value of below 0.10 was considered to provide a good model fit, while values above 1.0 indicated a poor model fit. Cramer (2003:34), in support, also suggests a RMSEA value of below 1.0 to yield a good model fit. However, Reisinger and Mavondo (2008:54) suggest that a good model fit is yielded by RMSEA values of below 0.05, with values between 0.05 and 0.08, while those above 0.08 show a poor fit. Table 6.23, below, shows the SEM model fit results.

Table 6.23: SEM Model Fit Indices Results

FIT INDEX	Results
Chi-Square/ d. f.	148.34
GFI (Goodness of Fit Index)	0.998
AGFI (Adjusted Goodness of Fit Index)	0.977
RMR (Root Mean Square Residual)	0.003
CFI (Comparative Fit Index)	1.000
RMSEA (Root Mean Square Error of Approximation)	0.018
NFI (Normal Fit Index)	0.999
TLI (Tucker Lewis Index)	1.000
IFI (Incremental Fit index)	1.000
RFI (Relative Fit Index)	0.994

As shown in Table 6.23 above, the structural model yielded a ratio of chi- square value to degree-of-freedom of 148.34. Previous studies (Hair *et al*., 2010:199; Sezen 2008:236) have accepted chi-square values of above the recommended seal of 3 in cases of a larger sample size of above 100units. For instance, a study by Sezen (2008:236) found a chi-square value of 507.74 to yield a good model fit. In light of the above, this study reports a chi-square value of 148.34 as indicative of a good model fit at a significance level of less than 0.05.

Table 6.23 further shows GFI, AGFI, NFI, RFI, IFI, CFI and TLI values (0.998, 0.977, 0.999, 0.994, 1.000, 1.000 and 1.000 respectively) that are above the recommended threshold of 0.9 or above. These results further confirm that the estimated model fit well the sample data in this study, which provides a good model fit. Table 6.23 also reports RMR of 0.003 and this value is within the recommended threshold of less than 0.05, thus yielding a very good model fit. The table also depicts a RMSEA value of 0.018, and is closer to zero, which provides a very good model fit. Based on the model fit acceptability guidelines provided in Table 6.21, and the actual SEM model fit results in Table 6.23 above, all the 10 selected model fit indices provide an good overall fitness of the SEM model to the specified sample data. The next section provides a discussion of the structural model (hypotheses testing).

6.5. SEM RESULTS AND THE CONCEPTUAL MODEL

The study at hand theorised that intra-firm supply chain practice has a significant positive influence on supply chain performance through the mediation effects of supply chain e-collaboration, strategic information sharing and supply chain competence. This section focuses on the linear relationships hypothesised to show the influence that supply chain practice has on supply chain performance through supply chain e-collaboration, strategic information sharing and supply chain competence, as shown in Figure 6.9 below.

Figure 6.9: Research Conceptual Model

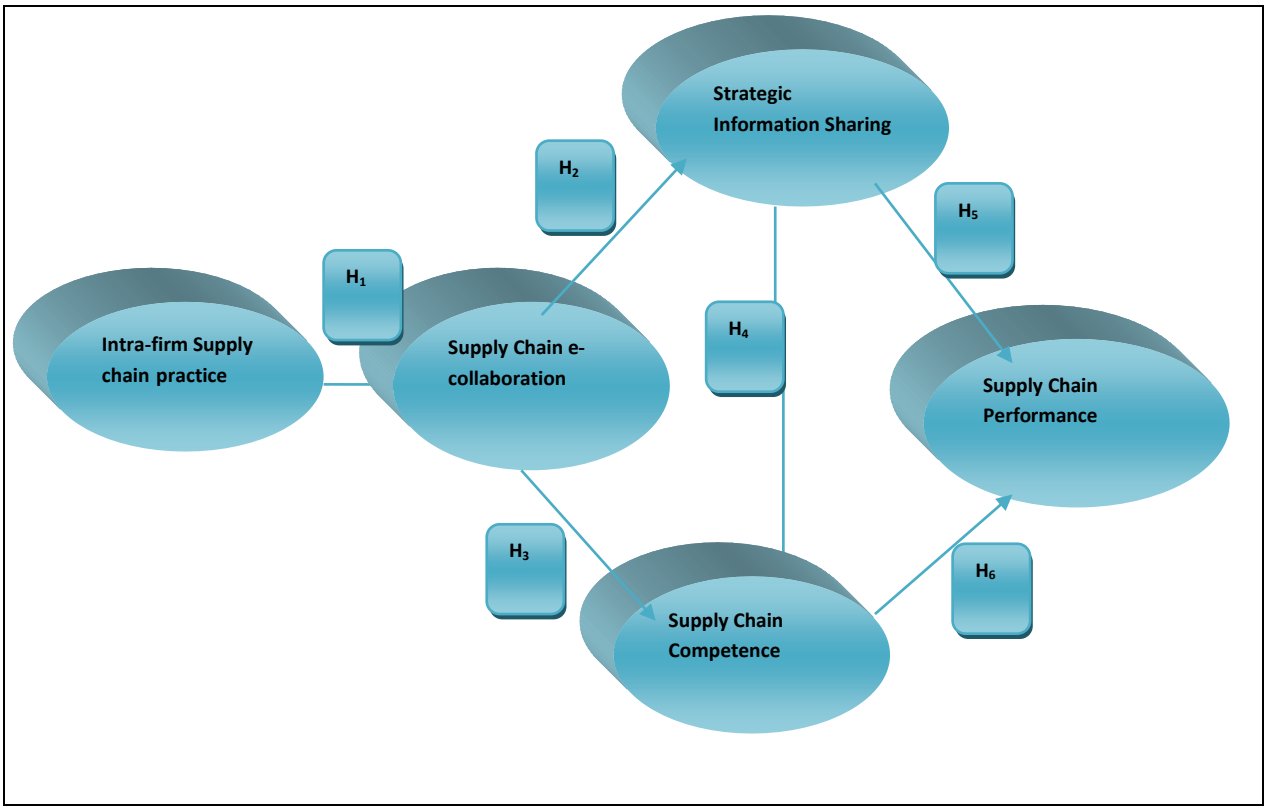


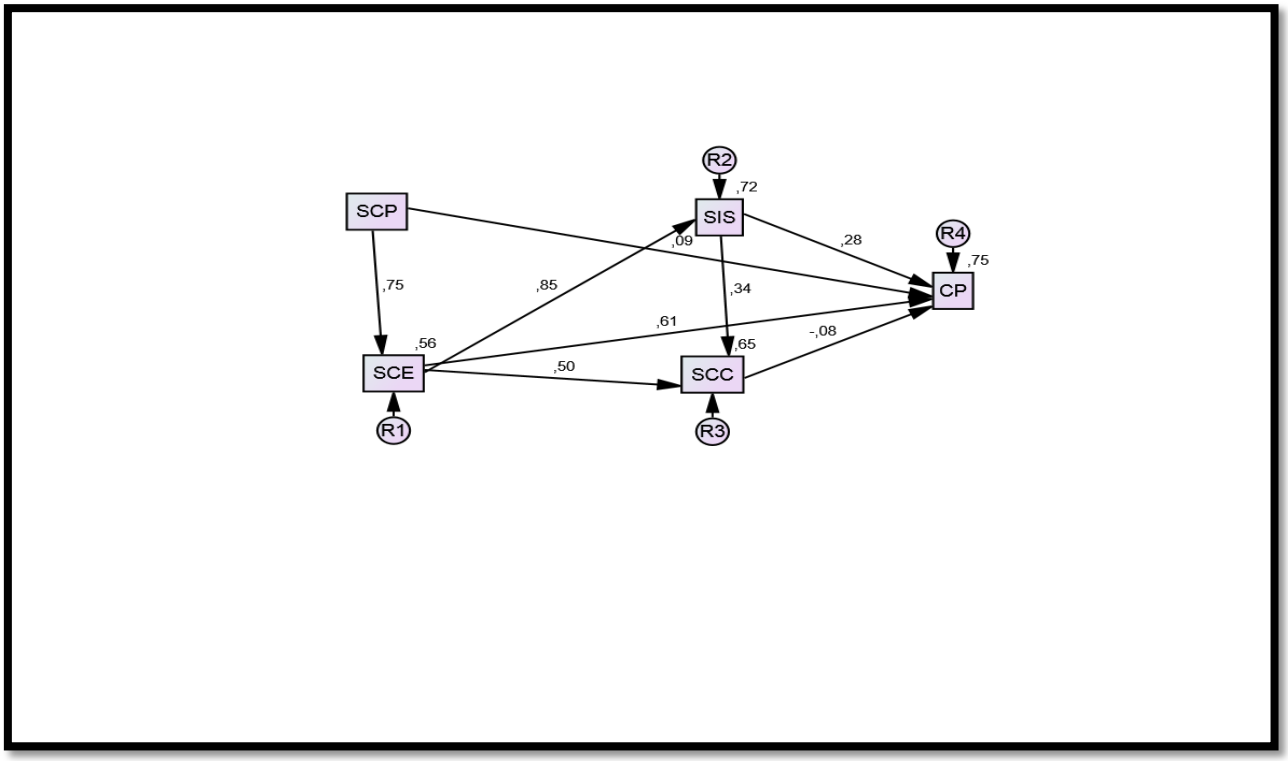
Figure 6.9 above, depicts the six posited linear relationships between the five research latent variables, namely: intra-firm supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. As noted earlier (in Chapter 4, section 4.3.2, the research conceptual framework), intra-firm supply chain practice is the predictor variable, supply chain e-collaboration, strategic information sharing and supply chain competence are the mediator variables, while supply chain performance is the outcome variable.

As shown in Figure 6.9, intra-firm supply chain practice has a positive significant influence on supply chain e-collaboration (H_1). Supply chain e-collaboration in turn has a positive and significant influence on strategic information sharing (H_2) as well as supply chain competence (H_3). Strategic information sharing further has a positive and significant influence on supply chain competence (H_4) and supply chain performance (H_5). Lastly, supply chain competence has a positive and significant influence on supply chain performance (H_6). The hypotheses tests results are displayed in Figure 6.10 and discussed in the next section.

6.5.1. The Hypotheses Testing Stage and Results

This section discusses the six tested hypotheses and addresses their validation or non validation based on the SEM results tabulated in Table 6.24, 6.25. 6.26, 6.27, 6.28, 6.29 6.30, and Figure 6.10 below. After the modification of the full conceptual model, results were obtained from it and proved the rest of the hypotheses. The following are the results of the hypotheses**.**

Figure 6.10: SEM Hypotheses Testing Results



Structural model fits: χ^2/df=148.34; GFI=0.998; AGFI=0.977; RMR=0.003; NFI=0.999; RFI=0.994; IFI=0.994; TLI=1.000; CFI= 1.000; RMSEA=0.018. Note: [c] significance level - ***p-value<0.001, [b] significance level-**p-value<0.05, [a] significance level- *p-value<0.1, [ns] significant level- insignificant (p-value>0.1).

- ***H_1:*** **Intra-firm s*upply chain practice has a positive influence on supply chain e-collaboration in South Africa*.**

A linear relationship (positive and significant) was hypothesised between intra-firm supply chain practice and supply chain e-collaboration. This hypothesis was formulated from the objective that aimed to investigate the influence of intra-firm supply chain practice on supply chain e-collaboration. Results are shown in Figure 6.10 above and Table 6.24, below.

Table 6.24: Hypothesis One SEM Results

Variables	Path	Variables	Hypothesis	Path coefficient	Standard Error	Critical Region	P-Value
Supply Chain Practice	→	Supply Chain e-Collaboration	H_1	0.75	0.036	20.002	[c]***

Structural model fits: χ^2/df=148.34; GFI=0.998; AGFI=0.977; RMR=0.003; NFI=0.999; RFI=0.994; IFI=0.994; TLI=1.000; CFI= 1.000; RMSEA=0.018. Note: [c] significance level - ***p-value<0.001, [b] significance level-**p-value<0.05, [a] significance level- *p-value<0.1, [ns] significant level- insignificant (p-value>0.1).

As shown in Table 6.24 above, intra-firm supply chain practice has a strong positive and significant linear relationship with supply chain e-collaboration. The current study posited a positive influence of intra-firm supply chain practice on supply chain e-collaboration and the findings of this study confirmed it. A high and positive path coefficient (0.75) validates the hypothesised strong positive influence that supply chain practice has on supply chain e-collaboration. These findings are consistent with the theoretical reasoning of the RV theory, which assumes that critical resources of a firm may extend beyond the firm boundaries and may be embedded in inter-firm resources as well as routines (Dyer & Singh 1998). The resources (particularly the site, human and physical specifity) and routines are an outcome of the supply chain practices employed by the supply chain member firms, and can enhance a firm's investment and commitment to e-collaborations with key supply chain partners.

The findings are also consistent with the supply chain management model by Lambert and Cooper (2000). As required by the supply chain management model supply chain partners need to first identify who their key partners are, know their position in the supply chain, the length of the supply chain and the type of supply chain practices they implement, before they can invest in e-collaboration commitments with the supply chain partners. This can help them assess the level of

commitment the other supply chain partners have, especially towards technology investments, before deciding on collaborating with them.

Thus, the validation of a strong positive influence of intra-firm supply chain practice on supply chain e-collaboration means; firms that effectively implement their intra-firm supply chain practices of supply chain planning, JIT production and inventory systems and delivery increase their chances of collaborating with their key supply chain members using technologies in an attempt to control and minimise supply chain costs. These findings to the best knowledge of the researcher are remarkable because they are new as no previous empirical evidence was found on the influence of supply chain practice on supply chain e-collaboration.

Important to note is the fact that the validation of each hypothesis under SEM depends on two main criteria. The first criterion deals with the path coefficients (beta). In other words, for a hypothesised positive influence, the path coefficient must be positive and above 0.5; while a negative influence requires a negative path coefficient of -0.5 or above (Hair *et al*., 2006:79). The second one requires that the tested influence has at least one star (*), two stars (**) or three stars (***). These stars show significance at three different levels, which are: (***) - p-value less than 0.001, (**) - p-value less than 0.05 and (*) - p-value less than 0.1. These p-values complement the critical values (C.R) commonly known as the t-statistic. The recommended threshold for a significant influence or relationship is a t-value of 2.00 or above.

In this study, the strong positive influence of intra-firm supply chain practice on supply chain e-collaboration was highly significant with a critical value of 20.002 and a p-value less than 0.001. As such, the high and positive path coefficient along with the high levels of significance shown by both the t-value and the p-value validates and renders support to the first hypothesis.

Important to note is the fact that these findings validated and rendered support to the claims of H_1. This means that the null hypothesis ($H0_1$), which claimed that intra-firm supply chain practice has a negative influence on supply chain e-collaboration was rejected in this study. The validation and support rendered to H_1 suggests that there is a significant linear relationship between intra-firm supply chain practice and supply chain e-collaboration. This may be due to the fact that a majority of the surveyed firms in this study were large in size. These larger firms may have higher levels of

intra-firm supply chain practice due to their complex supply chain network, which requires them to invest in technologies such as e-collaboration tools, for more effective supply chain management. **Therefore, H_1 is valid and supported; thereby necessitating the rejection of the null hypothesis of $H0_1$, which claims a negative influence of intra-firm supply chain practice on supply chain e-collaboration among supply chain partners.**

- ***H_2: Supply chain e-collaboration has a positive influence on strategic information sharing.***

A positive and significant influence of supply chain e-collaboration on strategic information sharing was posited. The SEM results that validate or invalidate this hypothesis are shown in Figure 6.10 on the previous pages and Table 6.25, below.

Table 6.25: Hypothesis Two SEM Results

Variables	Path	Variables	Hypothesis	Path coefficient	Standard Error	T-Value	P-Value
Supply Chain e-Collaboration	→	Strategic Information Sharing	H_2	0.85	0.036	28.365	[C] ***

Structural model fits: χ^2/df=148.34; GFI=0.998; AGFI=0.977; RMR=0.003; NFI=0.999; RFI=0.994; IFI=0.994; TLI=1.000; CFI= 1.000; RMSEA=0.018. Note: [c] significance level - ***p-value<0.001, [b] significance level-**p-value<0.05, [a] significance level- *p-value<0.1, [ns] significant level- insignificant (p-value>0.1).

Table 6.25, above, indicates that supply chain e-collaboration has a strong positive (path coefficient of 0.85) and highly significant ([C] *** - p-value less than 0.001; t-value of 28.365) influence on strategic information sharing. These findings depicted in Table 6.25, thus, validate H_2 since the two criteria of significance and positive path coefficients are met. As posited in H_2, the findings of this study suggest that the successful adoption of technology-enabled collaborations can enhance trust and commitment to share important information (for example tacit information on manufacturing and customers) among supply chain member firms. The findings are consistent with the RV theory which requires that firms in a certain alliance should invest in inter-firm knowledge routines to create relational rents. In other words, firms in supply chain e-collaboration relationships need to invest in information sharing structures and routines that will facilitate effective and profitable sharing of strategic information with each other.

These findings are also in agreement with previous empirical evidence (Choi & Ko 2012:556; Sheu *et al*., 2006:40), which suggested high levels of trust and interdependence as the pushing factors of managers to engage a firm in further collaborations (for example supply chain-collaboration) and the sharing of information.

The results of this study validated and supported H_2 since the two criteria of significance level and positive path coefficient were met, thereby rejecting the null hypothesis ($H0_2$). In other words, supply chain member firms who understand their position in the supply chain, have identified their key supply chain partners, and committed themselves to e-collaboration relationships with these key supply chain partners, can enjoy the benefits of sharing and transferring important and strategic tacit information, which their rivals who are not in such relationships cannot find in the secondary markets. **Therefore, this study strongly validates and supports the claim that supply chain e-collaboration has a positive influence on strategic information sharing (H_2); and rejects the null hypothesis $H0_2$, which claim a negative influence of supply chain e-collaboration on strategic information sharing.**

- ***H_3: Supply chain e-collaboration has a positive influence on supply chain competence.***

The current study also posited a significant and positive influence of supply chain e-collaboration on supply chain competence. This hypothesis was formulated in an attempt to ascertain the influence of supply chain e-collaboration on supply chain competence. The SEM results that validate or invalidate this hypothesis are shown in Figure 6.10 on the pages above and Table 6.26, below.

Table 6.26: Hypothesis Three SEM Results

Variables	Path	Variables	Hypothesis	Path coefficient	Standard Error	Critical Region	P-Value
Supply Chain e-Collaboration	→	Supply chain competence	H_3	0.50	0.072	7.968	[C] ***

Structural model fits: χ^2/df=148.34; GFI=0.998; AGFI=0.977; RMR=0.003; NFI=0.999; RFI=0.994; IFI=0.994; TLI=1.000; CFI= 1.000; RMSEA=0.018. Note: [c] significance level - ***p-value<0.001, [b] significance level-**p-value<0.05, [a] significance level- *p-value<0.1, [ns] significant level- insignificant (p-value>0.1).

As shown in Figure 6.10 and Table 6.26, supply chain e-collaboration has a positive (path coefficient of 0.50) and significant (^{C} *** or p-value less than 0.001 and t-value of 7.968) influence on supply chain competence. The positive path coefficient of exactly 0.5 confirms the existence of a reasonable positive effect of supply chain e-collaboration in creating supply chain competences. These findings suggest that supply chain member firms that invest in and use e-collaboration tools such as the message-based, shared collaborative as well as the electronic procurement and market place systems for their buying and selling with each other, are able to learn collectively and create a supply chain competence.

The results of this study are in agreement with the RV theory, which claims that the investment in complementary resources and inter-organisational assets by supply chain partners can generate relational rents (Dyer & Singh 1998). In other words, e-collaborating firms in a supply chain can create the ability to learn collectively and gain a competitive edge by investing in resources that complement those of their key supply chain partners, and which can only be bought from among the supply chain partners. More so, a supply chain competence can be created when these e-collaborating firms in a supply chain invest in assets such as plants and machinery specifically meant for their e-collaboration relationship.

These findings to the best knowledge of the researcher are also noteworthy since they are new, as previous empirical evidence that directly linked supply chain e-collaboration to supply chain competence was hard to find. As such, these findings are new, and significantly contribute to the supply chain body of literature on the influence of supply chain e-collaboration on the development of a supply chain competence. Since the findings validated and rendered reasonable support for hypothesis H_3; the null hypothesis $H0_3$ claiming a negative influence of supply chain e-collaboration on supply chain competence is rejected. **Therefore, this study validates and supports the hypothesis that supply chain e-collaboration has a positive influence on supply chain competence (H_3); and rejects the null hypothesis $H0_3$, which claims a negative influence of supply chain e-collaboration on supply chain competence.**

- ***H_4: Strategic information sharing has a positive influence on supply chain competence.***

The study also hypothesised a positive influence of strategic information sharing on supply chain competence as stated in H_4 above. This hypothesis was formulated in an attempt to determine the influence of strategic information sharing on supply chain competence. The SEM results on the support of H_4 are shown in Figure 6.10 in the previous pages and Table 6.27, below.

Table 6.27: Hypothesis Four SEM Results

Variables	Path	Variables	Hypothesis	Path coefficient	Standard Error	Critical Region	P-Value
Strategic Information Sharing	→	Supply chain competence	H_4	0.34	0.059	5.387	[C] ***

Structural model fits: χ^2/df=148.34; GFI=0.998; AGFI=0.977; RMR=0.003; NFI=0.999; RFI=0.994; IFI=0.994; TLI=1.000; CFI= 1.000; RMSEA=0.018. Note: [c] significance level - ***p-value<0.001, [b] significance level-**p-value<0.05, [a] significance level- *p-value<0.1, [ns] significant level- insignificant (p-value>0.1).

Figure 6.10 and Table 6.27 indicate that strategic information sharing has a weak positive (path coefficient of 0.34) and significant ([C] *** or p-value less than 0.001; t-value of 5.387) influence on supply chain competence. The influence is said to be weak because the path coefficient of 0.34 is less than the recommended threshold value of 0.5.

The positive influence though weak confirms the findings of Liu and Kumar (2003:525) who suggested that a centralised e-hub as an information sharing platform enhances the ability of firms to accurately forecast customer demand, promptly fulfil customer orders and even produce quality products (supply chain competences). The findings are also in agreement with the work of Choi and Ko (2012:557) who found that e-collaboration can facilitate information sharing among partners.

The assumption commonly made is that collaborating firms do share their important information within their supply chain. While this is true for some firms, a majority of these firms own basic technologies (such as computers, smart phones and Internet), which support the basic information sharing structures such as the sequential and

reciprocal information sharing structures. With these structures problems relating to coordination, information hoarding as well as opportunistic behaviour among the collaborating partners frequently occur. This in turn prevents the collaborating firms from learning collectively as a supply chain and fail to create a distinct supply chain competence.

These findings reveal strategic information sharing as having an indirect influence on supply chain competence. In other words, strategic information sharing is not a major determinant of supply chain competence and requires other factors such as supply chain e-collaboration, supply chain practice and organisational learning to develop a distinct supply chain competence. Given that supply chain management was adopted late in South Africa compared to other countries, it makes some logical sense to obtain a weak positive influence of strategic information sharing on supply chain competence. Perhaps most of the surveyed South African firms are still trying to gain understanding of the essence and benefits of supply chain e-collaborations and strategic information sharing before fully committing their funds in them.

These findings suggest that although the sharing of strategic information among supply chain partners can enhance their ability to learn collectively and develop a supply chain competence; there are other factors other than information sharing that are key in the creation of a supply chain competence. In other words, the sharing of strategic information among e-collaborating firms through e-hub structures like Carpenterdirect.com can enable firms to develop supply chain competences with the help of other factors. Given that to the best knowledge of the researcher, there are few studies that have directly linked strategic information sharing and supply chain competence; these findings also make significant contributions to the supply chain management body of literature in this regard. Since the influence is positive though weak and highly significant, the claims of H_4 are validated in this study. **Therefore, this study validates and supports the claim that strategic information sharing has a positive influence on supply chain competence (H_4); and rejects the null hypothesis $H0_4$ which claims a negative influence of strategic information sharing on supply chain competence.**

- ***H_5: Strategic information sharing has a positive influence on supply chain performance.***

The ability of firms to effectively and fully share their strategic and important information can improve the performance of a firm as well as of the entire supply chain. For instance, as earlier noted, a supply chain plan is part of the important information that needs to be shared among collaborating supply chain partners. This is because it contains information that will guide all collaborative supply chain processes in order to optimise the entire supply chain and improve supply chain performance. Strategic information sharing was posited to have a positive influence on supply chain performance in this study. This hypothesis was formulated in an attempt to examine the influence of strategic information sharing on supply chain performance.The SEM results that validate or invalidate this hypothesis are shown in Figure 6.10 in pages above and Table 6.28, below.

Table 6.28: Hypothesis Five SEM Results

Variables	Path	Variables	Hypothesis	Path coefficient	Standard Error	Critical Region	P-Value
Strategic Information Sharing	→	Supply Chain Performance	H_5	0.28	0.052	5.069	[C] ***

Structural model fits: χ^2/df=148.34; GFI=0.998; AGFI=0.977; RMR=0.003; NFI=0.999; RFI=0.994; IFI=0.994; TLI=1.000; CFI= 1.000; RMSEA=0.018. Note: [c] significance level - ***p-value<0.001, [b] significance level-**p-value<0.05, [a] significance level- *p-value<0.1, [ns] significant level- insignificant (p-value>0.1).

The path diagram presented in Figure 6.10 and the other SEM results in Table 6.28 shows that strategic information sharing has a weak positive (path coefficient of 0.28) and significant ([C] *** or p-value less than 0.001 and t-value of 5.069) influence on supply chain performance. The positive path coefficient of 0.28 is less than the acceptable threshold value of 0.5, thus making it a weak influence. More so, the positive path coefficient though weak, indicates that strategic information sharing needs to complement other factors such as supply chain learning and competitive advantage to enhance the performance of the entire supply chain. In other words, if the sharing of information does not result in collective learning of the entire supply chain, such that a supply chain competitive edge is developed, information sharing makes a minor contribution in terms of supply chain performance.

More so, the findings suggest that strategic information sharing has an indirect influence on supply chain performance. Thus, it requires other determinants of supply chain performance such as supply chain e-collaboration, supply chain practice, trust and balanced bargaining power to strongly improve supply chain performance. The weaker positive results also suggest that the collaborating supply chain partners lack the advanced technologies to support better information sharing structures such as the hub-and-spokes. The hub-and-spokes such as the Carpentercare.com, as previously defined in Chapter 3, is a web based information sharing structure based on a central hub that communicates with all supply chain partners and requires extranets. Based on the survey results, only 3.9% of the firms own extranets. This means almost 96% of the surveyed firms without these extranets are not able to share their information through the hub-and-spokes information sharing structures. Perhaps a majority of these firms, due to the basic forms of technology they own, are faced with the problems of supply chain partners' opportunistic behaviour, information hoarding and coordination issues. These tend to constrain and weaken the performance of the entire supply chain.

The weak influence of strategic information sharing on performance could be that the supply chain member firms share the least important information with their supply chain partners or that they withhold their importantly tacit information. This could be done to avoid the disruptive and negative effects of technologies, particularly e-collaboration, such as information hoarding, and losing business to their competitors. This is consistent with the findings of Vachon and Klassen (2007:299) which revealed that e-collaboration produces mixed outcomes on information sharing and performance. The mixed outcome could mean that the supply chain partners are sharing their information in an ineffective way such that the information received is not that useful performance wise.

The weaker path coefficient (0.28) could be indicative of the fact that although the supply chain member firms in South Africa have some e-collaboration tools that allow them to share strategic information; they never use them to collaborate with their supply chain partners. It could also be that the firms are partly collaborating with their partners such that the e-collaboration tools are not fully utilised to effectively share important information and improve their supply chain performance. This is consistent with the work of Rossouw and Binnekade (2013:4) who found that 46% of the

participated South African firms never or rarely collaborate with their supply chain partners; while 46% are partially managing to successfully collaborate.

More so, this is in agreement with the Supply Chain foresight (2015) report which reveals that 29% of the interviewed South African firms have aggressively embraced strategies to improve supplier-customer collaborations; 46% have partially embraced supply chain collaboration strategies; while 14% have plans to embrace supply chain collaboration. This makes the firms who do not collaborate to forfeit the benefits of using the e-collaboration tools to improve their firm and supply chain performance through sharing of tacit and important information. For the partly collaborating firms, it becomes difficult for the other supply chain partners to trust and commit their resources fully, when working with partly committed partners. In the end, the improvement made in terms of supply chain performance will be almost insignificant (weak).

Such weak results could also suggest that there is a lack of alignment in terms of the collaboration roles and incentives for the collaborating supply chain partners to share their important information with each other. In other words, where the roles of each supply chain partner is not aligned with the rewards for sharing information; the partners may not be willing to share their most important information. Thus, the partners may share the most basic information or not share their information at all, which in turn weaken the supply chain performance.

The weak positive influence of strategic information sharing on supply chain performance found in this study agrees with the theoretical reasoning of both the RV and the LKP theories. It suggests the presence of a mediation effect of strategic information sharing in the relationship between supply chain e-collaboration and supply chain performance. The RV theory specifically links knowledge routines to the generation of relational rents while the LKP suggests that creation and sharing of knowledge leads to collective learning (supply chain competence), which ultimately improves supply chain performance. The results of this study are also consistent with the empirical evidence from Sezen (2008) and Kocoglu *et al*. (2011), which found a positive relationship between information sharing and supply chain performance. **Therefore, this study validates and supports the hypothesis that strategic information sharing has a positive influence on supply chain performance (H_5);**

and rejects the null hypothesis $H0_5$, claiming a negative influence of strategic information sharing on supply chain performance.

- ***H_6: Supply chain competence has a positive influence on supply chain performance.***

Finally, the study posited that supply chain competence has a positive influence on supply chain performance. This hypothesis was formulated to ascertain the influence of supply chain competence on supply chain performance. The SEM results that validate or invalidate this hypothesis are shown in Figure 6.10 in pages above and Table 6.29, below.

Table 6.29: Hypothesis Six SEM Results

Variables	Path	Variables	Hypothesis	Path coefficient	Standard Error	Critical Region	P-Value
Supply chain competence	→	Supply Chain Performance	H_6	-0.08	0.072	-1.115	^{ns} 0.265

Structural model fits: χ^2/df=148.34; GFI=0.998; AGFI=0.977; RMR=0.003; NFI=0.999; RFI=0.994; IFI=0.994; TLI=1.000; CFI= 1.000; RMSEA=0.018. Note: ^{c} significance level - ***p-value<0.001, ^{b} significance level-**p-value<0.05, ^{a} significance level- *p-value<0.1, ^{ns} significant level- insignificant (p-value>0.1).

As noted from Figure 6.10 and Table 6.29, the results of the sixth path (H_2), supply chain competence has a weak negative (path coefficient of -0.08) and insignificant (^{ns} 0.265 or p-value greater than 0.1; t-value of -1.115) influence on supply chain performance.

The generally received wisdom is that a supply chain competence should improve the supply chain performance through the collective learning, which provides the supply chain a competitive edge against rivals working as individual firms. This study reports a negative influence, which means supply chain competence development constrains the performance of a supply chain. This is likely to be common where the collaborating partners in a supply chain are not fully committed because of lack of or insufficient incentives, which do not tally with their roles in the supply chain. In such cases, partners are hesitant or even unwilling to share their information because there are no rewards for doing so.

The negative result can also be explained by the existence of some opportunistic behaviour and lack of coordination among supply chain partners, which may hamper the effectiveness of sharing information among partners. This will in turn prevent the supply chain partners from learning collectively in a manner that creates a distinct supply chain competence. Ultimately, the performance of the entire supply chain is constrained due to the inability of partners to develop a unique, inimitable supply chain competence.

These findings fail to reveal the indirect positive influence of supply chain competence on supply chain performance through supply chain practice, supply chain e-collaboration and strategic information sharing. The findings are not in agreement with the theories used in this study and the empirical evidence that reports a positive influence. However, the findings agree with the suggestions of Rosenzweig (2009:471) that the benefits of e-collaboration in a supply chain cause greater improvement in terms of performance to smaller firms than larger ones. The argument here is that larger firms, despite the abundance of their resources, are partly hindered by their size to use technology effectively to their advantage and improve their performance.

In this study, a majority of the surveyed firms were large in terms of employment as well as turnover levels. In other words, it could be that the size of most firms by being large worked against them through information coordination problems. The supply chain collaborating firms end up failing to learn together as a supply chain because of the difficulties encountered in coordinating the shared information among each other. Thus, a weak supply chain competence may be created or no competence is created at all. This ultimately constrains the collaborating partners' supply chain performance.

To further clarify and mitigate the effects of the data analysis methods used, a regression analysis was performed. This was done with an aim of further ascertaining the influence of supply chain competence on supply chain performance. Given the negative path coefficient significantly closer to zero with no significance, this study using SEM results fails to validate and support the claims of H_6. **Therefore, this study invalidates and renders no support for H_6, thus the study do not reject $H0_6$, which claims that supply chain competence has a negative influence on supply chain performance.** Table 6.30, provides a summary of the SEM results.

Table 6.30: Summary of SEM Hypotheses Results

Variables	Path	Variables	Hypothesis	Path coefficient	Standard Error	Critical Region	P-Value
Intra-firm Supply Chain Practice	→	Supply Chain e-Collaboration	H_1	0.75	0.036	20.002	[c]***
Supply Chain e-Collaboration	→	Strategic Information Sharing	H_2	0.85	0.036	28.365	[c] ***
Supply Chain e-Collaboration	→	Supply chain competence	H_3	0.50	0.072	7.968	[c] ***
Strategic Information Sharing	→	Supply chain competence	H_4	0.34	0.059	5.387	[c] ***
Strategic Information Sharing	→	Supply Chain Performance	H_5	0.28	0.052	5.069	[c] ***
Supply chain competence	→	Supply Chain Performance	H_6	-0.08	0.072	-1.115	[ns] 0.265

Structural model fits: χ^2/df=148.34; GFI=0.998; AGFI=0.977; RMR=0.003; NFI=0.999; RFI=0.994; IFI=0.994; TLI=1.000; CFI= 1.000; RMSEA=0.018. Note: [c] significance level - ***p-value<0.001, [b] significance level-**p-value<0.05, [a] significance level- *p-value<0.1, [ns] significant level- insignificant (p-value>0.1).

Table 6.30, above, shows the 6 hypothesised linear relationships between intra-firm supply chain practice and supply chain e-collaboration (H_1); supply chain e-collaboration and strategic information sharing (H_2); supply chain e-collaboration and supply chain competence (H_3); strategic information sharing and supply chain competence (H_4); strategic information sharing and supply chain performance (H_5); and between supply chain competence and supply chain performance (H_6). Of these, 6 posited linear relationships, five (H_1, H_2, H_3, H_4 and H_5) were validated because they all had positive path coefficients and p-values less than 0.001 as well as t-values above the recommended value of 2.00. H_6 was the only hypothesis which was not supported and validated as it had a negative path coefficient significantly closer to zero and a p-value greater than 0.1 along with a t-value of less than -2.00. However, regression analysis was also performed to avoid making wrong conclusions especially on the claims of H_6. The next section provides a discussion of the regression analysis outcomes.

6.6. REGRESSION ANALYSIS

A regression analysis was performed to complement and confirm the SEM hypotheses testing results and the findings are presented on Table 6.31. The main aim of regression analysis was to avoid making wrong conclusions regarding the claims of the invalidated H_6. The next section provides a discussion of the regression analysis results.

Table 6.31: Regression Analysis Hypotheses Testing Results

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	Supply chain performance (CP) (Constant)	-.369	.120		-3.080	.002
	Supply chain practice (SCP)	.289	.091	.244	3.173	.002
	Supply chain e-collaboration (SCE)	.808	.072	.694	11.192	.000
	Strategic information sharing (SIS)	.204	.058	.202	3.514	.001
	Supply chain competence (SCC)	-.216	.081	-.206	-2.686	.008
a. Dependent Variable: Supply chain performance (CP)						

From Table 6.31, supply chain performance is the dependent variable predicted by intra-firm supply chain practice, e-collaboration, strategic information sharing. The first two results (intra-firm supply chain practice and e-collaboration) are not part of this study's objectives; as such no attention was paid to them. Table 6.31 shows a positive beta coefficient (0.202) for the relationship between strategic information sharing and supply chain performance. This beta coefficient is below the recommended threshold value of 0.5, and is consistent with the SEM results. The p-value is exactly 0.001 with a t-value of 3.514, which is above the acceptable value of 2.00. These findings suggest that strategic information sharing has a weak positive and significant influence on supply chain performance. Thus, based on these results, H_5 is also validated and supported and the null hypothesis, $H0_5$, claiming a negative influence of strategic information sharing on supply chain performance is rejected.

Table 6.31 also shows a negative beta coefficient of -0.206 for the relationship between supply chain competence and supply chain performance. The beta coefficient is below the acceptable threshold value of -0.5, which shows a weak negative influence of supply chain competence on supply chain performance. The results also show a t-value (2.686) above -2.00 and a p-value (0.008) less than 0.05. Thus, the regression analysis results for the hypothesis tests suggest that supply chain competence has a weak negative and significant influence on supply chain performance. This could mean that the supply chain member firms are not effectively utilising their supply chain e-collaboration tools to learn collectively and ultimately improve the performance of the entire supply chain.

As earlier noted in Chapter 3, collaboration levels differ, and in its very basic form it does not provide firms with a competitive edge over its rivals, instead it can make firms lose their business to their competitors, hence the negative influence on supply chain performance. These findings are not in agreement with theory but are consistent with the empirical evidence by Rosenzweig (2009:171). Rosenzweig (2009:471) found that the benefits of e-collaboration mostly improve the performance of smaller firms than larger ones, which are mostly hindered by their size in the effective use of e-collaboration tools. This makes some logical sense given that a majority of the firms surveyed in this study were larger firms: 73.2% using employment and 72.9% using turnover as a measure of firm size. In other words, the weak positive influence of supply chain competence on supply chain performance is because of the size of the larger firms acting as a hindrance, to using e-collaboration tools to collectively learn as a supply chain and ultimately enhance supply chain performance. **This study therefore fails to validate and support the claims of H_6, that supply chain competence has a positive influence on supply chain performance. Thus, the null hypothesis is not rejected and claims that supply chain competence has a negative influence on supply chain performance.**

6.7. CHAPTER SUMMARY

Chapter Six attended to six main issues, that is, descriptive analysis, principal component analysis, testing for measurement accuracy and checking for model fit in CFA. It also addressed the testing of the proposed hypotheses made using Structural Equation Modelling (SEM) and multiple regression analysis. Eventually, the SEM results were evaluated. Generally, the measurement items were found to be adequately acceptable and, therefore, reliable and valid. More so, the findings of the research model in this study show that the conceptualised model provides a good fit to the specified sample data.

The study investigated the influence of intra-firm supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. Of the posited six linear hypotheses, five (H_1, H_2, H_3, H_4 and H_5), were supported and validated, while H_6 was the only one not supported in this study. Both the SEM and regression analysis results showed that supply chain competence has a weak negative influence on supply chain performance (H_6). Thus the null hypothesis $H0_6$, claiming a negative influence of supply chain competence on supply chain performance was not rejected. The implications of these research findings and an overall conclusion as well as recommendations are provided in Chapter Seven.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1. INTRODUCTION

Empirical findings were presented and discussed in the previous chapter (Chapter 6). This chapter provides the definitive goal of every research study, which is, the theoretical and practical implications of the findings. The chapter commences by providing a reflection of how the study's objectives were achieved, and then gives the evaluation of the results' theoretical implications. Subsequently, the managerial implications and recommendations are suggested to supply chain firm owners/managers, researchers and policy makers. Finally, the chapter highlights some areas where more research work needs to be done in future (future research).

7.2. HOW THE OBJETIVES OF THE STUDY WERE AHIEVED

The scope of this research study covers all firm sizes, in all industries, across all sectors and in all the nine provinces of South Africa, since supply chains cut across every boundary. The main purpose of this study was to determine the influence of intra-firm supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance in South Africa. South Africa was targeted mainly because of its low adoption of supply chain management systems. As such, other countries that highly adopted supply chain management systems might have different experiences than South Africa (particurlarly in terms of the influence of intra-firm supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance). The anticipation is that the current study will make significant contributions towards the current body of literature on the topic by eliciting future research. It is also anticipated that the study will assist supply chain firm owners/managers and policy makers in understanding the benefits of adopting the best inter-firm practices such as e-collaboration and strategic information sharing in supply chains. The recommendations are expected to benefit the supply chain firm owners/managers, researchers as well as policy makers.

The research was undertaken using a supply chain management framework adapted from various models. The adapted framework constitutes five main variables; namely, intra-firm supply chain practice (SCP), supply chain e-collaboration (SCE), strategic information sharing (SIS), supply chain competence (SCC) and supply chain performance (CP). On one the hand, the RV theory was used to explain the relationship between supply chain practice and supply chain e-collaboration; supply chain e-collaboration, strategic information sharing and supply chain competence; strategic information sharing, supply chain competence and supply chain performance; as well as between supply chain competence and supply chain performance. On the other hand, the LKP theory was used to explain the relationship between strategic information sharing, supply chain competence and supply chain performance.

- Primarily, the purpose of this study was to investigate the influence of intra-firm supply chain practices on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. This was achieved through the achievement of the following secondary objectives.

- The current study sought to investigate the influence of intra-firm supply chain practice on supply chain e-collaboration among supply chain partners in South Africa. Theoretically, the influence of intra-firm supply chain practice on supply chain e-collaboration was discussed in Chapters 2, 3 and 4. The SEM empirical analysis in Chapter 6 shows that intra-firm supply chain practice has a strongly positive and highly significant influence on supply chain e-collaboration. Based on the above, the primary objective of this study was achieved. Therefore, this study concludes that Intra-firm supply chain practices such as the implementation of JIT production and inventory systems, supply chain planning and delivery practice can enhance the technology-enabled supply chain collaborations among supply chain partners.

- The study also aimed to determine the influence of supply chain e-collaboration on strategic information sharing among supply chain partners in South Africa. Theoretically, the influence of supply chain e-collaboration on strategic information sharing was discussed in Chapters 2, 3 and 4. The SEM empirical analysis in Chapter 6 shows a strongly positive and highly significant influence of

supply chain e-collaboration on strategic information sharing. Based on the above, the second objective of this study was achieved. Therefore, this study concludes that the successful development of supply chain e-collaboration relationships significantly and strongly positively influences the sharing of strategic information among supply chain partners.

- In addition, the research was also interested in ascertaining the influence of supply chain e-collaboration on the supply chain competence of supply chain partners in South Africa. Theoretically, the influence of supply chain e-collaboration on supply chain competence was discussed in Chapters 2, 3 and 4. The SEM empirical analysis in Chapter 6 shows that supply chain e-collaboration has a fairly positive and significant influence on supply chain competence. Based on the above, the third objective of this study was achieved. Therefore, this study concludes that the development of supply chain e-collaboration relationships among supply chain partners can promote collective learning among supply chain partners and create a supply chain competence.

- It also sought to determine the influence of strategic information sharing on supply chain competence of supply chain partners in South Africa. Theoretically, the influence of strategic information sharing on supply chain competence was discussed in Chapters 2, 3 and 4. The SEM empirical analysis in Chapter 6 shows a weak positive and significant influence of strategic information sharing on supply chain competence. Based on the above, the fourth objective of this study was achieved. Therefore, this study concludes that the sharing of strategic information among supply chain partners indirectly and positively influence supply chain competence development.

- It further aimed to examine the influence of strategic information sharing on the supply chain performance of supply chain partners in South Africa. Theoretically, the influence of strategic information sharing on supply chain performance was discussed in Chapters 2, 3 and 4. Both the SEM and multiple regression empirical analysis in Chapter 6 reveal that strategic information sharing has a weak positive and significant influence on supply chain performance. Based on the above, the fifth objective of this study was achieved. Therefore, this study concludes that the sharing of strategic information can, through complementing

other factors such as intra-firm supply chain practice; trust and e-collaboration indirectly enhance supply chain performance.

- Finally, the study sought to ascertain the influence of supply chain competence on supply chain performance of supply chain partners in South Africa. Theoretically, the influence of supply chain competence on supply chain performance was discussed in Chapters 2, 3 and 4. Both the SEM and multiple regression empirical analysis in Chapter 6 show that supply chain competence has a weak negative influence on supply chain performance. Based on the above, the sixth objective of this study was achieved. Therefore, this study concludes that supply chain competence has a weak negative indirect influence on supply chain performance.

7.3. THEORETICAL IMPLICATIONS

As alluded to previously, there is a dearth of literature on the influence of intra-firm supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. Indisputably, the study contributes to theory development for future studies. This study has created the theoretical groundwork for future empirical studies in the country. The main contribution to literature is the confirmation of hypotheses H_1, H_2, H_3, H_4 and H_5.

The study has established that supply chain collaborating firms in South Africa implement supply chain practices to enhance their supply chain e-collaborations with each other. It confirmed that the supply chain collaborating firms develop supply chain e-collaboration relationships to enhance the sharing of strategic information with each other. More so, it established that these firms develop supply chain e-collaboration relationships with their partners to create a supply chain competence. Moreover, it confirms that collaborating firms share their strategic information to indirectly develop a supply chain competence through collective learning. Lastly, the study established that collaborating firms indirectly improve their supply chain performance by sharing strategic information with each other.

The invalidation of H_6 can also assist scholars in formulating more research questions to try and understand the nature and factors that must be adopted by collaborating firms to improve their supply chain performance through supply chain

competence. In other words, scholars can now try to investigate the possible factors linearly related with supply chain performance through supply chain competence.

This study also suggests a new supply chain management conceptual model and managerial framework shown in Figure 7.1 and 7.2 below.

Figure 7.1: Proposed Supply Chain Management Conceptual Model

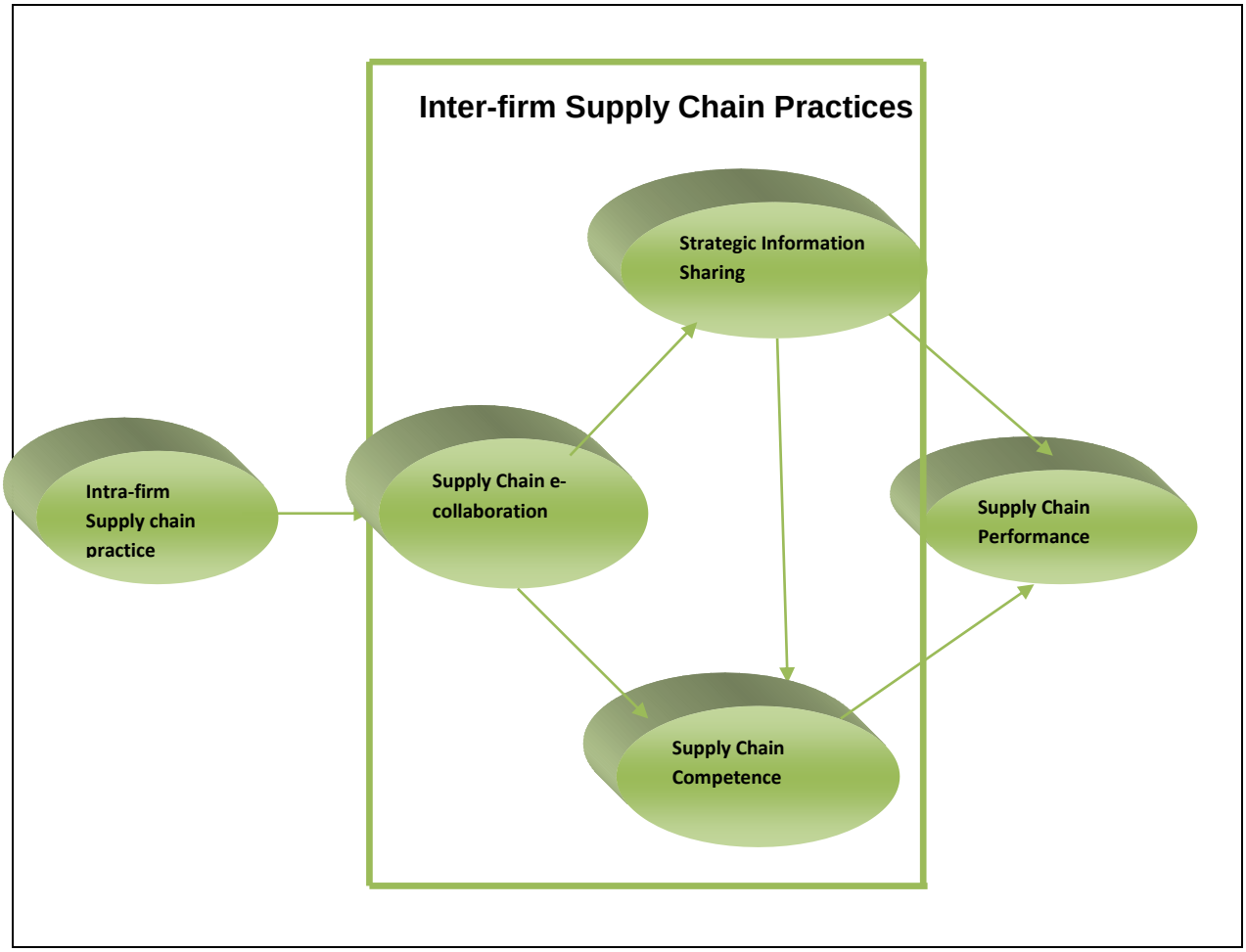
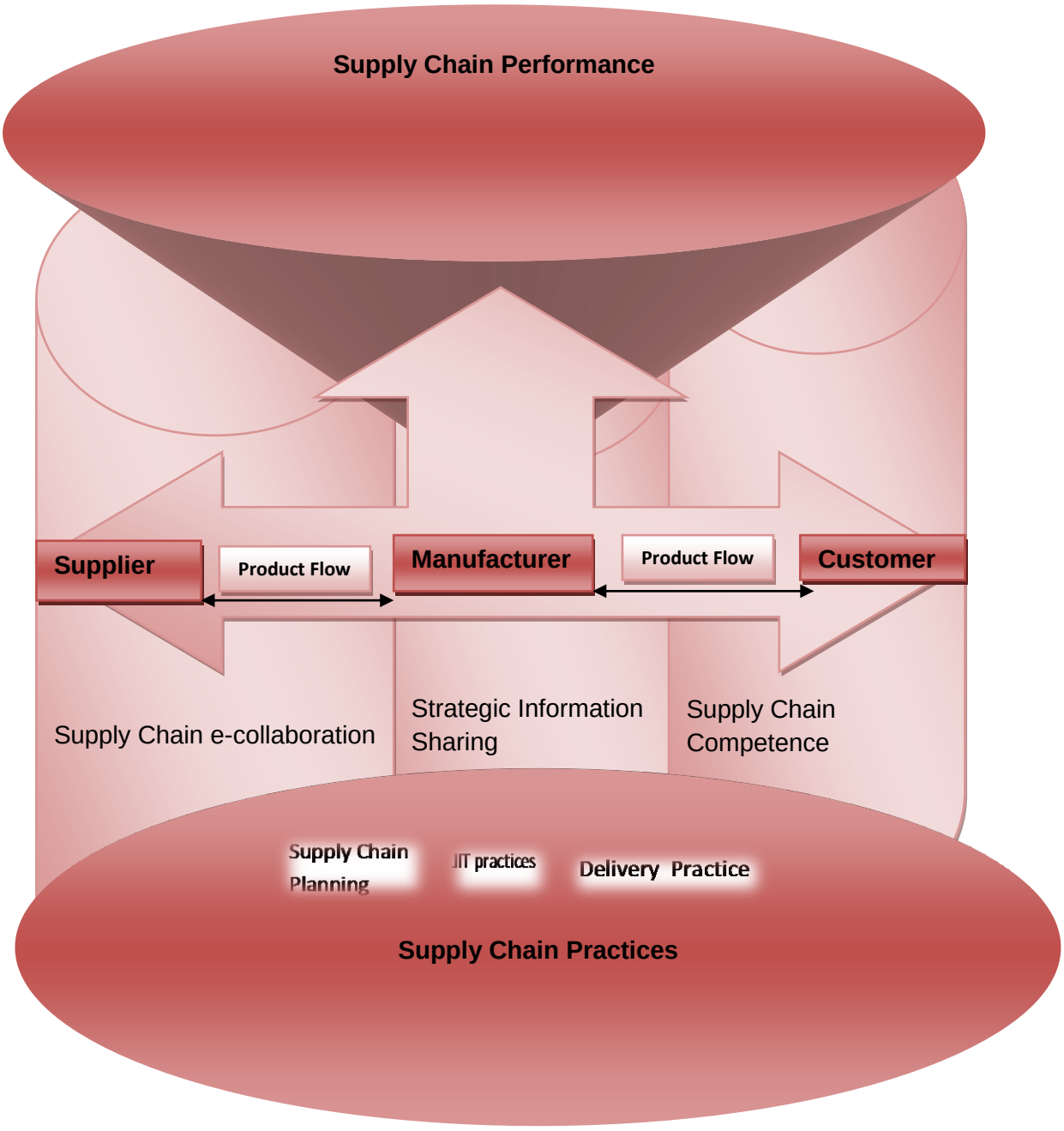


Figure 7.1 above shows the proposed supply chain management conceptual model suggested in this study. Since the SEM and multiple regression empirical analysis have tested and established the hypothesised linear relationships, this study proposes the above conceptual model for acceptance in research.

Figure 7.2: Proposed Supply Chain Management Implementation Framework



The current study identified the need to device a supply chain management model to help guide firms to formulate the most effective supply chain strategies or policies. This need was informed by the following: Firstly, the existing supply chain framework relevant to the current study, particularly by Lambert and Cooper (2000), was suggested about 15 years ago. A lot has happened in the supply chains between year 2000 and 2015, especially with technology advancements and globalisation shifting competition from being between individual firms to being between supply

chains. In other words, firms are forced to improve their supply chain efficiency and effectiveness in order to improve their individual business performance.

While Lambert and Cooper's supply chain management framework helps firms to gain understanding of supply chain management through its supply chain network structures and supply chain business processes and supply chain management components, it does not capture the drivers of supply chain performance. Secondly, their framework reveals information flow as the seal and ultimate outcome in supply chain management. The current study contends that, though information flow is a crucial issue in supply chain management, it can not be the ultimate goal in a supply chain. In light of the above, the current study suggests a new supply chain management model and managerial implementation framework to extend and complement Lambert and Cooper (2000)'s framework.

The new supply chain management implementation framework extends Lambert and Cooper (2000)'s framework in the sense that the supply chain network structures, supply chain business processes and supply chain management components still needs to be there. However, the new framework suggests the following implementation steps:

Step 1: Establish a supply chain management foundation

This stage requires that managers establish a strong foundation for the effective management of their supply chains. The foundation should consist of intra-firm supply chain practices particularly, supply chain planning, JIT production and inventory systems and delivery practices. Proper supply chain planning practices combined with JIT production practices, along with delivery practices can help firms to minimise supply chain costs and risks, and ultimately improve their supply chain performance.

Step 2: Anchor supply chain management on inter-firm practices

This stage requires managers to anchor the management of their supply chains on inter-firm supply chain practices such as suppy chain e-collaboration, sharing of strategic and tacit information, as well as developing a supply chain competence. In other words, this step encourages managers to support the foundation of their supply chain management by fully collaborating with their customers and suppliers through technology. By building e-collaborative relationships, trust and commitment will be

established for each other, which will make the firms to freely share their important and tacit information, in a mutually beneficial manner. This will inturn help the managers to create and cultivate a conducive environment that promotes collective learning in supply chains and enhance the creation of unique and inimitable supply chain competences.

Step 3: Maintain and improve supply chain management

This step requires managers to maintain effective supply chain management and improve it through supply chain performance. This can be done by ensuring that both the intra- and inter-firm supply chain practices are adopted and implemented effectively by all the supply chain partnering firms. Thus, managers can reduce supply chain costs and risks, as well as improve the performance of their entire supply chain, if they effectively follow these steps. The next section focuses on the practical implications of the study.

7.4. MANAGERIAL AND POLICY IMPLICATIONS

The identification and highlighting of practical implications to the supply chain collaborating firm owners/managers and policy makers are one of the fundamental goals of any theoretical business research. By virtue of it being a business research on the influence of intra-firm supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance, the current study highlights a number of practical implications. Most importantly, it highlights the relationships between intra-firm supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance among supply chain partners. Thus, the research study helps the owners/managers for the supply chain collaborating firms to gain a better understanding of the benefits of implementing intra-firm supply chain practices of supply chain planning, JIT production and inventory systems as well as the delivery practice, in terms of developing supply chain e-collaboration relationships.

A positive influence of intra-firm supply chain practice on supply chain e-collaboration was reported in this study. This encourages the supply chain collaborating firm owners/managers to implement supply chain practices like supply chain planning, JIT production and inventory systems as well as the delivery practices, in an attempt to develop strong supply chain e-collaboration relationships with each other. Effective

implementation of these intra-firm supply chain practices has the benefit of standardising the supply chain processes such as supply chain e-collaboration among supply chain partners. The standardisation is important as it helps reduce the uncertainties and protection risks associated with technology. Thus collaborating firms need to consider the supply chain practices for the standardisation of their inter- or intra- e-collaboration or e-collaboration with customers or suppliers.

However, a negative influence of intra-firm supply chain practice dissuades the supply chain member firms from developing supply chain e-collaboration relationships. This means that a negative influence causes negative returns on investments made on acquiring the supply chain e-collaboration technologies. For this reason, the current study assists supply chain member firms to make good investment decisions. This is vital as wrong investments can have long term negative effects on firms individually as well as their supply chain performance.

With rapid increase in the utilisation of advanced technologies in the contemporary business world, firm owners or supply chain/logistics/procurement/purchasing managers need to make informed decisions based on scientific research on the use of such technologies to establish supply chain e-collaboration relationships. The modern business world regards the use of advanced technologies such as extranets and satellites as being innovative and committed. These firm owners/managers can, be assisted in considering and weighing the benefits and costs of innovation, especially in relation to supply chain collaborations that lead to information sharing, creation of a supply chain competence and enhanced performance. Therefore, it is imperative that these firm owners/managers have a sound understanding of the benefits and limitations of supply chain e-collaboration tools.

This study can also help to dispel the fears of laggards with negative perceptions on the use of new and advanced supply chain collaboration technologies as well as the sharing of information with supply chain partners. Therefore it can help change the attitudes of such laggards as well as innovative firm owners/managers (especially the supply chain/logistics/procurement/purchasing managers).

The strong positive influence of supply chain e-collaboration on strategic information sharing will create positive attitudes towards the development of supply chain e-collaboration relationships; which involve sharing of important information among supply chain partners. The sharing of important information is a way to capture the

advantages or gain a competitive edge that comes through collective learning. Since these supply chain e-collaborations are standardised through the implementation of intra-firm supply chain practices, firms are able to control the information shared among their key supply chain partners. This will help reduce the costs and risks associated with information sharing, such as information hoarding, coordination issues as well as opportunistic behaviours.

The study has far-reaching effects on encouraging supply chain firm owners/managers to develop sustainable supply chain management models; as well as to efficiently and effectively drive their supply chain management processes. Both non-development and development of supply chain e-collaboration relationships has an influence on the efficiency and effectiveness of how firms achieve their objectives, since every firm seeks to be competitive, relevant and accessible. Therefore, non-development of supply chain e-collaboration relationships will entail the use of the conventional supply chain models; while development means making use of the new supply chain model that represents new and innovative ways of doing business. Firm owners/managers need to use the relevant supply chain management model to remain relevant and achieve their objectives.

A weak positive influence of strategic information sharing on supply chain competence was reported. This implies that the sharing of important information, if done through the correct structures and technologies, has the ability to create a unique competitive edge for the entire supply chain through collective learning. However, the collaborating firms need to consider factors such as balancing the bargaining power, aligning roles with incentives as well as developing strong trust before engaging in developing a supply chain competence. More so, it is imperative for these firm owners/managers to understand the two broad categories of supply chain competence, namely: quality and service, as well as design, operational and distributional effectiveness. This will help them know the type of information structures to develop given each dimension of supply chain competence. For instance, with the hub-and-spokes information sharing structures, firms can store, coordinate as well as communicate information and decisions; and develop both the quality and service competence; along with the design, operational and distributional effectiveness competence.

The study also reports a weak positive influence of strategic information sharing on supply chain performance. This means that firms can indirectly improve their supply chain performance by sharing information with their customers or suppliers. Clearly, firm owners/managers (supply chain/logistics/procurement/purchasing managers) should seek to achieve opportunities that improve supply chain performance. This can be done by exploiting opportunities to implement both effective supply chain practices, develop long-term supply chain e-collaboration relationships and effective information sharing that creates a supply chain competence.

The study also has strong implications on policy formulation by policy makers. In South Africa, government and quasi-government institutions formulate policies and strategies to improve the learning abilities and performance of entire supply chains in order to increase their economic contribution. Worldwide, supply chains are seen as the real drivers of competition, which achieve economic growth in terms of increasing the Gross Domestic Product (GDP) and solving the ever-increasing unemployment problem. This study provides a strong foundation to policy makers to formulate relevant policies.

The government and quasi-government organisations are interested in ensuring the growth and success of both large and small firms, mainly because they contribute immensely to the country's GDP, employment and poverty alleviation. These two types of policymakers need a sound understanding of supply chain practice and its influence on supply chain performance through supply chain e-collaboration, strategic information sharing and supply chain competence. This will help government and quasi-government agents formulate strategies and policies that can improve the supply chain performance of these firms and their supply chain's economic contribution.

The current study provides some empirical evidence for the government to consider when formulating supply chain management policies and strategies that are relevant and applicable to the South African context. The validation or invalidation of linear relationships between the five research variables can assist policy makers in formulating effective supply chain management policies and strategies. This will in turn mitigate the effects of the supply chain risks centred on technology use and the sharing of information.

7.5. RECOMMENDATIONS OF THE STUDY

Although the initial objective of the study was to determine the influence of intra-firm supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance, the ultimate goal is to formulate recommendations to improve the contribution of supply chains to the national economy. This can only be possible after determining the relationships between intra-firm supply chain practice, supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance. The recommendations are two-fold, and relate to recommendations made to supply chain collaborating firms as well as to policy makers (government and quasi-government agencies).

7.5.1. Recommendations to Collaborating Firm Owners/Managers

The results of this study indicate a strong positive influence of intra-firm supply chain practice on supply chain e-collaboration. The findings also report a positive influence of supply chain e-collaboration on strategic information sharing and supply chain competence. This means that supply chain collaborating firms can standardise their supply chain e-collaboration processes through the implementation of supply chain practices. This helps firms control the information shared, which in turn develops a supply chain competence. Thus, all firms regardless of size need to consider and prioritise the successful implementation of supply chain practice to enhance supply chain e-collaboration benefits. In line with these observations, the following suggestions are made to collaborating firm owners/managers:

7.5.1.1. Training and education

Supply chain partnering firms need to effectively implement their intra-firm supply chain practices of supply chain planning, JIT production and inventory systems, as well as delivery practice. This should be so because intra-firm supply chain practices play a major role in reducing the supply chain risks and costs through standardising supply chain processes. Given the role of intra-firm supply chain practice in supply chain management, there is therefore a need to train and educate all employees (from the least person to the top managers) on these intra-firm supply chain practices in order to improve effectiveness in their implementation. They also need to be trained and educated about supply chain processes such as supply chain e-

collaboration and strategic information sharing as well as their roles in supply chain management.

Employees, especially the supply chain/logistics/procurement/purchasing managers must enrol for supply chain management training workshops or courses. This training should emphasise the importance of supply chain practices, supply chain e-collaboration and strategic information sharing as the key drivers of supply chain competence and supply chain performance. This can help them to maximise the benefits of effectively implementing supply chain practices and the development of supply chain e-collaboration relationships. The training can also help firm owners/managers to fully understand the importance of sharing information in supply chain e-collaborations.

Supply chain e-collaboration tools cannot be successfully utilised with a leadership that lacks full understanding or that is not committed to the development of e-collaboration relationships. What normally happens is that the executive management vaguely defines the supply chain plan and intended supply chain e-collaboration tools to be used. This supply chain plan is then left to the information systems department to implement. These technologists have all the in-depth knowledge about the specific supply chain collaboration technologies required to meet the identified needs. However, the leadership (at the top) as the strategists come first and are required to have an understanding and appreciation of the importance of supply chain collaboration technologies in operation. Thus, executives must take responsibility for understanding the implications of up-and-coming technologies and anticipate when they can affect the supply chain management strategy.

7.5.1.2. Adoption of Advanced technologies and information sharing structures

Supply chain partnering firms ought to review and adopt the advanced collaboration technologies to keep abreast their key supply chain partners as well as with competition. The type of technologies that these firms invest in can hinder their ability to capture benefits from using advanced information sharing structures. For instance, firms with basic technologies such as computers, smart phones and Internet can only make use of the sequential and reciprocal information sharing structures. With sequential, information only flows in one direction while with reciprocal, information

flows in two directions from all the supply chain partners. With these structures of information sharing the common problems of information hoarding and opportunistic behaviour are likely to occur. This is because it will be hard to coordinate the shared information among supply chain partners.

Thus, firms are encouraged to invest in advanced technologies such as the extranets and satellites, which allow the use of advanced information sharing structures such as the hub-and-spokes. Examples of the successful implementation of the hub-and-spokes information sharing structures include the Carpentercare.com and Carpenterdirect.com used in Germany, which shares information with steel customers through extranet.

Supply chain collaborating firms in South Africa can also invest in extranet technologies and utilise the hub-and-spokes facility to share their important information with their key supply chain partners. This will ensure effectiveness in the sharing of information so that it creates a unique supply chain competence and improve supply chain performance.

7.5.1.3. Incentive alignment

Collaborating firms, as noted in Chapter 3, may be hesitant to share their strategic information with each other, especially where the risks and costs of sharing information is solely a burden of the disclosing supply chain partner. This tends to weaken the created supply chain competence as well as the supply chain performance. The empirical findings of this study indicated a weaker positive influence of strategic information sharing on supply chain performance and supply chain performance. This could mean that the supply chain partners have no incentive to share their information with the other supply chain partners since they are no clear mechanisms of considering costs, risks or profits. There is therefore a need for a mechanism that aligns the incentives to the roles for each supply chain partner.

Effective sharing of important information requires that supply chain partnering firms first agree on the strategic objectives and ways to motivate the partners to achieve each of these objectives. The supply chain partners also need to determine the type of activities and align them fairly to their associated rewards, so as to immediately offer recognition to each partner's effort. The supply chain collaborating firms can implement the following incentives: productive-behaviour based incentives, pay-for-

performance, and equitable compensation. The pay-for-performance requires that the supply chain partners set performance metrics to assess all the partners and reward them based on their activity outcomes. A typical example of this mechanism is the activity based costing (ABC), which can be used to align the partners work to benefits or costs/risks for sharing information. This mechanism will make supply chain partners increase their willingness to share information effectively with other partners due to the benefits to be received, or costs to be incurred. This will make the supply chain partners learn collectively, develop a supply chain competence and ultimately improve supply chain performance.

The sharing of information can also be enhanced through the implementation of equitable compensation mechanisms. The partners are required to jointly agree on a single set of performance metrics and have a universal profit sharing formula. Thus, with the equitable compensation mechanism, supply chain partners get to share all the risks, costs as well as benefits fairly, based on the evaluated actual performance of each partner. This also makes the supply chain partners more willing to effectively share their important information with each other. Effective sharing of information will then create a distinct supply chain competence. Ultimately, this will improve supply chain performance.

7.5.2. Recommendations to Policy Makers

Policy makers are generally responsible for creating a conducive environment for the success of all firms regardless of size. Good policies and strategies drive firms to success while poorly formulated policies and strategies spell doom and failure for the firms. As mentioned before, the findings show that the majority of firms are large in size. Therefore, poorly formulated policies and strategies lead to firms and their supply chains making an insignificant contribution to the national economy. The South African government and other governments worldwide are concerned with improving the growth and sustainability of firms, regardless of size. In line with the strong positive influence of intra-firm supply chain practice on supply chain e-collaboration established in this study, policy makers must formulate policies that encourage effective implementation of intra-firm supply chain practices as well as the development of supply chain e-collaboration relationships. The following recommendations are therefore proposed for policy makers to ensure and encourage

the implementation of intra-firm supply chain practices and develop supply chain e-collaboration relationships.

7.5.2.1. E-Business financing arrangement for e-collaborating firms

The government must create a technological fund for all firms, which would charge low interest rates mostly to SMEs and any other collaborating firms. This study reveals that of the surveyed firms, 26.7% are SMEs, which are known for problems associated with lack of access to finance. As such, the fund should be used specifically for the acquisition of supply chain e-collaboration technologies, which will make SMEs operate at the same level as the rest of their large supply chain partners. As noted in the previous sections, adopting advanced technologies such as extranets allows firms to share their information using better information sharing structures, especially the hub-and-spokes. In this study, only 3.9% of all the firms owned extranets, which means about 96% of the firms do not have use of extranets. This implies that a majority of these firms cannot capture the benefits of using effective information sharing structures of the hub-and-spokes for improved supply chain performance.

The major reason to this could be that of lack of funds, as advanced technologies require significant amounts of investment. The government, therefore, could introduce the finance arrangement to specifically target the extranets and satellites, which are not owned by most of the firms. Success stories of using government technology funds are recorded primarily in India, Brazil, Morocco, the Philippines, Ukraine and Vietnam. Specifically in India, the government fund on technology is known as India's National Venture Fund for Software and Information, while in Brazil the fund is called the Brazil's Inovar initiative.

7.5.2.2. Promoting synergies between collaborating SMEs and technological vendors

Policy makers can also encourage synergy between large technological vendor companies who sell supply chain solutions and SMEs along with any other e-collaborating firms. This is where the vendor companies can assist small enterprises in adopting supply chain e-collaboration technologies at lower costs. The technological companies such as the Supply chain Solutions and the Barloworld can also advise these SMEs to adopt the appropriate supply chain collaboration

technologies. The government can do this by providing tax benefits such as tax holidays to large technological firms. Through such synergies, firms will be able to collectively learn together and develop a supply chain competence, which in turn improves supply chain performance.

7.5.2.3. Ensuring affordability of supply chain e-collaboration technologies

High costs of supply chain e-collaboration technologies are a barrier to the adoption of these technologies. The government should implement direct intervention measures to reduce the price of these technologies through charging lower taxes and import duty on technological vendor companies. This can make the technology vendors to subsequently charge lower prices of e-collaboration technologies such as the extranets and satellites. The government can also enter into private-public partnerships with large technological corporations to supply supply chain e-collaboration technologies to all collaborating firms at lower prices. Thus, the government will in this partnership offer financial support while the private sector provide their technical expertise. The government can achieve this through its international developmental partners like World Bank and African Development Bank. These institutions can provide cheap finance that allows the government to subsidise the purchasing of supply chain e-collaboration technologies for all collaborating firms.

The negative influence of supply chain competence on supply chain performance can also assist in policy formulation. The government can use its financial resources efficiently without targeting these variables to improve the success of all supply chain collaborating firms. For the SMEs that seek to collaborate with their supply chain partners who might be large in size and with abundant resources; the government needs to assist SMEs by formulating a lending policy based on the empirical findings, as highlighted below:

- Accept loan applications that seek to improve supply chain competence through adopting supply chain e-collaboration technologies.
- Accept loan applications that seek to improve supply chain performance through the adoption of supply chain e-collaboration technologies.

7.6. RESEARCH LIMITATIONS AND AREAS FOR FUTURE RESEARCH

The study provides valuable contributions to both the development of theory and the provision of pioneering empirical evidence on the influence of intra-firm supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain competence in a developing African country, namely, South Africa. However, this study is not exempt from its own limitations, which may affect future research. To start with, the study of supply chains implies covering the entire country of South Africa, which is a broad scope and may be costly as well as timeous. However, the scope narrows down to firms that belong to the SAPICS in South Africa. In addition, SAPICS South Africa assisted with the data collection, which minimised the research costs.

The benefits of supply chain e-collaboration investments are said to materialise in the long term. As such, a long term study could have been conducted to capture the long term effect of supply chain e-collaboration among South African firms. However, future studies can make a replica of the study, to capture the long term effects of supply chain e-collaboration on strategic information sharing, supply chain competence and supply chain performance in South Africa.

More so, the current study reported a weak negative influence of supply chain competence on supply chain performance using both the SEM and multiple regression analysis. Clearly, the question of methodological problems is ruled out. Therefore, this study suggests that future studies investigate the other factors that influence supply chain competence besides strategic information sharing, with an ability to improve supply chain performance.

The empirical findings of this study also showed a weak positive influence of strategic information sharing on supply chain competence and performance. The implications suggested that it could be a question of the e-collaboration technologies used as well as the type of information sharing structures. Future studies can, thus, focus on the nature of e-collaboration technologies, the information sharing structures used and their influence on the quality and effectiveness of strategic information sharing. The studies can further link strategic information sharing to supply chain competence and supply chain performance.

7.7. SUMMARY

This chapter showed how the objectives of this study were achieved and provided the study's conclusions. It was concluded that: intra-firm supply chain practice has a strong positive influence on supply chain e-collaboration among supply chain partners in South Africa. In addition, the study concluded that supply chain e-collaboration has a strong positive influence on strategic information sharing as well as the supply chain competence of supply chain partners in South Africa. It also concluded that strategic information sharing has a weak positive indirect influence on supply chain competence and supply chain performance of supply chain partners in South Africa. The study further concluded that supply chain competence has a weak negative influence on supply chain performance of supply chain partners in South Africa. A conceptual model was proposed for research, while an implementation framework was suggested for supply chain management.

Theoretical as well as practical implications were highlighted with the intention that collaborating firm owners/managers and policy makers should benefit from the study. It recommended the following to the collaborating firm owners/managers: to train and educate all employees about the supply chain processes in order to enhance effective intra-firm supply chain practice implementation; to adopt advanced technologies and information sharing structures so as to enhance supply chain e-collaborations and effective information sharing among supply chain partners. Lastly, collaborating firms were encouraged to align their supply chain roles to incentives in order to enhance the effective sharing of strategic information, promote collective learning, develop a strong inimitable supply chain competence and ultimately improve supply chain performance.

The study also suggested areas to address the poorly formulated policies, and recommended that the government and quasi-governmental institutions: create a technological fund, encourage synergy between large technological firms and SMEs through tax benefits to the large firms. The government was urged to ensure the affordability of supply chain e-collaboration technologies to all the collaborating firms in South Africa. The study also recommended that the government should formulate a lending policy, which accepts loan applications from SMEs who aim to improve supply chain competence and performance through supply chain e-collaboration technologies. Future researchers were urged to investigate the long term influence of

supply chain practice on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance in South Africa and other African countries. The nature of supply chain e-collaboration technologies adopted as well as the information sharing structures used and their influence on information sharing, supply chain competence and performance also need to be investigated. The research findings must have implications on theory development and policy formulation. This chapter ensured the fulfilment of this ultimate goal.

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APPENDICES

APPENDIX A: COVER LETTER

Dear Respondent

04 February 2014

RE: COMPLETION OF QUESTIONNAIRE

I am a post graduate student at the Vaal University of Technology undertaking a Doctorate of Technology (D.Tech) in Business Logistics. My research topic is "The influence of supply chain practices on supply chain e-collaboration, strategic information sharing, supply chain competence and supply chain performance in South Africa."

A questionnaire has been prepared to gather information on supply chain member companies' supply chain practices, technology enabled supply chain collaboration, sharing of strategic information, supply chain competences and their overall supply chain performance within South Africa.

This cover letter serves as a kind request to you to complete the attached questionnaire. Your responses will be of great value to this research. Please be advised that you will remain unanimous and your feedback will be kept in utmost confidence. My promoter is Prof David Pooe (pooe@vut.ac.za) and co-promoter is Dr. Ken Mathu (kenmathu@yahoo.com)

YOUR VIEWS ARE VERY IMPORTANT TO ME!

Yours Sincerely

Hove Progress

Email address: 213125064@edu.vut.ac.za

APPENDIX B: QUESTIONNAIRE

Vaal University of Technology

Your world to a better future

VUT

QUESTIONNAIRE

Dear respondent, the Department of Logistics (Vaal University of Technology) is conducting a survey to investigate the influence of supply chain practices on supply chain e-collaborations, strategic information sharing, supply chain competence, supply chain performance in South Africa. Be informed that your cooperation and contributions in completing the questionnaire is greatly appreciated and valued. Your contributions will be held in confidence. Feel free to express yourself in the next 7 to 10minutes.

Name: Progress Hove. Email: 213125064@edu.vut.ac.za

Signature: .....

SECTION A: PERSONAL INFORMATION*(Put an X on the appropriate block)*

A1. Gender

Female	Male
1	2

A2. Education

High School	Diploma	Degree
1	2	3

A3. Race

Black	Indian	White	Coloured	Other(specify)
1	2	3	4	5

A4. Number of employees

5 or less	6-10	11-20	21-50	51 or above
1	2	3	4	5

A5. Amount of money from sales per year in Rands (R) in thousands (T) or millions (M):

Less than R1 million	R1m- R5 m	R5,1m-R10m	R10,1m -R20	Above R20m

1	2	3	4	5

A6. The number of years in business since start up:

2years or less	3-5years	6-10years	11-20years	21years or above
1	2	3	4	5

A7. What business are you in?

Manufacturing	Retailing	Wholesaling	Construction	Mining	Tourism	Agriculture	Financial
1	2	3	4	5	6	7	8

A8.Do you own any of the following marketing technology devices? (*Select by marking with an X on the block with the devices you own):*

Computers	Smart phones	Internet	Satellite	Other(specify)
1	2	3	4	5

SECTION B: IMPLEMENTATION OF SUPPLY CHAIN PRACTICES

Please circle the level of agreement on each of the items below based on the situation of your company. To what extent have the following planning practices been implemented in your company [1 = not implemented, 2 = less implemented, 3 = equally implemented, 4 = well implemented, 5 = extensively implemented]. There is no right or wrong response, the question asks for your opinion.

	Implementation of planning practices	**Responses of respondents**				
1	We use of historical data in the development of forecasts.	1	2	3	4	5
2	We have implemented a "What-if" analysis for supply/demand balancing.	1	2	3	4	5
3	A change in our demand information instantaneously ''reconfigures'' the production and supply plans.	1	2	3	4	5
4	We use online visibility for our supply-chain demand requirements	1	2	3	4	5
5	We assign a supply chain planning team	1	2	3	4	5
6	We involve marketing and manufacturing functions in supply chain planning process.	1	2	3	4	5
	Implementation of Production Practices	**Responses of respondents**				
7	We implement a pull operating system that coordinates work only upon authorisation from another downstream user in the system.	1	2	3	4	5
8	We implement a cellular manufacturing system for processing any products parts, jobs or components that follow same processing steps.	1	2	3	4	5
9	We have a cycle time reduction system that requires us to reduce our inventory levels through our purchase order quantities and production lot sizes.	1	2	3	4	5

10	We use an agile manufacturing strategy to allow our production systems to cope with rapid changes in demand.	1	2	3	4	5
11	We implement a bottleneck/constraint removal system to balance our resources and maximise production output.	1	2	3	4	5
	Practice of Delivery Practices	**Responses of respondents**				
12	We deliver products to our major customer on a just-in-time basis.	1	2	3	4	5
13	We have a single point of contact for all order inquiries.	1	2	3	4	5
14	We have real time visibilities of order tracking.	1	2	3	4	5
15	We consolidate orders by customers, sources, carriers, etc.	1	2	3	4	5
16	We use automatic identification during the delivery process to track order status.	1	2	3	4	5

SECTION C: SUPPLY CHAIN e-COLLABORATION

Please circle the level of agreement on each of the items below based on the situation of your company. There is no right or wrong response, the question asks for your opinion.

1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

	e-Collaboration with Suppliers	**Responses of respondents**				
17	The level of information exchange with our suppliers through internet is very high.	1	2	3	4	5
18	The participation level of our suppliers in the process of electronic procurement is very high.	1	2	3	4	5
19	The participation level of our suppliers in the process of production is very high.	1	2	3	4	5
20	The speed of ordering system to procure materials is very high in our company due because of technology.	1	2	3	4	5
21	We help our suppliers through technology with improving their processes to better meet our company needs.	1	2	3	4	5
22	We involve our key suppliers in continuous improvement programs.	1	2	3	4	5
	Internal e-Collaboration	**Responses of respondents**				
23	We have technology-enabled data integration among our company's internal functions	1	2	3	4	5
24	We use real-time searching of the level of inventory in our company	1	2	3	4	5
25	We implement data integration in production process of our company.	1	2	3	4	5
26	We do integrative inventory management in our company.	1	2	3	4	5
27	We use periodic inter-departmental meetings among internal functions in our company via the internet.	1	2	3	4	5
28	We use cross functional teams in our company to improve process.	1	2	3	4	5

	e-Collaboration with customers	Responses of respondents				
30	We often use the primary Business-to-Business market space to facilitate the collaborative product design with our primary customer today.	1	2	3	4	5
31	We often use the primary Business-to-Business market space to facilitate the Collaborative forecasting/production planning with our primary customer today.	1	2	3	4	5
32	We often use the primary Business-to-Business market space to facilitate the logistics planning with our primary customer today.	1	2	3	4	5
30	We frequently follow-up with customers for feedback.	1	2	3	4	5
31	The level of computerisation for customer ordering in our company is very high.	1	2	3	4	5
32	The level of organic linkage with our customers through internet is very high.	1	2	3	4	5
33	We frequently have periodical contacts with our customers via the internet.	1	2	3	4	5

SECTION D: STRATEGIC INFORMATION SHARING

Please circle the level of agreement on each of the items below based on the situation of your company. There is no right or wrong response, the question asks for your opinion.

1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

	Strategic Information Sharing with Suppliers	Responses of respondents				
34	Technology-enabled supply chain collaborations make our company to provide our suppliers with the demand forecast information.	1	2	3	4	5
35	Our company and our suppliers share their capacity planning information because of the technology enabled supply chain collaborations.	1	2	3	4	5
36	Our company can easily monitor the status of its orders due to the technology enabled supply chain collaborations.	1	2	3	4	5
37	Our company can easily find information about the suppliers' products and prices because of the supply chain e-collaborations.	1	2	3	4	5
38	Supply chain e-collaborations make our company to share its production plans with suppliers.	1	2	3	4	5
	Strategic Information Sharing with Customers	**Responses of respondents**				
39	Our customers provide us with the demand forecast information because of e-collaboration in our supply chain	1	2	3	4	5
40	Our customers share their production plans with us because of e-collaboration in our supply chain.	1	2	3	4	5
41	Our customers can easily monitor the status of their orders due to e-collaboration in our supply chain.	1	2	3	4	5
42	Our firm and its customers share their capacity planning information with the help of technology	1	2	3	4	5

	used in our supply chain collaborations.					
43	E-collaboration in our supply chain makes our customers to share their long term plans with us.	1	2	3	4	5

SECTION D: SUPPLY CHAIN COMPETENCE

Please circle the level of agreement on each of the items below based on the situation of your company. There is no right or wrong response, the question asks for your opinion.

1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

	Quality and Service	**Responses of respondents**				
44	Our company has the ability to fill orders with improved accuracy because of sharing of strategic information between supply chain members	1	2	3	4	5
45	Our company has the ability to forecast sales with greater accuracy because of the shared information among supply chain members.	1	2	3	4	5
46	Our company has the ability to issue advanced notices on shipping delays due to the culture of sharing strategic information within our supply chain collaborations.	1	2	3	4	5
47	Strategic information sharing makes our company to have the ability to respond to a request in a timely manner.	1	2	3	4	5
48	E-collaboration in our supply chain gives our company the ability to produce high quality products.; the ability to deliver high-quality services	1	2	3	4	5
49	E-collaboration in our supply chain gives our company the ability to deliver high-quality services.	1	2	3	4	5
50	E-collaboration and information sharing enables our company to respond to the needs of key customers.	1	2	3	4	5
51	E-collaborations with key suppliers and sharing information with them gives our company the ability to work with our key suppliers.	1	2	3	4	5
	Operations and distribution	**Responses of respondents**				
52	E-collaborations in our supply chain give our company the ability to manage supply chain inventory.	1	2	3	4	5
53	Sharing strategic information in our supply chain gives our company the ability to meet a promised delivery date.	1	2	3	4	5
54	Sharing strategic information in our supply chain gives our company the ability to enhance our supply chain's position in terms of integrity	1	2	3	4	5
	Design Effectiveness	**Responses of respondents**				

55	E-collaborations in our supply chain give our company the ability to design low-pollution production process.	1	2	3	4	5
56	E-collaborations and sharing of strategic information in our supply chain gives our company the ability to design low-pollution delivering process.	1	2	3	4	5
57	E-collaborations and sharing of strategic information in our supply chain has the abilityto enhance our supply chain's position in terms of social responsibility.	1	2	3	4	5

SECTION D: SUPPLY CHAIN PERFORMANCE

Please circle the level of agreement on each of the items below based on the situation of your company. There is no right or wrong response, the question asks for your opinion.

1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

	Flexibility performance	**Responses of respondents**				
58	Our supply chain has the ability to respond to and accommodate demand variations, such as seasonality.	1	2	3	4	5
59	Our supply chain has the ability to respond to and accommodate periods of poor manufacturing performance (machine break downs).	1	2	3	4	5
60	Our supply chain has the ability to respond to and accommodate periods of poor supplier performance	1	2	3	4	5
61	Our supply chain has the ability to respond to and accommodate periods of poor delivery performance.	1	2	3	4	5
62	Supply chain competence gives our supply chain the ability to respond to and accommodate new products, new markets, or new competitors.	1	2	3	4	5
	Resource Performance	**Responses of respondents**				
63	Supply chain competence has reduced the total cost of resources used in our supply chain as a whole.	1	2	3	4	5
64	Supply chain competence and sharing of strategic information has reduced the total cost of distribution, including transportation and handling costs	1	2	3	4	5
65	Sharing of strategic information and our supply chain competence has reduced the total cost of manufacturing, including labor, maintenance and re-work costs.	1	2	3	4	5
66	Strategic information sharing has reduced the costs associated with holding inventory in our entire supply chain.	1	2	3	4	5
67	Supply competence and sharing strategic information has increased our entire supply chain's return on investments.	1	2	3	4	5

	Output Performance	Responses of respondents				
68	Strategic information sharing has increased our overall supply chain sales.	1	2	3	4	5
69	Strategic information sharing has improved our overall supply chain order fill rate.	1	2	3	4	5
70	Strategic information sharing has increased our overall supply chain on-time deliveries.	1	2	3	4	5
71	Strategic information sharing has increased our overall supply chain customer response time.	1	2	3	4	5
72	Strategic information sharing has reduced our supply chain shipping errors	1	2	3	4	5
73	Strategic information sharing has reduced our supply chain manufacturing lead time.	1	2	3	4	5
74	Strategic information sharing has reduced our overall supply chain customer complaints.	1	2	3	4	5

Thank you for your cooperation

APPENDIX C: DATA ANALYSIS TABLES AND FIGURES

CFA TABLES: Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	22	84,843	23	,000	3,689
Saturated model	45	,000	0		
Independence model	9	1504,307	36	,000	41,786

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	,063	,947	,896	,484
Saturated model	,000	1,000		
Independence model	,502	,362	,202	,289

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	,944	,912	,958	,934	,958
Saturated model	1,000		1,000		1,000
Independence model	,000	,000	,000	,000	,000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	,639	,603	,612
Saturated model	,000	,000	,000
Independence model	1,000	,000	,000

NCP

Model	NCP	LO 90	HI 90
Default model	61,843	37,373	93,895
Saturated model	,000	,000	,000
Independence model	1468,307	1345,123	1598,864

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	,266	,194	,117	,294
Saturated model	,000	,000	,000	,000
Independence model	4,716	4,603	4,217	5,012

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	,092	,071	,113	,001
Independence model	,358	,342	,373	,000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	128,843	130,267	211,746	233,746
Saturated model	90,000	92,913	259,574	304,574
Independence model	1522,307	1522,889	1556,222	1565,222

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	,404	,327	,504	,408
Saturated model	,282	,282	,282	,291
Independence model	4,772	4,386	5,181	4,774

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	133	157
Independence model	11	13

Estimates (Group number 1 - Default model)

Scalar Estimates (Group number 1 - Default model)

Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
SCE18	<---	Supplychainecollaboration	,517	,049	10,464	***	
SCE4	<---	Supplychainecollaboration	1,000				
SIS1	<---	strategicinformationsharing	1,000				
SIS5	<---	strategicinformationsharing	1,091	,099	11,044	***	
SCC14	<---	Supplychaincompetence	,870	,071	12,187	***	
SCC12	<---	Supplychaincompetence	1,000				
SCC8	<---	Supplychaincompetence	1,212	,066	18,387	***	
CP10	<---	Supplychainperformance	,626	,049	12,861	***	
CP9	<---	Supplychainperformance	,426	,058	7,340	***	
CP5	<---	Supplychainperformance	1,000				
SIS10	<---	strategicinformationsharing	,984	,109	9,035	***	
SCE19	<---	Supplychainecollaboration	,505	,058	8,756	***	
SCP10	<---	Supplychainepractice	1,000				
SCP9	<---	Supplychainepractice	1,234	,054	22,650	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
SCE18	<---	Supply chain e-collaboration	,544
SCE4	<---	supply chain e-collaboration	,979
SIS1	<---	Strategic information sharing	,730
SIS5	<---	Strategic information sharing	,701
SCC14	<---	Supply chain competence	,678
SCC12	<---	Supply chain competence	,775
SCC8	<---	Supply chain competence	,938
CP10	<---	Supply chain performance	,630
CP9	<---	Supply chain performance	,421
CP5	<---	Supply chain performance	,995
SIS10	<---	Strategic information sharing	,666
SCE19	<---	Supply chain e-collaboration	,474
SCP10	<---	Supply chain practice	,846
SCP9	<---	Supply chain practice	,952

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Strategic information sharing	<-->	Supply chain e-collaboration	,614	,071	8,595	***	
Supply chain e-collaboration	<-->	Supply chain competence	,305	,057	5,393	***	
Strategic information sharing	<-->	Supply chain competence	,372	,049	7,545	***	
Supply chain competence	<-->	Supply chain performance	,219	,054	4,066	***	
Strategic information sharing	<-->	Supply chain performance	,570	,069	8,297	***	
Supply chain e-collaboration	<-->	Supply chain performance	1,175	,103	11,464	***	
Supply chain e-collaboration	<-->	Supply chain practice	,311	,058	5,334	***	
Supply chain competence	<-->	Supply chain practice	,566	,060	9,488	***	
Strategic information sharing	<-->	Supply chain practice	,348	,048	7,233	***	
Supply chain performance	<-->	Supply chain practice	,253	,056	4,492	***	
e68	<-->	e69	,406	,059	6,834	***	
e37	<-->	e46	-,194	,040	-4,865	***	
e35	<-->	e36	,274	,058	4,768	***	
e69	<-->	e73	-,009	,022	-,396	,692	

Correlations: (Group number 1 - Default model)

			Estimate
strategicinformationsharing	<-->	Supplychainecollaboration	,790
supplychainecollaboration	<-->	Supplychaincompetence	,376
strategicinformationsharing	<-->	Supplychaincompetence	,722
supplychaincompetence	<-->	Supplychainperformance	,268
strategicinformationsharing	<-->	Supplychainperformance	,730
supplychainecollaboration	<-->	Supplychainperformance	,956
supplychainecollaboration	<-->	Supplychainepractice	,362
supplychaincompetence	<-->	Supplychainepractice	,993
strategicinformationsharing	<-->	Supplychainepractice	,638
supplychainperformance	<-->	Supplychainepractice	,294
e68	<-->	e69	,464
e37	<-->	e46	-,381
e35	<-->	e36	,300
e69	<-->	e73	-,073

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
Strategic information sharing	,494	,075	6,573	***	
Supply chain e-collaboration	1,224	,113	10,855	***	
Supply chain competence	,539	,070	7,698	***	
Supply chain performance	1,235	,110	11,230	***	
Supply chain practice	,602	,069	8,769	***	
e21	,053	,035	1,494	,135	
e35	,777	,066	11,744	***	
e37	,432	,047	9,164	***	
e41	,609	,058	10,444	***	
e54	,108	,016	6,601	***	
e60	,479	,042	11,530	***	
e58	,359	,032	11,203	***	
e68	,733	,063	11,645	***	
e69	1,044	,090	11,638	***	
e73	,013	,033	,410	,681	
e46	,599	,060	9,970	***	
e36	1,078	,091	11,793	***	
e49	,239	,023	10,452	***	
e50	,094	,018	5,106	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
SCP9	,907
SCP10	,716
SCE19	,225
SIS10	,444
CP5	,989
CP9	,177
CP10	,397
SCC12	,600
SCC14	,460
SCC8	,880
SIS5	,491
SIS1	,533
SCE18	,296
SCE4	,959

Matrices (Group number 1 - Default model)

Residual Covariances (Group number 1 - Default model)

	SCP9	SCP10	SCE19	SIS10	CP5	CP9	CP10	SCC12	SCC14	SCC8	SIS5	SIS1	SCE18	SCE4
SCP9	,000													
SCP10	,000	,000												
SCE19	-,106	-,028	,000											
SIS10	,099	,116	-,001	,000										
CP5	-,009	,015	,020	-,142	,000									
CP9	,187	,241	,273	,025	,000	,000								
CP10	,134	,211	,247	,126	,000	,000	,000							
SCC12	-,029	,010	-,085	,119	,010	,129	,184	,000						
SCC14	-,027	,090	-,173	,059	,025	,141	,100	,102	,000					
SCC8	,008	-,005	-,096	,114	-,011	,197	,175	-,008	-,014	,000				
SIS5	,000	,032	,096	,051	-,061	,222	,245	,082	-,009	,037	,000			
SIS1	-,103	-,029	,147	,000	,137	,073	,112	-,057	-,044	-,127	-,040	,000		
SCE18	,029	,061	,000	,000	-,036	-,020	,136	,084	,027	,074	,130	,110	,000	
SCE4	-,021	,067	-,010	-,130	,001	,008	,001	,033	,021	-,012	-,055	,121	,006	,000

Standardized Residual Covariances (Group number 1 - Default model)

	SCP 9	SCP 10	SCE 19	SIS 10	CP 5	CP 9	CP 10	SCC 12	SCC 14	SCC 8	SIS 5	SIS 1	SCE 18	SC E4
SCP 9	,000													
SCP 10	,000	,000												
SCE 19	-1,478	-,432	,000											
SIS10	1,476	1,931	-,010	,000										
CP5	-,128	,237	,227	-1,849	,000									
CP9	2,751	3,903	3,400	,348	,000	,000								
CP10	2,008	3,461	3,078	1,766	,000	,000	,000							
SCC 12	-,414	,165	-1,267	1,908	,156	2,032	2,937	,000						
SCC 14	-,410	1,514	-2,600	,967	,400	2,232	1,612	1,700	,000					
SCC 8	,102	-,071	-1,422	1,777	-,165	3,080	2,778	-,115	-,217	,000				
SIS5	,007	,502	1,208	,679	-,745	2,969	3,257	1,235	-,138	,546	,000			
SIS1	-1,630	-,515	2,096	,000	1,900	1,100	1,681	-,975	-,762	-2,099	-,564	,000		
SCE 18	,446	1,055	,000	-,003	-,456	-,277	1,874	1,406	,453	1,221	1,828	1,739	,000	
SCE 4	-,291	1,042	-,111	-1,658	,005	,097	,007	,495	,319	-,176	-,660	1,633	,073	,000

SCALE RELIABILITY CHECK

SUPPLY CHAIN PRACTICE RELIABILITY CHECK

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.886	.889	14

Item Statistics

	Mean	Std. Deviation	N
SCP1	3.7906	1.07548	320
SCP2	3.3875	1.25440	320
SCP4	3.5938	1.30731	320
SCP5	3.5000	1.21382	320
SCP6	3.8625	1.06519	320
SCP8	3.2938	1.23986	320
SCP9	3.8750	1.17311	320
SCP10	4.0250	1.05611	320
SCP11	3.9000	1.08971	320
SCP12	4.1063	.90000	320
SCP13	3.9875	1.04739	320
SCP14	4.0719	.97516	320
SCP15	3.9875	.87807	320
SCP16	3.4969	1.17176	320

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.777	3.294	4.106	.813	1.247	.073	14
Item Variances	1.233	.771	1.709	.938	2.217	.081	14
Inter-Item Covariances	.441	.078	.995	.917	12.695	.036	14
Inter-Item Correlations	.364	.074	.736	.662	10.005	.022	14

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
SCP1	49.0875	85.811	.532	.411	.880
SCP2	49.4906	84.759	.487	.522	.883
SCP4	49.2844	82.505	.563	.552	.879
SCP5	49.3781	86.581	.421	.339	.886
SCP6	49.0156	84.862	.590	.463	.877
SCP8	49.5844	81.811	.634	.511	.875
SCP9	49.0031	80.467	.747	.685	.869
SCP10	48.8531	84.665	.607	.599	.877
SCP11	48.9781	82.460	.704	.707	.872
SCP12	48.7719	86.992	.582	.528	.878
SCP13	48.8906	85.910	.544	.520	.879
SCP14	48.8063	86.100	.581	.549	.878
SCP15	48.8906	88.543	.500	.480	.882
SCP16	49.3813	86.694	.436	.358	.885

SUPPLY CHAIN E-COLLABORATION RELIABILITY CHECK

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.904	.903	19

Item Statistics

	Mean	Std. Deviation	N
SCE1	3.6625	1.13859	320
SCE2	3.3500	1.25795	320
SCE3	3.6469	1.09301	320
SCE4	3.6938	1.16907	320
SCE5	3.7688	1.00919	320
SCE6	3.9844	.95169	320
SCE7	3.6750	1.10598	320
SCE8	3.5313	1.20824	320
SCE9	3.6063	1.11753	320
SCE10	3.4063	1.19191	320
SCE11	3.3594	1.04097	320
SCE12	4.0469	.96376	320
SCE13	3.9938	1.00779	320
SCE14	3.9844	1.02159	320
SCE15	4.0313	.96602	320
SCE16	3.9844	.94175	320
SCE17	3.6656	1.11026	320
SCE18	3.6406	1.10239	320
SCE19	3.3219	1.21620	320

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.703	3.322	4.047	.725	1.218	.060	19
Item Variances	1.186	.887	1.582	.696	1.784	.045	19
Inter-Item Covariances	.392	.002	1.389	1.386	555.859	.048	19
Inter-Item Correlations	.329	.003	.908	.905	359.937	.029	19

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
SCE1	66.6906	137.882	.647	.877	.896
SCE2	67.0031	137.865	.576	.896	.898
SCE3	66.7063	139.337	.618	.614	.897
SCE4	66.6594	134.990	.740	.701	.893
SCE5	66.5844	141.197	.594	.527	.897
SCE6	66.3688	147.174	.363	.408	.903
SCE7	66.6781	140.068	.580	.440	.898
SCE8	66.8219	141.852	.457	.405	.902
SCE9	66.7469	137.318	.683	.618	.895
SCE10	66.9469	138.822	.578	.598	.898
SCE11	66.9938	143.781	.465	.457	.901
SCE12	66.3063	144.545	.474	.527	.901
SCE13	66.3594	142.175	.552	.695	.899
SCE14	66.3688	143.770	.476	.725	.901
SCE15	66.3219	144.921	.456	.686	.901
SCE16	66.3688	145.726	.433	.560	.902
SCE17	66.6875	143.607	.437	.386	.902
SCE18	66.7125	138.243	.656	.873	.896
SCE19	67.0313	139.209	.550	.899	.899

STRATEGIC INFORMATION SHARING RELIABILITY CHECK

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.875	.873	9

Item Statistics

	Mean	Std. Deviation	N
SIS1	3.6938	1.07404	320
SIS3	3.6781	1.07091	320
SIS4	3.9125	1.01331	320
SIS5	3.5188	1.19546	320
SIS6	3.5125	1.15282	320
SIS7	3.5313	1.18201	320
SIS8	3.3563	1.18954	320
SIS9	3.3063	1.06525	320
SIS10	3.6625	1.14955	320

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.575	3.306	3.913	.606	1.183	.034	9
Item Variances	1.262	1.027	1.429	.402	1.392	.022	9
Inter-Item Covariances	.551	.180	1.020	.840	5.652	.038	9
Inter-Item Correlations	.432	.167	.726	.558	4.339	.018	9

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
SIS1	28.4781	42.896	.498	.349	.871
SIS3	28.4938	41.216	.632	.465	.860
SIS4	28.2594	44.726	.391	.227	.879
SIS5	28.6531	39.118	.703	.539	.853
SIS6	28.6594	40.677	.616	.475	.861
SIS7	28.6406	38.657	.749	.657	.849
SIS8	28.8156	39.304	.693	.622	.854
SIS9	28.8656	41.364	.625	.503	.861
SIS10	28.5094	40.802	.608	.415	.862

SUPPLY CHAIN COMPETENCE RELIABILITY CHECK

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.909	.914	14

Item Statistics

	Mean	Std. Deviation	N
SCC1	3.4188	1.19283	320
SCC2	3.0125	1.18500	320
SCC3	3.5844	1.31750	320
SCC4	3.3938	1.21947	320
SCC5	3.8344	1.10033	320
SCC6	3.0875	1.20025	320
SCC7	3.4969	1.16640	320
SCC8	4.0031	1.06379	320
SCC9	4.0000	1.05937	320
SCC10	4.0469	.95723	320
SCC11	4.0125	.96968	320
SCC12	3.9156	1.08383	320
SCC13	3.9938	.99527	320
SCC14	3.8125	1.05455	320

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.687	3.013	4.047	1.034	1.343	.126	14
Item Variances	1.246	.916	1.736	.820	1.894	.056	14
Inter-Item Covariances	.518	.178	.999	.821	5.610	.035	14
Inter-Item Correlations	.430	.157	.799	.642	5.087	.032	14

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
SCC1	48.1938	97.918	.528	.537	.906
SCC2	48.6000	100.517	.416	.341	.910
SCC3	48.0281	95.432	.569	.587	.905
SCC4	48.2188	97.112	.550	.457	.905
SCC5	47.7781	96.211	.667	.505	.900
SCC6	48.5250	101.003	.388	.311	.912
SCC7	48.1156	96.617	.603	.558	.903
SCC8	47.6094	95.085	.752	.734	.897
SCC9	47.6125	95.153	.752	.773	.897
SCC10	47.5656	97.808	.691	.689	.900
SCC11	47.6000	96.642	.746	.797	.898
SCC12	47.6969	95.623	.708	.772	.899
SCC13	47.6188	96.926	.709	.714	.899
SCC14	47.8000	97.145	.652	.667	.901

SUPPLY CHAIN PERFORMANCE RELIABILITY CHECK

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.920	.919	17

Item Statistics

	Mean	Std. Deviation	N
CP1	3.5906	1.14110	320
CP2	3.5875	1.14682	320
CP3	3.2875	1.28355	320
CP4	3.7250	1.04116	320
CP5	3.7031	1.21485	320
CP6	3.7313	1.05177	320
CP7	4.0000	.91658	320
CP8	3.6781	1.14723	320
CP9	3.6281	1.18341	320
CP10	3.6188	1.17642	320
CP11	3.4813	1.19020	320
CP12	3.4844	1.08556	320
CP13	4.1031	.95936	320
CP14	3.9906	.95834	320
CP15	3.6188	1.12744	320
CP16	3.6000	1.17284	320
CP17	3.3906	1.27204	320

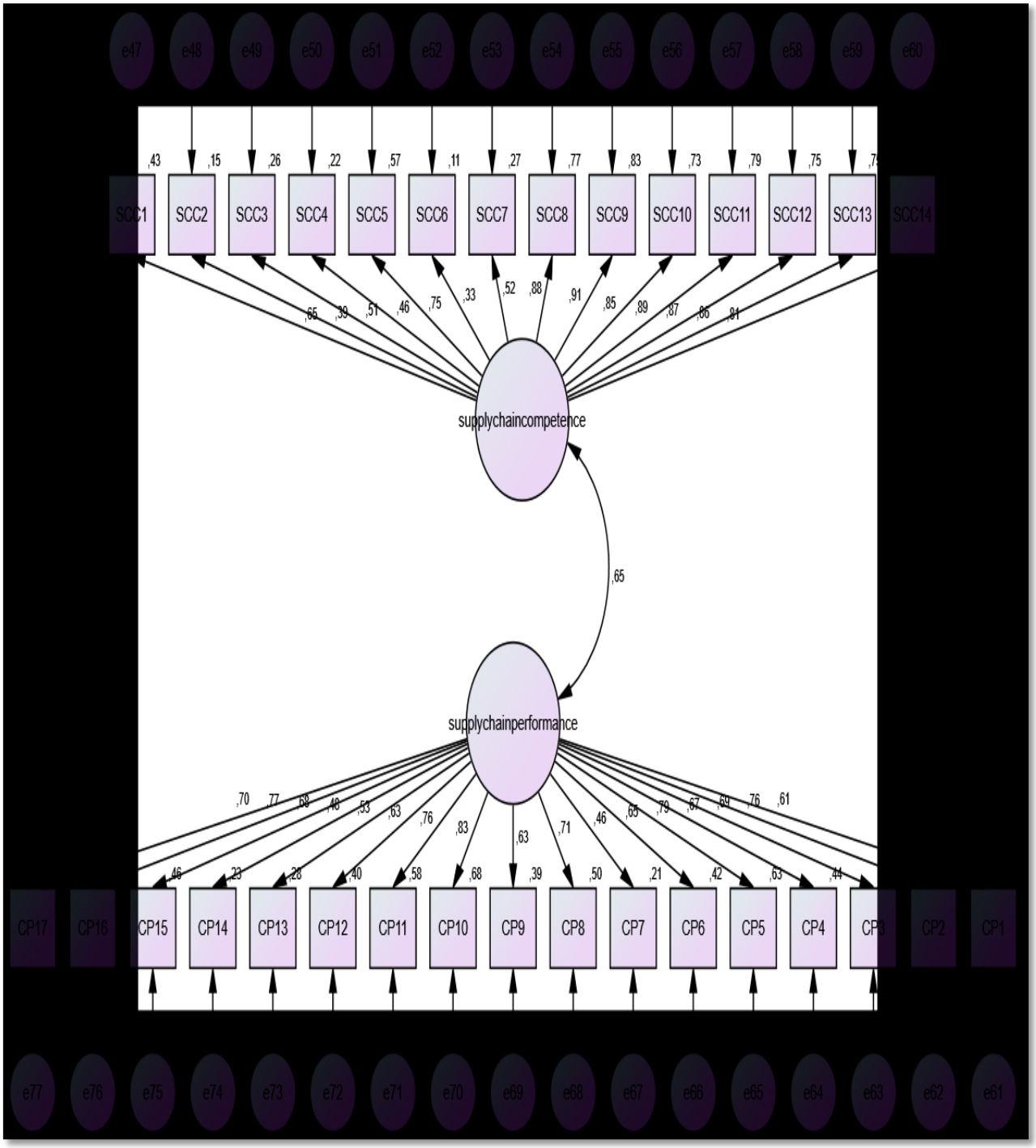
Summary Item Statistics

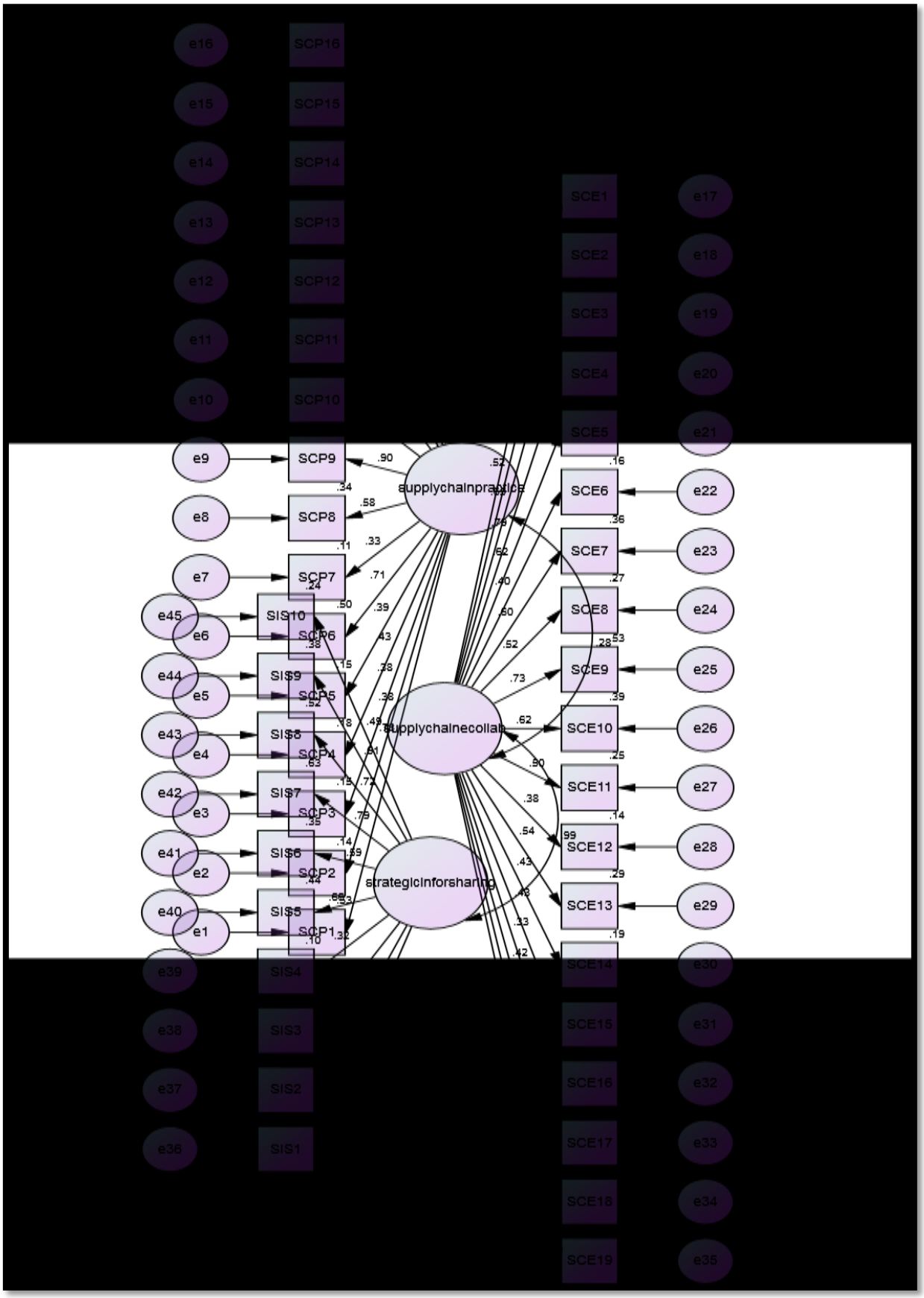
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.660	3.288	4.103	.816	1.248	.045	17
Item Variances	1.269	.840	1.647	.807	1.961	.055	17
Inter-Item Covariances	.514	.062	1.370	1.308	22.004	.052	17
Inter-Item Correlations	.399	.051	.860	.810	16.999	.023	17

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
CP1	58.6281	144.247	.573	.842	.917
CP2	58.6313	141.462	.678	.918	.914
CP3	58.9313	139.619	.659	.919	.914
CP4	58.4938	144.276	.636	.625	.915
CP5	58.5156	139.122	.721	.694	.913
CP6	58.4875	144.501	.619	.538	.916
CP7	58.2188	152.541	.348	.389	.922
CP8	58.5406	142.575	.634	.501	.915
CP9	58.5906	143.308	.584	.486	.917
CP10	58.6000	139.419	.736	.692	.912
CP11	58.7375	140.589	.682	.656	.914
CP12	58.7344	146.315	.524	.511	.918
CP13	58.1156	149.225	.474	.632	.919
CP14	58.2281	149.876	.446	.614	.920
CP15	58.6000	143.068	.627	.849	.915
CP16	58.6188	139.842	.723	.915	.913
CP17	58.8281	140.519	.634	.911	.915

Factor Loadings

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SEM RESULTS TABLES

SEM MODEL FIT RESULTS

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	13	296.688	2	,000	148,344
Saturated model	15	,000	0		
Independence model	5	1725,772	10	,000	172,577

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	,003	,998	,977	,067
Saturated model	,000	1,000		
Independence model	,286	,278	-,083	,186

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	,999	,994	1,000	1,000	1,000
Saturated model	1,000		1,000		1,000
Independence model	,000	,000	,000	,000	,000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	,100	,100	,100
Saturated model	,000	,000	,000
Independence model	1,000	,000	,000

NCP

Model	NCP	LO 90	HI 90
Default model	,087	,000	7,218
Saturated model	,000	,000	,000
Independence model	1879,479	1740,299	2026,008

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	,004	,000	,000	,026
Saturated model	,000	,000	,000	,000
Independence model	6,677	6,641	6,149	7,159

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	,018	,000	,160	,450
Independence model	,815	,784	,846	,000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	29,087	29,694	80,173	94,173
Saturated model	30,000	30,650	84,735	99,735
Independence model	1899,479	1899,695	1917,724	1922,724

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	,103	,102	,128	,105
Saturated model	,106	,106	,106	,108
Independence model	6,712	6,220	7,230	6,713

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	1000	1727
Independence model	3	4

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
SCE	,592
SIS	,813
SCC	,899
CP	,835

Matrices (Group number 1 - Default model)

Residual Covariances (Group number 1 - Default model)

	SCP	SCE	SIS	SCC	CP
SCP	,000				
SCE	,000	,000			
SIS	,007	,000	,000		
SCC	,001	,000	,007	,002	
CP	,001	,000	,001	,001	,000

Standardized Residual Covariances (Group number 1 - Default model)

	SCP	SCE	SIS	SCC	CP
SCP	,000				
SCE	,000	,000			
SIS	,237	,000	,000		
SCC	,032	,000	,205	,054	
CP	,040	,000	,014	,037	,004

Observations farthest from the centroid (Mahalanobis distance) (Group number 1)

Observation number	Mahalanobis d-squared	p1	p2
5	77,509	,000	,000
179	77,509	,000	,000
2	62,063	,000	,000
1	23,605	,000	,000
176	23,605	,000	,000
15	21,956	,001	,000
8	21,917	,001	,000
182	21,917	,001	,000
4	21,215	,001	,000
178	21,215	,001	,000
7	21,205	,001	,000
22	21,205	,001	,000
181	21,205	,001	,000
18	20,782	,001	,000
14	20,738	,001	,000
25	18,322	,003	,000
11	18,211	,003	,000
185	18,211	,003	,000
3	17,045	,004	,000
177	17,045	,004	,000
280	15,296	,009	,000
284	15,296	,009	,000
9	15,025	,010	,000
183	15,025	,010	,000
12	14,802	,011	,000
23	14,802	,011	,000
186	14,802	,011	,000
19	14,349	,014	,000
36	12,857	,025	,000
262	12,857	,025	,000
21	12,085	,034	,000
62	10,172	,070	,006
192	10,172	,070	,003
20	9,617	,087	,036
75	9,410	,094	,059
205	9,410	,094	,040
65	8,776	,118	,292
195	8,776	,118	,234
70	7,709	,173	,956
200	7,709	,173	,938
73	7,632	,178	,942
203	7,632	,178	,921
13	7,186	,207	,993
24	7,186	,207	,990
187	7,186	,207	,984
61	6,766	,239	,999
191	6,766	,239	,999
52	6,572	,254	1,000
278	6,572	,254	1,000
282	6,572	,254	,999
163	6,487	,262	1,000
160	6,196	,288	1,000
76	6,190	,288	1,000
206	6,190	,288	1,000
109	5,665	,340	1,000
239	5,665	,340	1,000
170	5,579	,349	1,000

Observation number	Mahalanobis d-squared	p1	p2
51	5,555	,352	1,000
277	5,555	,352	1,000
281	5,555	,352	1,000
48	5,535	,354	1,000
274	5,535	,354	1,000
92	5,176	,395	1,000
222	5,176	,395	1,000
10	5,003	,416	1,000
184	5,003	,416	1,000
141	4,819	,438	1,000
29	4,814	,439	1,000
107	4,770	,445	1,000
237	4,770	,445	1,000
41	4,672	,457	1,000
267	4,672	,457	1,000
168	4,457	,486	1,000
106	4,400	,493	1,000
236	4,400	,493	1,000
164	4,391	,495	1,000
171	4,354	,500	1,000
17	4,346	,501	1,000
169	4,137	,530	1,000
124	4,125	,532	1,000
254	4,125	,532	1,000
144	4,086	,537	1,000
159	3,978	,553	1,000
63	3,858	,570	1,000
193	3,858	,570	1,000
117	3,828	,574	1,000
247	3,828	,574	1,000
69	3,763	,584	1,000
199	3,763	,584	1,000
78	3,696	,594	1,000
208	3,696	,594	1,000
97	3,688	,595	1,000
227	3,688	,595	1,000
110	3,638	,603	1,000
240	3,638	,603	1,000
35	3,534	,618	1,000
95	3,467	,628	1,000
225	3,467	,628	1,000
55	3,424	,635	1,000
85	3,268	,659	1,000

Assessment of normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
SCP	1,688	5,000	-,787	-5,411	,801	2,755
SCE	1,316	5,000	-,862	-5,931	1,510	5,193
SIS	1,400	5,000	-,678	-4,662	,569	1,957
SCC	1,357	5,000	-1,272	-8,748	2,208	7,595
CP	1,118	5,000	-1,051	-7,232	1,782	6,129
Multivariate					65,085	65,549

APPENDIX D: THE LANGUAGE EDITOR'S LETTER

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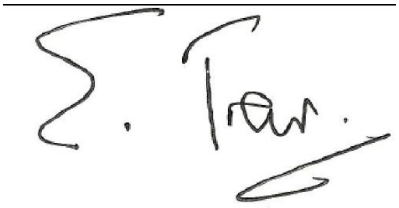
Vaal University of Technology

Vanderbijlpark.

12 February 2015

COPY- EDITING

This is to certify that I copy-edited the thesis "The Influence of Supply Chain e-Collaboration, Strategic Information Sharing, Supply chain Competence and Supply chain Performance in South Africa", by Ms Progress Hove for her D. Tech degree in the Faculty of Management Sciences



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