

**SUPPLY CHAIN CAPABILITIES, AGILITY AND FIRM PERFORMANCE IN A
DEVELOPING ECONOMY**

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PhD

In the discipline of

LOGISTICS MANAGEMENT

In the

FACULTY OF MANAGEMENT SCIENCES

At the

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DECLARATION

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DEDICATION

This work is dedicated to:

MAMOLANE ELIZABETH TLALE,

My Mother,

A strong and gentle soul who taught me to trust in God, believe in hard work and that so much can be done with little effort. I have made this entire work for you mom. You have helped me along all of my life. If it was not for you, I am sure I would not be who I am today. You are my heroine and there are no words to express my gratitude.

To my Family,

Thank you for all that you have done for me during this process. I love you from the bottom of my heart.

ACKNOWLEDGEMENTS

First and foremost, I give thanks and glory to the Almighty God, who has granted me with the life and for blessing me with wisdom, commitment and good health to travel throughout the journey of this research study. Without God, everything would be in vain.

Secondly, I would like to take this opportunity to express sincere appreciation to the following individuals who contributed to the success of this research study.

- My promotor, Dr Johannes van der Westhuizen, for embracing this vision without hesitation. I deeply appreciate the valuable contribution, motivation, professional guidance and useful comments I received. Thank you for your patience with me.
- My co-promoter, Dr Elizabeth Chinomona, thank you for having confidence in my potential and for your willingness to be associated with this research study. Thank you for the advice and encouragement; your hard work will always inspire me. You challenged me to increase the depth of my research skills.
- My colleagues in the logistics department for the wise counsel and encouragement.
- Gratitude to my family and friends for their moral and spiritual support.
- Mrs. N. Kokoali and Mrs N. Phume (higher degrees' department), for the financial support and tireless advice you gave me and a special thanks to Mrs. M.C. Zundana, for all the hot cups of tea in the morning.
- To Professor Chendedzai Mafini (Head of Department: Logistics), for your helpful advice during my difficult times. You provided me with intellectual advice, emotional support and encouragement. You are the best.

- All the participants, for their invaluable time and contributions that were instrumental in the success of this research study.

ABSTRACT

Nowadays, the business environment is characterised by faster technological development, customer satisfaction, shorter product life cycles, and more intense global competition. This new competitive landscape has forced firms to acquire new ways to achieve competitive advantage actively since a firm's competitive advantage is now dependent on operating efficiency and productivity across functional areas of the firm. The most successful manufacturers seem to be those that have carefully linked their internal processes to external suppliers and customers in unique supply chains. The manufacturing sector represents 15 per cent of gross domestic product (GDP) of the South African commercial industry. Competitive challenges in the modern business environment have resulted in the need for firms to collaborate their business processes strategically across other business units within the supply chain.

Supply chain network theory, dynamic capabilities theory, and the resource-based view theory are discussed to better understand the importance of firms' supply chain capabilities, supply chain agility, and firm performance.

The primary objective of this research study was to investigate the association between supply chain capabilities (supply chain network design, supply chain information competency, and supply chain integration) and supply chain agility on firm performance in the manufacturing sector of the Gauteng province in South Africa. It also aimed to ascertain the kind of relationships between supply chain network with supply chain agility, supply chain network with firm performance, supply chain information competency with supply chain agility, supply chain integration with supply chain agility, supply chain integration with firm performance, and finally supply chain agility with firm performance. Structured questionnaires were distributed to various manufacturing firms in the Gauteng province. The data were collected from manufacturing firm managers and owners.

SPSS 25.0 was used to analyse the data, and AMOS 25.0 used to perform the confirmatory factor analysis (CFA) and path analysis. The structural equation modelling (SEM) was used to assess the proposed model fit and to test the statistically significant relationship between the various hypotheses. The research study results revealed that supply chain technologies and supply chain

agility positively influence firm manufacturing performance. This study contributes new knowledge to the existing literature by providing a research framework that can enhance manufacturing firms' performance and also offer practical recommendations based on the research findings for manufacturing firms and future research. Furthermore, as one of the first studies to address the association between supply chain capabilities and supply chain agility on firm performance in the Gauteng province, this study generates new insights and information, as well as outlines the strategic reasons for manufacturing firms' managers and owners to improve on their organisational relationships. Hence, the study found that firms have realised significant supply chain coordination through supply chain capabilities and supply chain agility and that firms have been able to attain strategic goals, reduce risks and improve internal and external coordination of operational processes.

Keywords: supply chain network design; supply chain information competency; supply chain integration; supply chain agility; firm performance.

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LIST OF ABBREVIATIONS

AMOS	Analysis of Moment Structures
AVE	Average Variance Extracted
BSC	Balanced Scorecard
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CR	Composite Reliability
FOCAC	Forum on China - Africa Co-operation
FP	Firm Performance
GDP	Gross Domestic Product
DC	Dynamic Capability
GFI	Goodness of Fit Index
Ha	Alternative Hypothesis
H ₀	Null Hypothesis
HSV	Highest Shared Variance
IDC	Industrial Development Corporation
IFI	Incremental Fit Index
IT	Information Technology
NAACAM	National Association of Automotive Components and Allied Manufacturers
NFI	Normed Fit Index
R&D	Research and Development
RBV	Resource-Based View
ROA	Return on Assets
ROI	Return on Investment
ROS	Return on Sales
ROE	Return on Equity

RMR	Root Mean Square Residual
RMSEA	Random Measure of Standard Error Approximation
SACU	South African Customs Union
SADC	Southern African Developing Community
SCA	Supply Chain Agility
SCIC	Supply Chain Information Competency
SCI	Supply Chain Integration
SCM	Supply Chain Management
SCMBP	Supply Chain Management Best Practices
SCND	Supply Chain Network Design
SCNT	Supply Chain Network Theory
SD	Standard Deviation
SCC	Supply Chain Capabilities
SEM	Structural Equation Modelling
SMEs	Small and Medium Enterprises
SPSS	Statistical Package for Social Sciences
TLI	Tucker-Lewis Index
WTO	World Trade Organisation

CHAPTER 1

INTRODUCTION AND PROBLEM ORIENTATION

1.1 INTRODUCTION AND BACKGROUND TO THE STUDY

In a rapidly changing business environment, firms should be capable of responding to changes efficiently and effectively. Agility has been credited with helping firms respond in a timely and effective manner by accounting for volatility and other uncertainties, thereby allowing them to establish a competitive position (Gligor & Holcomb 2012:295). Moreover, agility is considered to be one of the fundamental characteristics needed for a supply chain to survive and thrive in an environment of turbulent and volatile markets (Braunscheidel & Suresh 2010:119; Gligor, Holcomb & Stank 2013:94). Originating in manufacturing, agility was viewed as the means for meeting widely varied customer requirements in terms of price, specification, quality, quantity and delivery (Katayama & Bennett 2010:43), as well as addressing the increasing internationalisation of competition (Kasarda & Rondinelli 2010:73).

Over the past two decades (1999-2019), the relationships in supply chain capabilities (supply chain network design, supply chain information competency, and supply chain integration) have evolved from arms-length transactions to partnerships with a view to addressing uncertainty and enhanced performance in the supply chain, since partnerships are better at responding to dynamic and unpredictable changes (Farahani, Rezapour, Drezner & Fallah 2014:92). Co-operation is particularly crucial for innovation and responsiveness during manufacturing. Given the complex and interdependent nature of the supply chain, a network approach provides a more vibrant view by considering the various interactions taking place amongst firms in the supply network (Kim, Choi, Yan & Dooley 2011:215). In contrast to the conventional approach, where firms are viewed as autonomous and self-reliant entities striving to use their resources to compete with other such entities, the network design approach focuses on the structural elements of the firm and its internal and external network design (Bellamy, Ghosh & Hora 2014:360). The elements that influence supply chain network design include advances in information technology, sophisticated customer requirements, and intense global competition.

Supply chain information competency (SCIC) enables the formation, transfer and deployment of a firm's information technology resources, to support and improve other individual functions that are competent at strength and skill, creating the latent potential for maintaining continuous

competitive advantages, through IT architecture and routines, IT infrastructure, IT human resources, and IT relationship assets (Jiao, Chang & Lu 2013:872). Leveraging IT capability to derive competitive advantage is emerging as a top priority for firms (Kopalle, Lehmann & Farley 2010:251). For practical and useful knowledge and change management in supply chain integration and supply chain information, competency is required (Malhotra, Gosain & Sawy 2005:145; Wu, Yeniyurt, Kim & Cavusgil 2011:493). The concept of supply chain integration (SCI) and its applications to business practices have gained prominence (Xia & Tang 2011:95). Although the theory and practices are evolving fast, many firms are still searching for the best ways in which to incorporate and implement supply chain integration principles into their supply chain (Morali & Searcy 2013:635).

The manufacturing sector plays a vital role in the developing economy of any country (Gligor *et al.* 2013:94), and "one could settle on a description of the South African economy as a developing economy that has made substantial industrial progress, to the extent of the manufacturing sector being the most important commodity-producing sector in terms of employment and income creation" (McCarthy 1988:23). As such, Haasje (2006:56) stated that, since 1994, the government has shown dedication towards the development of this sector by strategically positioning a sizeable amount of capital resources, such as machinery, financial assistance and has developed policies which are all geared to support the development of this sector.

It was emphasised by the former minister of finance Mr Gordhan "that the manufacturing sector holds/plays a significant role in addressing unemployment issues and in finding solutions for the economic development problems of any country" (Mail & Garden 2011:82). The First National Bank's 2010 report on business study, in partnership with the Gordon Institute of Business Science, provided a dialogue of the state of this sector in developing countries and highlighted that a consideration of the dynamics of the manufacturing firms is essential, not only for the development of support programmes but also for the growth of the economy as a whole (Hussain & Windsperger 2010:10).

1.2 PROBLEM STATEMENT

In this period of industrialisation, there is an increased rate of research and innovation, which has raised the need to give more consideration to information technology if firms need to be

more competitive (Imran, Hamid, Aziz & Hameed 2019:63). Within the manufacturing sector, there is evidence that, due to rapid technological advances, the majority of manufacturing firms cannot keep abreast with supply chain information competencies. Consequently, supply chain agility is affected, which, in turn, leads to poor firm performance within the manufacturing sector.

According to a Deloitte Consulting report (2011:2), experts from different large industries in Europe believe that in future, the whole supply chain of companies will compete against each other instead of competing among individual firms. Moreover, Rice and Hoppe (2013:87) believe that competition in the future will not be between companies but between supply chains in the same entity. Scholars such as Maqbool, Mendez Alva and Van Eetvelde (2019:131) are of the same view as they site that there is as yet a critical requirement for research and innovation at all dimensions of social, technological and business fronts to reshape supply chain network, redesign products and introduce new organisational models to demonstrate the feasibility of firms in the manufacturing sector in particular. Hence, the more likely scenario will find companies competing and winning, based on the capabilities they can assemble across their supply chain.

However, little is known about the underlying structural characteristics of a firm's supply chain network design, information competency and integration and whether these capabilities have any influence on a firm's supply chain agility and performance output. Several supply chain researchers have emphasised the value of incorporating the supply chain network when considering agility and performance implications (Bernardes 2010:562).

This research study assesses the adoption of supply chain capabilities (supply chain network design, supply chain information competency, and supply chain integration) usage by firms in the manufacturing sector and their perceived impact on the firms' performance. There is extensive literature covering supply chain agility and firm performance. However, limited attention has been devoted to the adoption of supply chain capabilities usage and the corresponding perceived impact on supply chain agility and firm performance, specifically within firms in the manufacturing sector of a developing economy.

This research study will, therefore, contribute significantly to the already established supply chain management literature. It provides insight for existing and emerging entrepreneurs who

are in the manufacturing business or have plans to start a manufacturing venture on the use of supply chain capabilities and the perceived impact on agility and performance. Furthermore, it is anticipated that current and future manufacturing firms can gain insight into the benefits of adopting these supply chain capability levels in the manufacturing process. Moreover, manufacturing firms in this sector will also gain valuable information on how to improve their performance and competitiveness, nationally and globally.

1.3 PRIMARY OBJECTIVE

The primary objective of this study was to investigate the association between supply chain capabilities (supply chain network design, supply chain information competency, and supply chain integration), supply chain agility, and firm performance in the manufacturing sector of the Gauteng Province in South Africa.

1.4 SECONDARY OBJECTIVES

1.4.1 Theoretical Objectives

Below are the theoretical objectives:

- Conduct a literature review on the manufacturing sector in the context of a developing economy;
- Conduct a literature review on supply chain network design;
- Conduct a literature review on supply chain information competency;
- Conduct a literature review on supply chain integration;
- Conduct a literature review on supply chain agility, and
- Conduct a literature review on firm performance.

1.4.2 Empirical Objectives

The following empirical objectives with regards to the manufacturing sector of Gauteng Province were undertaken for this study to:

- Determine the influence of supply chain network design on supply chain agility;
- Evaluate the influence of supply chain network design on firm performance;
- Determine the influence of supply chain information competency on supply chain agility;
- Ascertain the influence of supply chain integration on supply chain agility;

- Evaluate the influence of supply chain integration on firm performance;
- Determine the influence of supply chain agility on firm performance; and
- Develop a conceptual model for the association between supply chain capabilities, supply chain agility and firm performance of manufacturing firms.

1.5 CONCEPTUALISED FRAMEWORK

Drawing from the literature review in particular, and the theoretical and empirical literature, a research model was conceptualised. The hypothesised relationships between research constructs were developed after that. In the conceptualised research model, supply chain capabilities (supply chain network design, supply chain information competency, and supply chain integration) were the predictors. Supply chain agility was the mediating variable, while firm performance was the outcome variable. Figure 1 on the next page illustrates this conceptual model.

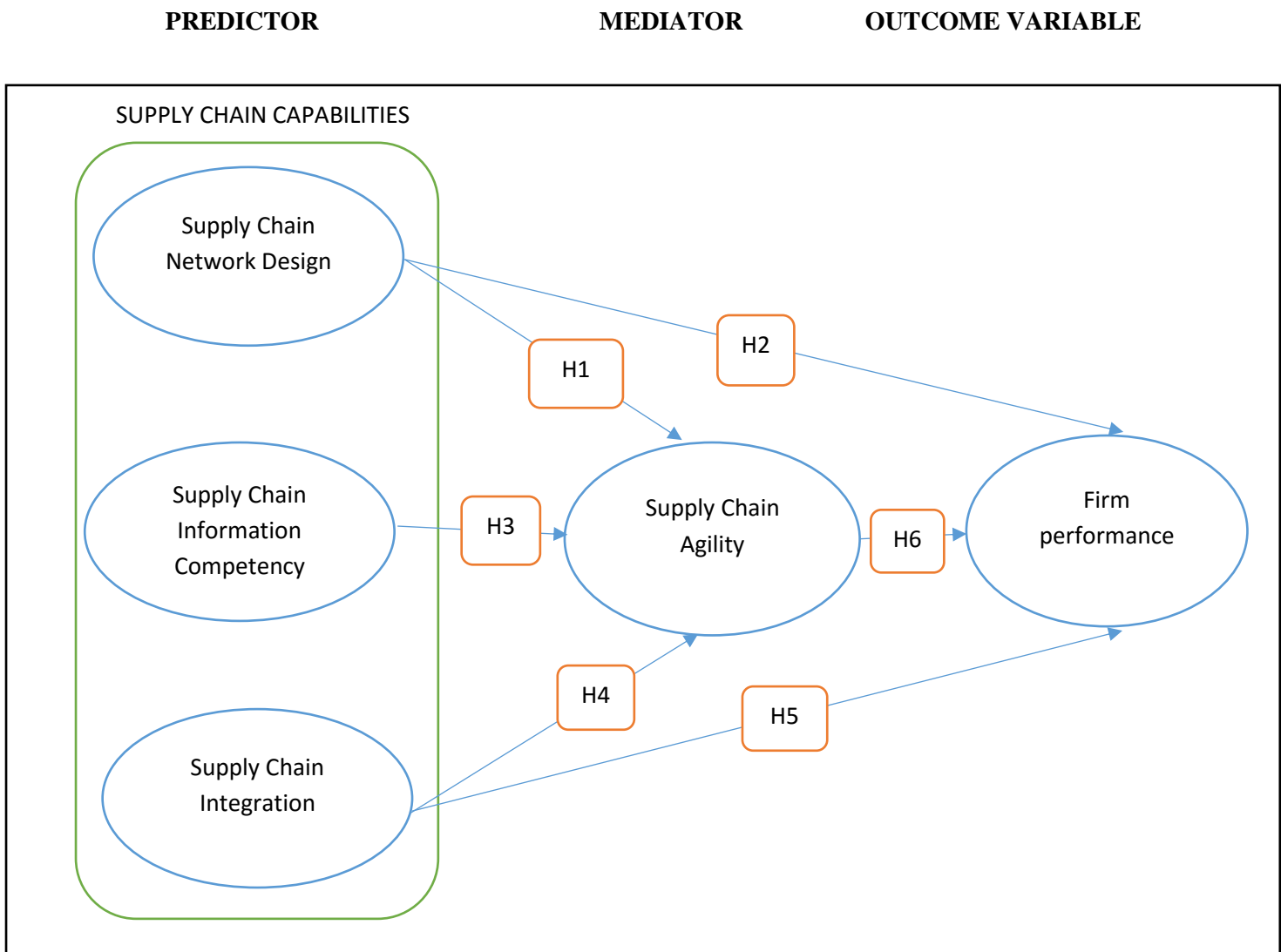


Figure 1. 1: The Research Model

Based on the conceptualised research model, the following hypotheses were formulated.

- H1:** There is a positive influence between supply chain network design and supply chain agility.
- H2:** Supply chain network design has a positive impact on firm performance.
- H3:** There is a positive influence between supply chain information competency and supply chain agility.
- H4:** Supply chain integration has a positive impact on supply chain agility.
- H5:** There is a positive influence between supply chain integration and firm performance.
- H6:** There is a positive influence between supply chain agility and firm performance.

1.6 SCOPE OF THE STUDY

The scope of this research study involves firms that fall within the supply chain sector of the manufacturing industry of Gauteng Province in South Africa.

1.7 THEORETICAL GROUNDING

1.7.1 Resource-Based View Theory

An organisation's ability to accumulate knowledge about suppliers and other major participants in its supply chain (SC) has emerged as an essential theme (Willis, Genchey & Chen 2016:157) because learning and growing among SC partners is a strategic action (Yang, 2016:286). The emergence of the resource-based view (RBV) can be traced back to the groundbreaking work of (Penrose 1959). In her study, she showed that firms' were fundamentally different when it came to their strategic and resource capabilities and their abilities to explore and maximise these resources to develop a sustainable economic advantage over the competition (Frynas & Yamahaki 2016:258). The RBV rests upon assumptions of resource heterogeneity (firms' in competition with each other may possess diverse collections of resources) and resource immobility (resources that are not highly mobile between these firms, meaning the differences may persist) (Rockwell 2019:85).

RBV is always the base for strategy research because of the relationship between resource deployment and performance (Kim, Song & Triche 2015:535). It is particularly well suited in investigations involving innovative strategy and sustainability (Hult & Tomas 2011:172). Minbashrazgah and Shabani (2019:138) also suggest that value and rare resources are linked to competitive advantage and that competitive advantage is linked to performance. Valuable resources can enable an organisation to conceive of and/or implement a value-creating strategy that improves its effectiveness. Rare resources are those that competing firms' do not possess. For instance, a resource that is possessed by many organisations is not rare and will not be a source of competitive advantage (Omondi-Ochieng 2018:2).

The RBV theory applies to this research study because it helps with inter-firm relationships and relational strategies that improve a firm's competitive position. It also enables the firm to conceive and implement strategies that improve its efficiency and effectiveness.

1.7.2 Dynamic Capability Theory

Over the past decades, research in strategic management has devoted ample attention to the concept of dynamic capabilities (DC) (Helfat & Winter 2011:1243). The emergence of the DC framework can be traced back to a call for a dynamic theory of strategy (Williamson 2010:269). Indeed, DC is increasingly considered as a theory of strategic change (Arend & Bromiley 2010:75). Dynamic capabilities are often described as the firms' ability to change, given changes in the environment (Winter 2013:991). Moreover, Teece and Pisano (1997:516) defined DC as "the ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments". This definition is widely cited, and it has encouraged others to refine the notion of DC. Consequently, some researchers have proposed a direct link between DC and firm performance, arguing that DCs are difficult-to-imitate combinations of resources and should, therefore, be conceived as a source of sustainable competitive advantage (Drnevich & Kriauciunas 2011:294).

Most of the extant research on firm capabilities report the positive impact of DCs on performance (Gudergan, Devinney, Richter & Ellis 2012:455). The empirical evidence confirms that DCs play an essential role in firms' long-term survival and success (Lin & Wu, 2014:410). Blyler and Coff (2005:682) proposed that network design among individual firms facilitate the development of new capabilities by promoting a constant flow of information from various external and internal sources. These capabilities, in turn, affect performance. Hsu and Wang (2012:191) proposed a model to explain how performance is influenced by intellectual capital (including relational capital) through DCs (Lew, Sinkovics & Kuivalainen 2013:1109).

The DC theory applies to this study because it helps partners to coordinate actions in pursuit of market opportunities or in response to threats. It also reflects the ability of a pair of partners to integrate and reconfigure resources to cope with rapidly changing environments.

1.8 LITERATURE REVIEW

1.8.1 Supply Chain Network Design

Bellamy, Ghosh and Hora (2014:357) defined supply chain network design as an inter-linked network of firms' consisting of manufacturers, suppliers, customers, third-party service providers, and alliance partners that interact to execute the supply chain activities of the firm. The various firms in the supply network are generally referred to as supply network partners of a given focal firm in the network. According to Min and Schilling (2010:295), supply chain network design can be traced back to the pioneering study by Weber (1909) on facility location. In his book published in 1909, *Theory of the location of industries*, Weber analysed how to locate a plant in order to minimise the total weighted distance between the plant and its several customers (Varsei & Polyakovskiy 2017:237).

Since then, the facility location problem has attracted the attention of scholars from various academic communities, such as operations and supply chain management, industrial engineering, economics and regional science. The application side of the problem has proved to be highly crucial for a broad range of private and public companies (Farahani, Drezner & Asgari 2012:167). Supply chain network design aims to find the best possible supply chain configuration in accordance with a company's competitive strategy and long-term goals. It is concerned with the long-term strategic decisions related to the number, location and capacity of production plants and distribution centres, the flow of raw material, intermediate and finished products throughout the supply chain, and a set of suppliers to select (Chopra & Meindl 2013:3).

1.8.2 Supply Chain Information Competency

Yoon (2016:281) defines supply chain information competency (SCIC) as the ability to integrate other resources of firms by using and allocating IT resources. Information competency was first defined by Ross, Beath and Goodhue (1996:31) as the ability to control IT-related costs, deliver systems when needed and affect business objectives through IT implementations. Similarly, Bharadwaj (2000:169) defines SCIC as a firm's ability to mobilise and deploy IT-based resources in combination or co-operation with other resources and capabilities. Resources that are valuable and rare can lead to a competitive advantage that can be sustained over a more extended period if the firm can protect against resource imitation,

transfer or substitution. Recently, the interests of this domain focused on the relationship between IT capability and organisational performance and investigating customer services while also focusing on IT infrastructure capability (Wade & Hulland 2004:130).

Measuring information competency should be a key concern of firms and IT executives as it demonstrates the effectiveness and added business value of IT (Lu & Ramamurthy 2011:931). There are numerous methods, tools and best practices that exist to support firms with their performance management responsibilities. Traditional performance methods, such as return on investment (ROI), capture the financial worth of IT projects and systems but reflect only a limited (tangible) part of the value that can be delivered by supply chain information competency (Mao, Liu & Zhang 2014:358). The more sophisticated IT-balanced scorecard (BSC) is an evaluation method that incorporates tangible and intangible values. One of the best-known versions of the IT BSC is the one developed by Van Grembergen (2000), which indicates that the IT BSC can also be an effective means for IC management (Yoon 2016:281).

1.8.3 Supply Chain Integration

Supply chain integration (SCI) can be defined as the degree to which a manufacturer strategically integrates with its supply chain partners and collaboratively manages intra-and inter-organisation processes (Flynn, Huo & Zhao 2010:62). The theoretical foundation of SCI traces back to Porter's value chain model (Porter 1987:44), suggesting that the value chain enhances the effectiveness of the linkages between activities (primary and support) and enhances efficiency, thereby increasing profitability. Supply chain integration is conceptualised as a process of redefining and connecting entities through co-ordinating or sharing information and resources (Katunzi 2011:109).

The importance of SCI has been conceptually and empirically addressed in the literature and has become well accepted by researchers (Flynn, Huo & Zhao 2010:63). The benefits of integrating and co-ordinating supply chain partners have been recognised in many industries (Wong, Boon-itt & Wong 2011:632), and SCI is considered to be one of the significant factors in improving performance (Van der Vaart & Van Donk 2012:47). Supply chain integration is critical in ensuring correct supply chain relationships and facilitating the coordination of information flows from supplier to manufacturer and customer, as well as the backward flow from customer to manufacturer and supplier (Cousins & Menguc 2010:3). Moreover, SCI

provides a firm with the opportunity to focus on its core competencies and particular area of expertise and attempts an alignment with other supply chain members having varied resources, technological knowledge and expertise (Kim 2014:121).

1.8.4 Supply Chain Agility

Gunasekaran (1999:5) defines supply chain agility as the ability to survive and prosper in a competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets driven by customer-defined products and services. The concept of agility as a business strategy was presented by Dove (2005) as the firm's ability to thrive in a continuously changing and unpredictable business environment. An agile firm has designed its organisation, processes and products in such a way that it can respond to changes appropriately within a useful time frame.

An equally important attribute of agility is an effective response to change and uncertainty. The foundation of SCA lies in the integration of customer sensitivity, organisation, processes, networks and information systems (Gligor & Holcomb 2014:160). Agility encompasses both firms and the supply chain as a whole. It recognises the fundamentals for survival in turbulent and volatile markets and helps companies to deliver the right product at the right time to the right customers. Supply chain agility can also be founded on business processes and structures which facilitate speed, adaptation and robustness, and which are capable of achieving competitive performance in a highly dynamic and unpredictable business environment (Khan, Bhimaraya, Metri & Sahay 2009:41).

1.8.5 Firm Performance

In the latest literature on the subject, firm performance is frequently defined in terms of productivity gains (Aldieri & Vinci 2017:17500352; Ortega-Argilés, Potters & Vivarelli 2011:819) employment growth (Oliveira & Fortunato 2017:615; Capasso, Treibich & Verspagen 2015:40) and sales growth (Ahn, Yoon & Kim 2018:318; Xia & Roper 2016:915). Moreover, Lo, Mohamad, Ramayah and Wang (2015:410) defined firm performance as a concept that measures a firm's position in the market place and the firm's ability in meeting its stakeholders' needs. It can also be known as the extent to which a firm fulfils its performance objectives (primary measures) and meets the needs of the customers (secondary measures) (Slack, Chambers & Johnston 2010:108). Hence, Peteraf and Barney (2013:312) propose that

for a firm to have a competitive advantage, it will have to create more economic value than the marginal competitors of the same product market.

Different dimensions have been adopted by researchers to determine firm performance. Some of them are profitability, return on asset (ROA), gross profit, return on investment (ROI), return on sale (ROS), return on equity (ROE), sales growth, export growth, revenue growth, market share and stock price (Marr & Schiuma 2010:1112; Kenneth, Green, Pamela & Vikram 2012:290). These authors emphasise that no single determinant of performance may fully clarify all areas of the concept. Some authors also report different measurements of firm performance, though most researchers measure firm performance using quantitative data such as return on investments, return on sales and so forth (Wong & Wong 2011:940). The importance of performance has integrated both business employee satisfaction and growth and efficiency-related measures that relate to the input or output relationship (Iacobucci & Churchill 2010:200). The majority of practitioners seem to use the term 'performance' to explain a variety of measurements, as well as input efficiency, output efficiency and transactional efficiency (Gligor & Holcomb 2014:160).

1.9 RESEARCH METHODOLOGY AND DESIGN

A research methodology focus on the research process and the types of tools and procedures implemented to execute the research design strategy (Govind 2013:64). This section provides a synopsis of the study research methodology and design as well as its data analyses. Wengner (2012:110) maintains that the sampling process guides the selection of a sample to make sure that it is representative of its target population so that the sample findings provide information which is relevant to the study objectives.

A research design is a format or blueprint, similar to an architect's sketch for a building, for conducting research. It details the research philosophy, research paradigm and research method used as the groundwork for acquiring the data needed to obtain research objectives and solve research questions (Mouton 2012:108). More so, a research design is a logical sequence that connects the empirical data to a study's initial research questions and thus to its conclusions (Maje 2015:53). Taking into account the nature and strengths of the various research method techniques (quantitative and qualitative), it was decided to employ a quantitative research technique for this research for reliability and validity reasons.

1.9.1 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 (Barndt & Petzer 2011:348). This research study followed an inferential and descriptive analysis since the underlying relationships of variables surrounding the problem are known (Cant *et al.* 2003:34). A quantitative research technique was employed in order to obtain the manufacturing firm's managers and owner's perceptions on the association between supply chain technologies on supply chain agility and firm performance.

This study made use of quantitative techniques that generally involve the collection of primary data from a large number of manufacturing firms in Gauteng Province of South Africa. This was done to generalise the results to the broader population of Gauteng Province. Quantitative primary research was conducted by employing a self-administered questionnaire in the gathering of primary data for this study.

1.9.2 Questionnaire development

The questionnaire was developed based on various sources found in the literature. The initial pilot study questionnaire was reviewed by several university lecturers who are experts in supply chain for comprehensibility and accuracy. The various instruments were double-checked to confirm that they met specific requirements, including how well each scale captured the construct that it was intended to measure, whether the wording of each item was clear and understandable and whether the format was user-friendly.

After the initial development of the questionnaire, it was then distributed to various manufacturing firms in the Vaal Triangle region, which were part of a pilot study. For the pilot study, 88 manufacturing firms were selected. The pilot study was used to improve the reliability and validity of the questionnaire. The questionnaire was also designed in such a way that it allowed for the performance of the confirmatory factor analysis and path analysis. Also, a cross-sectional study was conducted due to the time limitations, which restricts the use of longitudinal study.

1.10 EMPIRICAL STUDY

The empirical part of this research comprised the following methodological aspects:

1.10.1 Sampling Design

Sampling design can be viewed as a provision of a plan for a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population (Creswell 2009:145). Also, sampling design consists of the following, namely, target population, sampling frame, sampling size, and sampling method (Hong, Hao, Kumar, Ramendran & Kadiresan 2012:60).

1.10.2 Target Population

Target population is defined as the total collection of elements from which the study seeks to make some inferences (Seelke & Blumberg 2008:691). The target population in this study was the manufacturing sector of Gauteng Province. The manufacturing firm's managers and owners were the target population of this study and those firms which are members of National Association of Automobile Manufacturers of South Africa, Chemical and Allied Industries' Association, Independent Communications Authority of South Africa, South African Iron and Steel Institute and Textile Federation of South Africa.

1.10.3 Sampling Frame

The sampling frame is a list of all those within a population who can be sampled and may include individual households or institutions (Cooper & Schindler 2011:170). Sampling frame denotes the set of all cases from which the sample is actually selected; it is a list of elements in the target population and consists of a list or a set of directions for the identified target population. For the purpose of this study, only 600 manufacturing managers and owners of firms who are members of the associations formed part of the sampling frame.

1.10.3.1 Sampling Size

In an attempt to obtain a realistic and representative sample for the purpose of this study, the sample consisted of firms in the manufacturing sector around Gauteng Province. Leedy and Ormrod (2010:214) recommended that if the population size is about 1500, at least 20 per cent should be sampled. For the purpose of this research study, 600 (n) participants were selected

from the total population of manufacturing firms' in the sector ($N = 2500$), thus, targeting approximately 20 per cent of the selected population.

1.10.3.2 Sampling Method

There are two types of sampling methods, namely, probability and non-probability sampling (Hair, Babin, Anderson & Tatham 2010:20). This research used probability random sampling because it is objective. A simple random sampling was used because all the elements in the sample have an equal chance of being selected, and this probability can be accurately determined.

As for systematic probability sampling, it is used when the subjects or respondents in the study are arrayed or arranged in some systematic or logical manner such as an alphabetical arrangement. Stratified Random Sampling, also sometimes called *proportional* or *quota* random sampling, involves dividing the population into homogeneous subgroups and then taking a simple random sample in each subgroup. Simple random probability sampling technique was suitable for this study the reason being that it facilitates easier selection of the sampling elements (Mudau & Obadire 2017:67).

1.10.4 Data Collection Method

In this study, a self-administered questionnaire was used, and 600 questionnaires were distributed to respective firms after making appointments with different managers and owners of the various firms since structural equation modelling requires an extensive data set to obtain meaningful results (Hair *et al.* 2010:50). Self-administered structured questionnaires were used in this research study.

1.10.5 Measuring Instrument

The questionnaire was designed in such a way that it suited the manufacturing sector context of South Africa, based on previous work and the objectives of this proposed research study. The questionnaire was divided into six sections. The questionnaire items were measured on a five-point Likert-type scale that was anchored on 1, denoting strongly disagree, to 5, denoting strongly agree, to show the degree of agreement or disagreement to statements. A five-point

Likert-type was used because previous researchers used the same scale (Flynn, Hou & Zhao 2010:58).

The scale was based upon the assumption that each statement/item on the scale has equal attitudinal value, importance or weight in terms of reflecting attitudes towards the questions (Kumar & Phrommathed 2005:145). The questionnaire items represented the five constructs, namely, supply chain network design, supply chain information competency, supply chain integration, supply chain agility and firm performance, respectively. The research study incorporated questions on managers or owners' profiles such as gender, marital status, home language, educational level of respondents (Chinomona, Lin, Wang & Cheng 2010:54; Flynn, Hou & Zhao 2010:58).

1.10.6 Data Analysis

Data analysis is not an end in itself; its purpose is to produce information that helps address the problem at hand (Malhotra 2010:434).

1.10.7 Data Analyses Procedure, Statistical Approach and Testing the Hypotheses

To accomplish the research objectives of this research study, it was first important to commence with the coding of data in an Excel spreadsheet and then effectively doing data cleaning. SPSS.25 was used to analyse the data. The researcher then proceeded to check confirmatory factor analyses (CFA) and path modelling. In addition, AMOS 25 statistical software for structural equation modelling (SEM) was utilised. This tested the theoretical linkages of the proposed research study and the significance of the relationship between the model's constructs (Hair, Babin, Anderson & Tatham 2010:952). These techniques were selected because they give clear interpretations for data analysis and are considered appropriate for quantitative data (Naidoo & Botha 2012:9223).

1.10.8 Validity and Reliability

Validity can be defined as the extent to which differences in observed scale scores reflect actual differences between objects on the characteristics being measured, rather than systematic or random errors (Cant *et al.* 2003:235). Construct validity comprises of convergent and discriminant validity. In this research study, convergent validity was measured using item-to-

total correlation, factor loadings and average variable extracted (AVE) values. Discriminant validity was measured using average variable extracted value versus shared variance and inter-construct correlation matrix.

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

1.11 ETHICAL ISSUES

For most professions, ethical codes in research are an integral part of their research, though some research bodies have evolved their own codes (Kumar *et al.* 2005:216). In research, ethical issues can be examined as they relate to participants, researchers, and sponsoring firms. According to Kumar (2005:216), the participants, the researcher and the sponsoring firms all have ethical issues, which should be considered when formulating a research document.

The researcher obtained a letter indicating that permission had been obtained to conduct a study on the mentioned companies or firms. Employee perception of firm politics is a sensitive issue, so when collecting data, there is an imperative need to seek permission from owners or managers of the business and the employees concerned, to obtain the information that is needed. There was also a need, in the case of this research study, to complete an ethical clearance or approval from the Vaal University of Technology.

1.12 OUTLINE OF THE STUDY/RESEARCH FLOW STRUCTURE

This thesis has seven chapters with the contents as mentioned below:

CHAPTER 1: INTRODUCTION AND PROBLEM ORIENTATION

This chapter encompassed the introduction and theoretical underpinning of the study on supply chain technologies, supply chain information competency, supply chain agility, and firm performance of firms in the manufacturing sector. A brief outline of the research, the research problem and proposed module outline, research objectives, the design process, data analysis and ethical considerations were highlighted.

CHAPTER 2: THE MANUFACTURING SECTOR OF SOUTH AFRICA

Chapter two defined the manufacturing firms, both from an international perspective and from a South African perspective. It also describes and explains the importance of the manufacturing sector to economic growth and the various challenges and problems faced by these firms in this sector.

CHAPTER 3: THEORETICAL REVIEW

Chapter three presented the resource-based view (RBV) theory, dynamic capability (DC) theory and supply chain network (SCNT) theory based on the previous literature. Literature review on supply chain network design was presented.

CHAPTER 4: SUPPLY CHAIN INFORMATION COMPETENCY, SUPPLY CHAIN INTEGRATION, SUPPLY CHAIN AGILITY AND FIRM PERFORMANCE

Chapter four reviewed the literature on supply chain network design, supply chain information competency, supply chain integration, supply chain agility and firm performance. A conceptual research was developed, based on the literature and the hypothesis statements posited.

CHAPTER 5: RESEARCH DESIGN AND METHODOLOGY

This chapter discussed issues such as the sampling technique, method of data collection and statistical techniques also receive attention.

CHAPTER 6: DATA ANALYSIS

This chapter covered Descriptive statistics with SPSS and CFA and path modelling with AMOS formed subsequently for the structural equation model.

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

This chapter covered recommendations based on the final conclusion followed. Future research options are identified. The limitations of this research study were reflected upon. Finally, the contribution of this research study was considered.

1.13 SUMMARY OF THE CHAPTER

This chapter serves as a roadmap for the entire research study and provides an overview of the research title, the nature of the study constructs, namely, supply chain network design, supply chain information competency, supply chain integration, supply chain agility and firm performance, have been highlighted. The conceptual framework indicating the causal relationships between the study's constructs, the research hypotheses, the study objectives, target population, significance of the study and methodology were provided. Lastly, the research flow structure of the chapters was outlined.

Given the theoretical objectives introduced in this chapter, the next chapter presents the background of the manufacturing sector of South Africa and the challenges and problems faced by these firms.

CHAPTER 2

AN OVERVIEW OF THE MANUFACTURING SECTOR

2.1 INTRODUCTION

Chapter one provided a brief overview of the background, research problem, the significance of the research and the research process, with specific reference to supply chain technologies, agility and firm performance as the main concepts for this study. In this chapter, a comprehensive literature study on various aspects pertaining to the manufacturing sector and its characteristics is undertaken.

The chapter provides an overview of the manufacturing sector of South Africa and its history. The role of manufacturing firms in the economy and their import and export experience are explored. This chapter also provides an account for industry analysis, domestic prices, regulatory framework and characteristics of high growth manufacturing firms in South Africa are examined. The handicaps and government support to firms in this sector are also investigated.

The South African government has recognised the importance of the manufacturing sector as the biggest employer, innovators of new products and engines of economic growth. This means that the success of this sector in South Africa is significant to the continuous development of the economy. With this recognition and the importance of manufacturing, the manufacturing sector, therefore, has an obligation to be successful in their business environment. They also need to position themselves strategically within their business environment and become innovative to satisfy the future needs of the country as well as the economy. It is only when the manufacturing sector is thriving can they contribute significantly to the wealth and development of the South African economy (Seda 2012:13).

2.2 THE SOUTH AFRICAN MANUFACTURING SECTOR

"Located at the southern tip of the African continent, South Africa borders Namibia, Botswana, Zimbabwe and Mozambique and has more than 1500km of coastline along the Atlantic and Indian Oceans" (Das 2011:02). South Africa is home to about 51,73 million people. Figure 2.1 illustrates the geographical layout of South Africa (Census 2012:14).

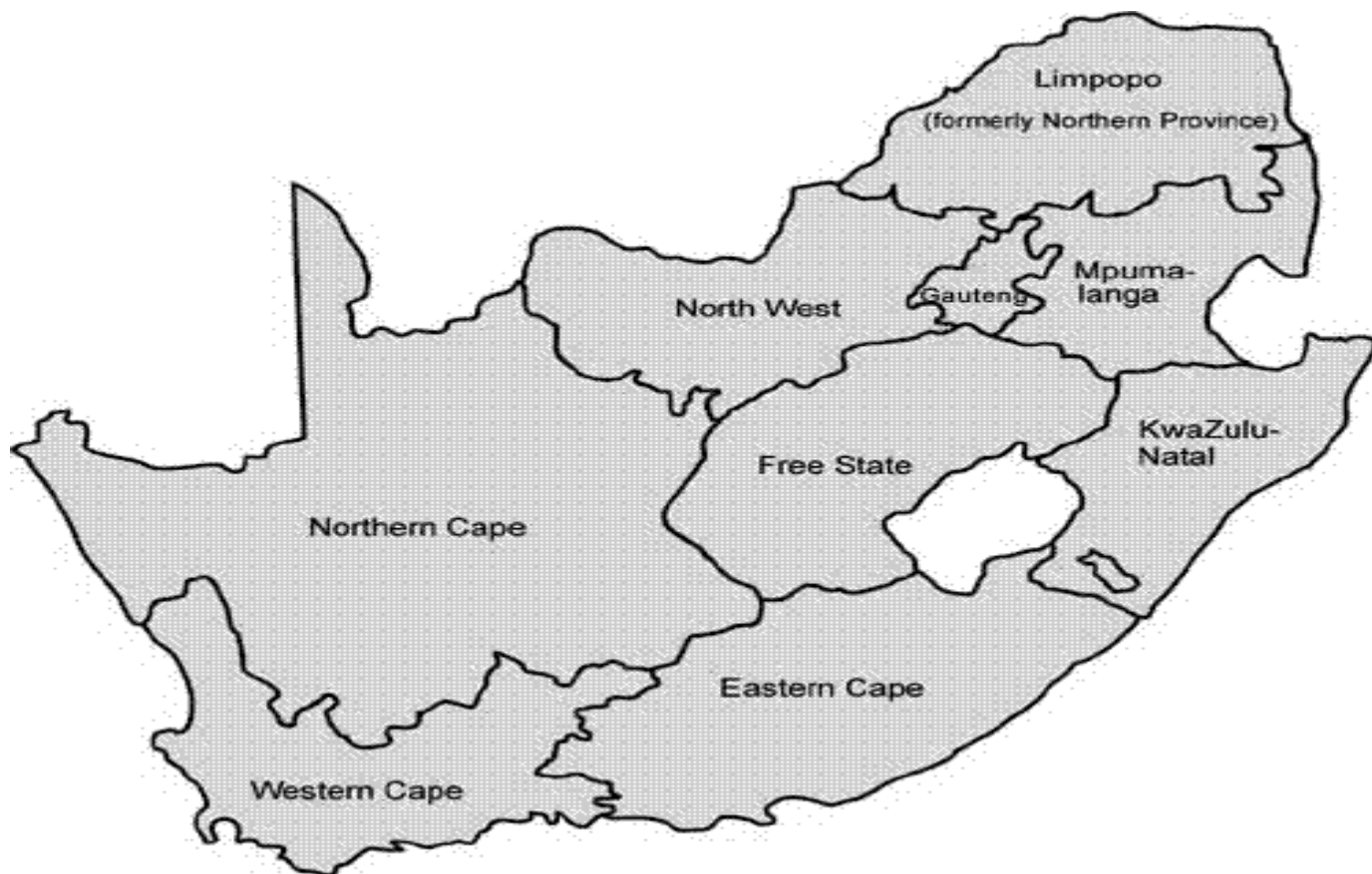


Figure 2. 1: Geographical layout of South Africa.

Source: Mulabisana, Cloete, Mabasa, Laurie, Oelofse, Esterhuizen and Rey (2018:282)

Table 2.1 shows that Gauteng province has the highest population of (14 717 000), followed by KwaZulu-Natal Province (11 384 700), Western Cape Province (6 621 100), Eastern Cape Province (6 522 700), Limpopo Province (5 797 300) and then Mpumalanga with (4 523 900), North West Province (3 979 000), Free State Province (2 954 300). The smallest population by province is the Northern Cape (1 225 600). Table 2.1 also illustrates the population growth that South Africa has experienced since 1996, which has not been met by growth in job opportunities.

Table 2.1: South African Population

Province	Census 1996	Census 2001	Census 2009	Census 2018
Western Cape	3 956 875	4 524 335	5 822 734	6 621 100

Province	Census 1996	Census 2001	Census 2009	Census 2018
Eastern Cape	6 147 244	6 278 651	6 399 053	6 522 700
Northern Cape	1 011 864	991 919	1 145 861	3 979 000
Free State	2 633 504	2 706 775	2 845 590	2 954 300
KwaZulu-Natal	8 572 302	9 584 129	10 267 300	11 384 700
North West	2 727 223	2 984 129	3 409 953	3 979 000
Gauteng	7 834 125	9 388 854	12 272 263	14 717 000
Mpumalanga	3 123 869	3 365 554	4 019 939	4 523 900
Limpopo	4 576 566	4 995 462	5 104 868	5 797 300
South Africa	40 583 573	44 819 778	51 287 561	57 730 000

Source: Census (2018:14)

In search of job opportunities, South Africans have relocated from other provinces, primarily to Gauteng, the Western Cape and KwaZulu-Natal, respectively. From Census 2011 to Census 2018, Gauteng Province has seen the highest number of relocations (2 444 737) (16.61 per cent) followed by Kwa-Zulu Natal (1 117 400) (9.81percent) and then the Western Cape (798 366) (12.05 per cent). This is due to the economic activity taking place in these provinces. Gauteng has the highest population, although it is the smallest South African province (1,4 per cent), Figure 2.2. Depicts the distribution of land by provinces and Kwa-Zulu Natal (7,7 per cent) has the second smallest land area, followed by the Western Cape (10,6 per cent) despite being in the top three most populated provinces of South Africa. The above highlights the economic and population concentration levels, which are not supported by the availability of land.

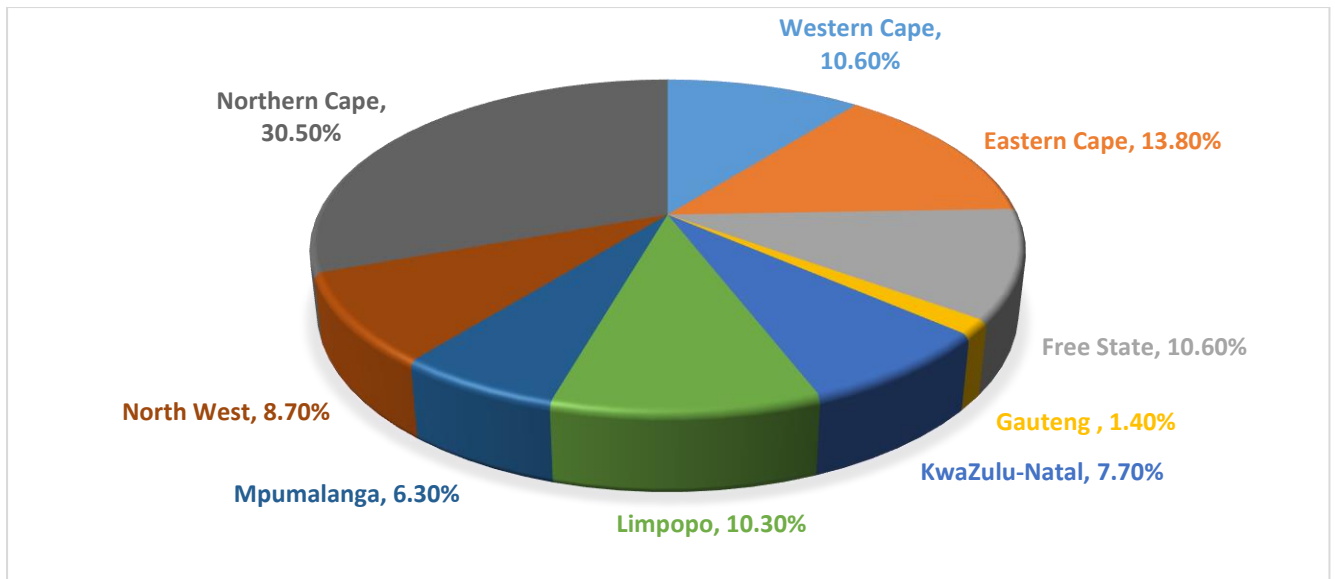


Figure 2. 2: Distribution of Land by Provinces

Source: Census (2012:13)

Figure 2.2 also shows that the Northern Cape has the most significant slice of South African land (30.5 per cent). However, it has the smallest population (1 225 600). This is due to its low contribution to the 'country's GDP; from 2002 to 2012, it averaged 2.2 per cent (Gross domestic product 2013:10). This highlights the underutilisation of land for economic activity despite the Northern Cape being one of the four provinces located on the coast.

Through its 1500km of coastline, South Africa houses seven ports. Figure 2.3 illustrates the contribution of each port to the South African economy. Figure 2.3 also shows that the Western Cape has the most ports (Cape Town, Mossel Bay, and Saldanha Bay). This accounts for the 'province's status in the top three provinces that contribute to the GDP of South Africa, although its ports contribute an estimated 30%, as can be seen in Figure 2.3. The Eastern Cape has two ports (Port Elizabeth and East London) contributing an estimate of 6 per cent as per Figure 2.3. This is due to its lack of contribution to the GDP, ranked fourth in Figure 2.3. One can conclude that exports and imports play a vital role in the 7.5 per cent contribution made by Eastern Cape to the 'country's GDP.

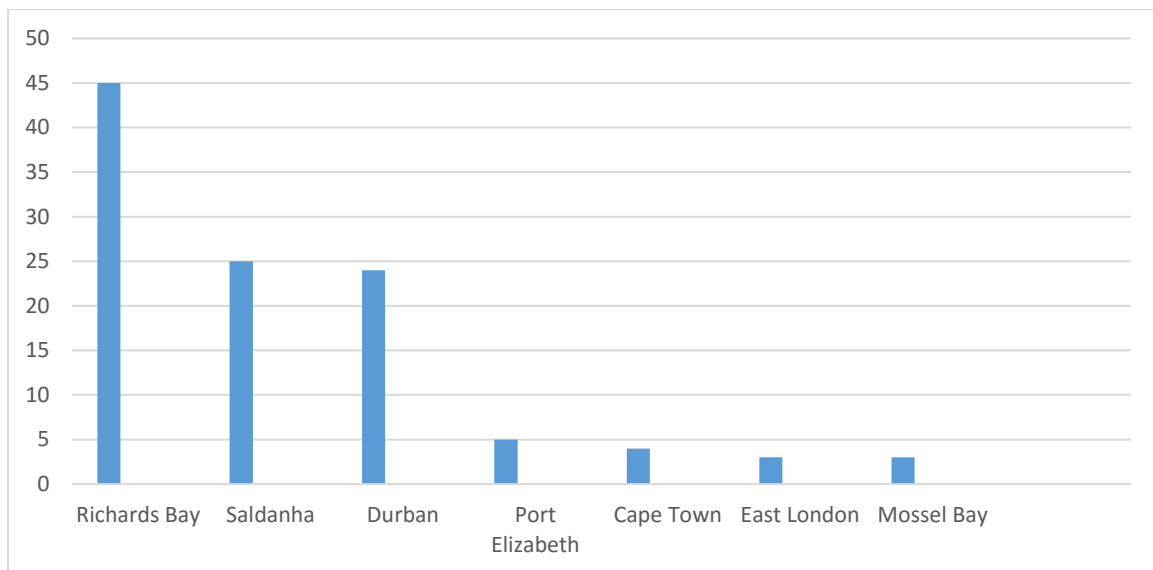


Figure 2. 3: Contribution of South African Ports

Source: Tang (2008:12)

As per Figure 2.3, KwaZulu-Natal has two of South Africa 'n's biggest ports (Richards Bay and Durban), which make an estimated contribution of 64 per cent. This accounts for its status in the top three provinces contributing to the GDP of South Africa as can be seen in Figure 2.4. It can be concluded that imports and exports are at the centre of 'KwaZulu-Natal's economic landscape.

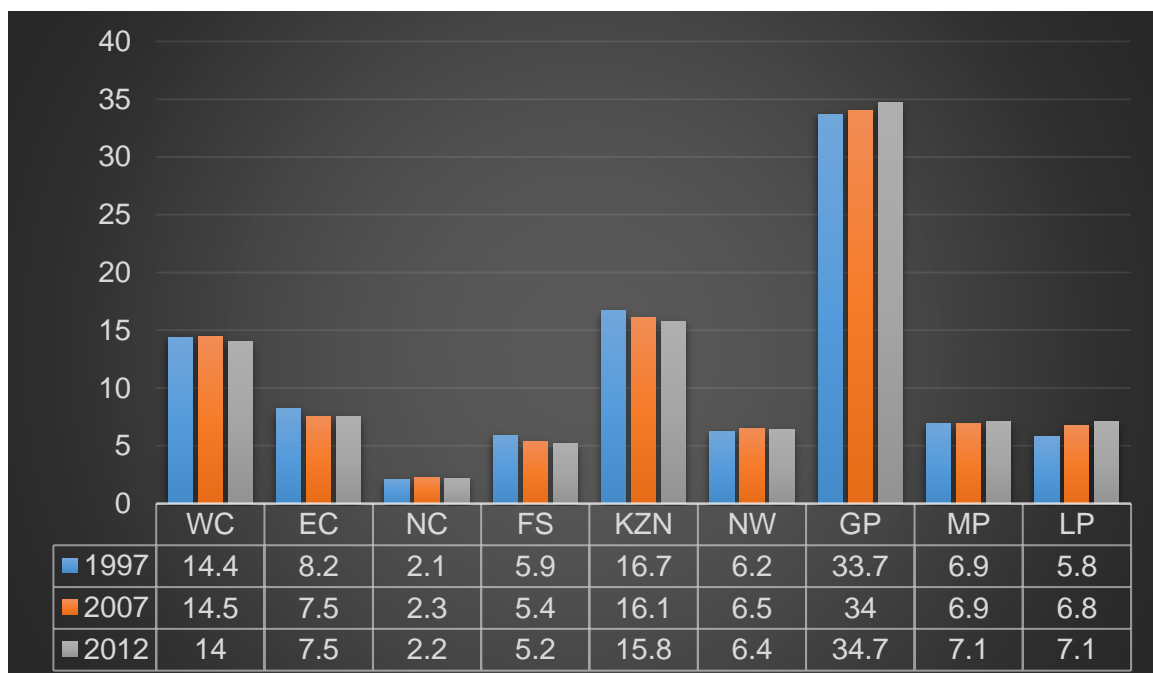


Figure 2. 4: Provincial Contribution to South African GDP: 1997, 2007 and 2012

Source: Gross Domestic Product (2013:10).

Despite the fact that Gauteng has the smallest share of land in South Africa (Figure 2.2), Figure 2.4 shows that it contributes the majority to the 'country's GDP at 35 per cent. Manufacturing (12.8 per cent), wholesale, retail and motor trade, catering and accommodation (14.8 per cent), general government services (17.5 per cent) and finance, real estate and business services (23 percent); this propels Gauteng as the leader in GDP contributions (Gross domestic product 2013:11). 'Gauteng's ability to have an import and export market is contributed to its industrial processing zone situated at OR Tambo international airport, accounting for 35 per cent of GDP (Ganotakis 2013:50). One can conclude that Gauteng is the core of the South African economy.

2.2.1 Global and Local Definition of the Manufacturing Sector

According to the Statistical United Kingdom (UK) (2011:68), the manufacturing sector can be defined as the "Agglomeration of businesses engaged in chemical, mechanical, or physical transformation of materials, substances, or components into consumer or industrial goods. Helfat and Winter (2011:1240) defined manufacturing as the branch of manufacture and trade based on the fabrication, processing, or preparation of products from raw materials and commodities: "A system of value-creating activities required to develop, produce and deliver goods and services to customers. Activities may stretch from research and development (R&D) at one end to recycling at the other." This includes all foods, chemicals, textiles, machines, and equipment.

The manufacturing sector in South Africa can be defined as the process of converting raw materials, components, or parts into finished goods that meet a customer's expectations or specifications. Manufacturing commonly employs a man-machine set up with division of labour in a large scale production (Mitusch & Schimke 2011:30). Industries at a Glance defines the manufacturing sector as part of the goods-producing industries super-sector group that comprises establishments engaged in the mechanical, physical, or chemical transformation of materials, substances or components into new products (Industrial Glance 2014:31).

2.3 BACKGROUND OF THE MANUFACTURING SECTOR

In a statement by the former president of South Africa, Mr Mbeki (2011:61) contended that while the virtues of globalisation are quickly extolled, casualties such as the South African manufacturing sector also exist. He stated that in 1980, 30 per cent of the country's output came from manufacturing, a situation which does not compare favourably to 15 per cent contribution of manufacturing output currently. This, he said, has contributed to the unacceptable levels of unemployment. Unlike China and India, South Africa already had a thriving manufacturing sector, and while developed countries rushed to supply the newly industrialised Asian nations with capital goods to fuel their growth, the South African manufacturing sector was left behind.

At a sectoral level, the slowing down in South African growth may be attributed chiefly to the poor performance of the secondary sector, particularly manufacturing (TIPS 2009:2). The Trade and Industrial Policy Strategies (TIPS) study echoed Mbeki's (2011:63) sentiment that this is important, given that manufacturing has, for many decades, been the main driver and measure of economic growth locally and internationally. The report further noted that before the crisis, utilisation of manufacturing production capacity increased faster than investments in manufacturing which is an important point, considering investment is required to foster new job creation (Zuppo 2012:2).

Whereas a decade ago, the manufacturing sector was the largest employer in the country; the sector is currently well behind government services. Together with a parallel drop in the mining and agricultural sectors, the South African economy has been totally reconfigured into a raw mineral exporter and consumer economy (Ramos & Ford 2014:458). The previous president alarmingly presumed that South Africa is turning into a settlement in financial relations with China and India and that the nation is "eating ourselves through our common asset riches" (Opperman 2012:21).

The South African Government is aware of the situation and, through the Industrial Policy Action Plan (IPAP2), attempts to promote long-term industrialisation and industrial diversification that will hopefully bring about less reliance on commodities. The lofty purpose of the IPAP2 is to expand production in value-added sectors of the economy with high employment and growth multipliers that can be competitive in export markets and compete locally against imports (Republic of South Africa 2010a:1).

The IPAP2 document further accentuated the urgency of the situation in that it stated that South Africa has no alternative action than the proposals in the policy action plan. Manufacturing is seen as an engine of long-term sustainable growth and job creation for developing countries (Yan & Sengupta 2011:360). The policy document portrayed South African growth in the past as being reliant on growth in consumption, fueled by credit extension (Wong & Wong 2011:950). The document stated that between 1994 and 2008, 7.7 per cent annual growth was recorded in consumption-driven sectors compared to the 2.9 per cent annual growth in the productive sectors of the economy. This has meant that even at the height of the South African average annual growth of 5.1 per cent between 2005 and 2007, unemployment still hovered near the 23 per cent level (Terziovski 2010:880).

The relative profitability of manufacturing, as part of value-added production, has been low as a result of a number of factors that include (Republic of South Africa 2010a:5):

- A volatile and lack of a sufficiently competitive rand;
- The cost of capital relative to South Africa's trading partners and particularly the capital channelled towards value-added sectors such as manufacturing that results in the limited allocation of said capital;
- Monopolistic provision and pricing of key inputs;
- Aged, unreliable and expensive infrastructure system;
- Weak skills base and system; and
- Inability to adequately leverage public capital and other areas of public expenditure.

Further worsening for this sector has been the recent electricity price hikes that will adversely affect the economy's production side. Recently, Stewart Jennings, the chairperson of South Africa's Manufacturing Circle, argued that having already adopted compound increases of 14 percent over the past four years, a further envisioned two increases at the 25 per cent level would have severe consequences for a sector that has shed 300 000 jobs since 2008 (Lamprecht 2011:121).

Roger Pitot, executive director of the National Association of Automotive Component and Allied Manufacturers (NAACAM), echoed the previous sentiment and reported that for some of their affiliated member companies, electricity currently comprises 15 per cent of their total

cost (Lamprecht 2011:124). According to Pitot (2012:122), a short-term relief is needed for manufacturers that are heavy electricity users. In the medium term, the government should upgrade infrastructure, especially in ports and rail, as the number of products transported per road is too high. The government should also focus on ensuring labour stability as strikes significantly dampen productivity.

The manufacturing sector revealed heterogeneous performances at sub-sector level prior to the global financial crisis (Vachon & Klassen 2008:233). Market changes were observed since the 2000s with some industries shrinking while other sub-sectors were sustaining and even growing (TIPS 2009:2). The report further noted that before the global financial crisis, utilisation of manufacturing production capacity increased faster than investment in manufacturing which is essential considering investment is required to create additional jobs (Tsai, Lee & Wu 2010:241). Table 2.3 indicates the real value addition of specific manufacturing sub-sectors.

Table 2.2: Manufacturing Sub-Sectors' Share of Total Manufacturing by Real Value Added (%)

Sub-sector	1994	2000	2010
Food	6.7	4.4	5.3
Textiles	6.1	4.1	2.6
Paper and paper products	8.5	6.8	7.3
Coke and refined petroleum products	1.3	2.5	4.1
Basic chemical	8.0	11.4	13.1
Plastic products	6.0	5.3	5.2
Basic iron and steel	7.2	8.7	8.9
Machinery and equipment	8.6	5.4	4.2
Motor vehicle, parts and accessories	8.6	15.5	19.4
Other manufacturing	1.2	0.9	0.8

Source: TIPS (2010:8)

Analysing the above table, the TIPS report highlighted the performance of the motor vehicles, parts and accessories sub-sector that has more than doubled its operations since 1994, which

attributed it to the Motor Industry Development Programme (MIDP). Textiles have performed poorly and are significantly down from 1994 levels in terms of real value added (Venkatesh, Thong & Xu 2012:111)

Table 2.4 presents South African total manufacturing trade from 2005–2011 with Figure 2.4 displaying the country’s manufacturing trade balance.

Table 2. 3: Total South African Manufacturing Trade (Rbn)

Year	Manufacturing exports	Manufacturing imports
2005	203,779	295,409
2006	242,392	381,821
2007	304,857	462,399
2008	404,211	563,779
2009	287,372	428,418
2010	320,952	477,195
2011	360,938	590,344
2012	392,758	620,426

Source: Republic of South Africa (2012:321)



Figure 2. 5: South African Manufacturing Trade Balance

Source: Republic of South Africa (2011:186)

As seen in Table 2.4 and Figure 2.4, manufacturing imports have been consistently higher than manufacturing exports. Pacheco-Lopez (2005:1168) stated that imports could be seen as evidence that a market exists and as such, Foreign Direct Investment (FDI) might be attracted to the local economy. Put differently, evidence of a rise in imports in a local country could justify the investment and production of manufacturing.

2.3.1 Export Activities in the Manufacturing Sector

Exports are considered suitable for economic growth. The benefits of exports for growth include knowledge economies of scale, accumulation of foreign exchange and efficient allocation of resources (Foster 2006:257). Exports, as a generator of economic growth, are therefore always included in government policy. South Africa is no exception (Edwards, Rankin & Schoër 2008:68). In 2010, the South African government launched its new strategy for economic growth and development.

The New Growth Path sets forth a plan to increase the economic growth rate to 7 per cent per annum over 20 years, thereby eliminating the persistent and large-scale unemployment that the country faces. One component of the New Growth Path is to grow the South African market through increased exports to the Southern African region and other fast-growing economies (South African Government 2010:52). Alongside the New Growth Path and the emphasis on exports, is the much-debated topic of the overvalued rand exchange rate. Recently, there have been calls from business and trade unions for the South African Reserve Bank to strengthen the value of the rand, stating that the undervalued rand is the reason for South Africa's inadequate export performance (Creamer 2010:41).

Export performance is, however, not only influenced by macroeconomic factors such as the exchange rate but also by the exporting firms' supply-side capabilities and the barriers they experience in both the entry into foreign markets and in expanding their exporting activities (Hollensen 2007:165). It is therefore imperative that both private and public sector decision-makers understand the extent of exporting firms' capabilities and the barriers that they face (Ramaseshan & Soutar 1996:55). Edwards *et al.* (2008:71) emphasise that in order to understand exporting firms in South Africa, one needs to examine the dynamic nature of firms over time and also barriers to doing business, such as electricity, customs delays and

transportation, and the use of imported inputs influence manufacturing export firms' supply-side capabilities.

2.3.1.1 Export barriers

Firm-level exports are the result of firm internationalisation, which can be defined as a strategic manner in which entrepreneurial firms can achieve growth (Suárez-Ortega 2003:410), especially those firms whose business scope has been restrained geographically or firms that are experiencing competition on both local and international fronts (Lu & Beamish 2001:567). Benefits of firm internationalisation include the improvement of a firm's financial position by generating more revenues and funds that could be used for reinvestment and growth, efficiently allocating and utilising production capabilities and improving management skills (Leonidou 2004:280; Arteaga-Ortiz & Fernández-Ortiz 2010:396).

Originally, internationalisation implied that a firm either participated in foreign markets by exporting or through foreign direct investment. Nowadays, a firm can choose to undertake international activities through exporting, licensing and franchising, joint ventures or the establishment of foreign subsidiaries. Of these, exporting is the most common and usually the norm, especially for smaller firms (Czinkota & Ronkainen 2002:819; Szabó 2002:18).

In the process of internationalisation, however, barriers exist that obstruct successful export operations and cause firms to be unable to reap the benefits mentioned above (Leonidou 2004:281). Export barriers can be defined as "all those factors – external or internal – that serve to dissuade a firm from exporting or which hinder its actual export activity" (Suárez-Ortega 2003:403). In other words, export barriers (also called problems or obstacles) occur at various stages in the internationalisation process - it could either deter export initiation or hamper the process of internationalisation (Hollensen 2007:9).

Also, firms experience the barriers differently depending on their size, whether or not they are interested in internationalising and the stage at which they are during the internationalisation process (Morgan & Katsikeas 1997:679; Jaeger 2008:32). Since Bilkey and Tesar (1977:44) and Bilkey (1978:35) pioneered the first studies, export barriers have been investigated extensively in various contexts and countries (Arteaga-Ortiz & Fernández-Ortiz 2010:411). Such research aims to identify the barriers to firm internationalisation and to provide

recommendations on how to reduce or eliminate them subsequently. Research has also been focused on smaller firms, as these firms experience more barriers than their larger counterparts that have more resources at their disposal (Jaeger 2008:58).

In the literature, a wide range of barriers have been identified (Arteaga-Ortiz & Fernández-Ortiz 2010:401). In order to explain them logically, different classifications have been used to group export barriers. A brief overview of all the various classifications follows in the paragraphs below. Leonidou (2004:283) classifies export barriers as either internal or external. Internal barriers relate to the firm's capabilities, resources and capacity to operate internationally. They are grouped as informational, functional and marketing barriers. External barriers are those factors over which the firm has no control and are a result of the environment in which the firm operates, and are grouped into procedural, governmental, task and environmental barriers.

Fillis (2002:919), for example, investigated the United Kingdom (UK) micro-enterprises' internal and external barriers to internationalisation. A further refinement of this classification is to organise internal and external barriers into four groups according to domestic or foreign location (Morgan & Katsikeas 1997:681; Crick, Al Obaidi & Chaudhry 1998:185). The first group is internal-domestic problems, which are problems that arise within the firm and are experienced in the home country. Examples include lack of qualified personnel (Yang, Leone & Alden 1992:90), insufficient production capabilities (Yaprak 1985:78) and management focusing on the domestic market (Rabino 1980:90). The second group is internal-foreign problems, that is, problems within the firm, but experienced in a foreign country. Barriers included here are high transportation costs and logistical difficulties, global payment problems (Morgan & Katsikeas 1997:686) and limited knowledge of foreign markets (Barrett & Wilkinson 1985:38).

The third source of export barriers is problems that arise from the external environment but experienced within the home country (that is, external-domestic problems). Here the complexity of the documentation required (Rabino 1980:67) and the high cost to finance export activities (Korth 1991:25) cause export barriers. The fourth group consists of external-foreign problems, which are uncontrollable problems found in international markets. Examples include foreign government restrictions and rules (Hook & Czinkota 1998:53), language and cultural

differences (Westhead, Wright & Ucbasaran 2002:61), and the intensity of foreign competition (Ramaswami & Yang 1990:199).

The fourth classification of export barriers is where the barriers are bundled into the knowledge, procedural, exogenous and resource categories (Ramaswami & Yang 1990:201). Knowledge barriers are broadly defined as the lack of information on the exporting activity or ignorance on the matter. Internal resource barriers are due to lack of finances, productive capacity or external aid. Procedure barriers are elements in the process of exporting that makes the activity difficult – for example, logistics and the documentation required. Finally, exogenous barriers include any obstacles that arise as a result of uncertainty in the international marketplace or other role players, such as governments and competitors (Suárez-Ortega 2003:409; Arteaga-Ortiz & Fernández-Ortiz 2010:412; Okpara & Koumbiadis 2011:743). South African research has not focused on export barriers but has examined the determinants or predictors of firms' export propensities and intensities.

Early work by Rankin (2001:777) examined firm-level data collected by the Greater Johannesburg Metropolitan Council (GJMC) and the World Bank in 1999. In this sample of 325 firms, 71 per cent of firms exported, which export intensity was, on average, 18 per cent of output. However, less than half of the firms exported more than 10 per cent of their output. Larger firms were more likely to export. The exporters typically produced more output per employee, and they had higher average labour costs. The more efficient firms are, the more likely they are to export outside of the Southern African Development Community (SADC) (Toktay, Wein & Zenios 2000:1333). Rankin (2001:795) argued that there might be some efficiency threshold that firms have to exceed before they can export globally.

In later work, Gumede (2004:388) re-examined the NES data using information from 941 firms, of which 415 were exporters. Correlation and regression analysis were undertaken to examine export propensities and intensities. The results from a logistic regression showed that the probability of exporting is positively associated with firm size, age, linkages, access to information, and whether a firm was constrained by competition in South Africa. The export intensity was positively associated with the number of employees, access to information and linkages. It was negatively associated with sunk costs, financial constraints and an unstable exchange rate.

Further work by Rankin and collaborators (Timmons & Spinelli 2007:1384) also examined firm-level data collected by the World Bank Investment Climate Assessment (ICA) Surveys in 2003. This was a survey of predominantly manufacturing firms (603 firms) in the metropolitan areas of the Gauteng Province, Western Cape, Eastern Cape and KwaZulu-Natal. Edwards, Rankin and Schoër (2008:87) examined exporting, labour demand and wages using firm-level data matched with workers from the 2007 survey. They found that exporters were more likely to employ older workers, males and workers with more education. However, when they controlled for firm size, job type, sector and province, the differences are not significant.

They also considered direct exporters and significant exporters that export a greater share of output, but this did not affect the type of people employed. Only the export destination came up as important where workers employed by Southern African Developing Community (SADC) exporters were more likely to be male and younger than those employed by non-SADC exporters. Edwards *et al.* (2008:89) also estimated Mincerian wage equations to determine whether there is a difference in earnings between workers at firms with different types of export behaviour. They found that working for an exporter does not imply different levels of earnings, although it did seem that significant exporters paid higher wages. However, SADC exporters paid lower wages than other firms.

Edwards *et al.* (2008:67) summarised the South African literature on South African exporting firms. The basic facts were that South African exporters were more substantial and more productive than non-exporters, but relatively few firms exported, and they exported only a small proportion of output. Also, the productivity of exporters has been closely linked to the export destination with the results showing that firms that export beyond the SADC were more productive. Other contributions to the South African literature have focused less on exporters, but have examined aspects that may be relevant as export barriers.

Rankin (2006:242) examined the regulatory environment and the impact that it has on manufacturing firms using data from the 2004 ICA survey. Krugell and Mathee (2010:314) employed the 2009 ICA data to examine access to finance, sources of finance and productivity. The results showed that firms that were finance-constrained were more vulnerable to shocks and competition as well and were weaker contributors to employment creation and growth. They were typically small and less established. They held less stock and had lower capacity

utilisation. They were unlikely to be exporters or to introduce new products in response to competition.

The results from the regression model confirmed that access to finance and different sources of finance were drivers of productivity at the firm level. Loots and Krugell (2011:241) also built upon Rankin's work by developing indicators of infrastructure service delivery using the 2009 ICA dataset. The results showed that the firms that were surveyed did not perceive infrastructure to be a significant obstacle to doing business and the majority experienced average and above-average infrastructure service delivery. The services received by large firms raised the most significant concern, and there did not seem to be systematic delivery differences between the four major South African cities (Pitot 2012:258). There was a positive correlation between the aggregate infrastructure service delivery measure and output per worker.

2.3.2 Import Activities in the Manufacturing Sector

The lack of dynamism in the manufacturing sector has been seen as a critical factor explaining slow growth and high unemployment in South Africa since the ending of apartheid (Rodrik 2008:54; DTI 2010:486). Concerns have been expressed over the 'deindustrialisation' of the economy. Maia (2011:521) reflected on falling shares of manufacturing in GDP and employment, which over the past decade have co-incided with the rapid growth of imports from China.

Since China joined the World Trade Organisation (WTO) in 2001, bilateral trade between South Africa and China has proliferated. In 2009, China became South African's largest export market, ahead of the United States, and its most significant supplier of imports, ahead of Germany (Tambunan 2008:99). These imports are overwhelming of manufactured goods, while South African exports are mainly natural resources. The growth and composition of bilateral trade flows with China have fed concerns about deindustrialisation and became an issue in South African's engagement with China (Sun & Sohal 2009:133).

President Zuma commented at the Forum on China–Africa Co-operation (FOCAC) in Beijing on July 2012 that an unequal trade relationship based on the supply of raw materials was unsustainable (Mail & Guardian 2012:10). The common perception in South Africa is that the effects of the growth of trade with China has been negative for the manufacturing sector, with

several industries, most notably textiles and clothing, demanding increased protection from imports from China (Morris & Einhorn 2008:358). The Free Trade Agreement between the South African Customs Union (SACU) and China first mooted in 2004 faced considerable opposition by business associations (Lennox 2008:4) and unions (Mde 2005:19) within South Africa.

The current position of the Minister of Trade and Industry, Rob Davies, is that a conventional free trade agreement with China is not in the interests of the country (Langeni 2012:59). In addition, Chinese import penetration tended to reduce the employment intensity of production, raising productivity within industries. There is also evidence that imports from China contributed towards lower producer price inflation in South Africa, which moderated increases in consumer prices and helped to curtail production cost increases.

2.3.2.1 Industry analysis of this sector

The growing Chinese presence in South Africa's total imports is reflected in the scope and dominance of imports from China in specific products and manufacturing industries. Table 2.3 reports the share of China in total South African imports and total domestic consumption for 44 manufacturing industries between 2000 and 2010. In the mid-1990s, China dominated as a source of imports in the traditional labour-intensive sectors such as clothing, footwear and other manufacturers (toys), but by 2010, its dominance had also shifted to high-technology electronics and machinery sectors (Hollensen 2007:16).

For example, China accounted for between 48 per cent and 77 per cent of total South African imports of knitted and crocheted fabrics, clothing, leather and leather products, footwear, household appliances, electrical lamps, furniture and other manufacturing in 2010 (Morali & Searcy 2013:639). It is only in the resource-based products (dairy products, other food products and beverages) that China remains outside of the top 10 sources of imports, but even in these industries, China's rankings and share of total imports rose dramatically over this period (Mirescu 2010:5).

The extent of the impact of imports from China across the manufacturing sector is also reflected in the rising share of these goods in domestic consumption (termed import penetration and with 'consumption' defined in this article as domestic absorption, including intermediate input use

as well as all final demand) (Yan & Sengupta 2011:369). On aggregate, imports from China rose from a negligible 0.4 per cent of domestic consumption in 1995 to 6.7 per cent in 2018, with much of the increase occurring after 2010. Indeed, during the past decade, China has accounted for over three-quarters of the increase in import penetration of the South African market (Melnik, Narasimhan & Decampos 2018:1888).

Looking across the sectors, all manufacturing sectors in South Africa experienced increases in Chinese import penetration ratios between 2000 and 2017 (Stats SA 2018:13). In contrast, substantial increases in the share of imports from China in domestic consumption were recorded from 2000 to 2017 in knitted and crocheted fabrics (38.4 per cent points); footwear (32.2 percent points); television, radio and other electronic equipment (28.5 percent points); clothing (22.4 percent points); electric lamps and lighting equipment (21.8 percent points); and general-purpose machinery (19.4 percent points) (Srikanth & Puranam 2018:459).

Table 2. 4: Share of Imports from China in Total South African Imports and Domestic Consumption, 2000–2010

		Share of China in total SA imports (Percentage)		Chinese import penetration (Percentage of Consumption)		
SIC	Industry description	2000	2010	2000	2010	2017
301	Meat, fish, fruit, vegetables, oils & fat	4.1	4.3	0.6	0.9	5.6
302	Dairy products	0.0	0.8	0.0	0.0	1.9
303	Grain milling & animal feeds	0.2	4.1	0.0	0.4	2.3
304	Other food products	0.5	4.0	0.0	0.3	3.9
305	Beverages	0.1	0.2	0.0	0.0	2.5
311	Spinning and weaving	10.1	43.5	2.8	18.2	4.1

		Share of China in total SA imports (Percentage)		Chinese import penetration (Percentage of Consumption)		
312	Other textiles	12.1	38.2	1.7	12.6	8.9
313	Knitted and crocheted fabrics	13.8	66.7	3.7	42.2	0.6
314/ 5	Clothing	51.9	75.1	5.9	28.3	-1.6
316	Leather and leather products	17.7	49.0	6.0	19.1	15.4
317	Footwear	40.6	76.8	13.7	45.8	10.5
321	Sawmilling and planing of wood	0.0	5.8	0.0	0.8	-13.3
322	Wood and wood products	5.2	24.6	0.5	2.1	-0.6
323	Paper and paper products	0.4	8.6	0.1	1.3	8.4
324	Publishing	0.9	5.7	0.2	1.4	-11.0
325	Printing and related services	10.2	43.0	0.1	0.4	-10.0
331/ 2	Coke oven and petroleum products	10.6	2.8	0.8	0.7	16.5
334	Basic chemicals	3.5	12.6	1.4	5.4	7.2

		Share of China in total SA imports (Percentage)		Chinese import penetration (Percentage of Consumption)		
335	Other chemicals	1.7	7.2	0.6	2.7	12.8
337	Rubber products	2.5	23.1	0.6	9.6	-2.4
338	Plastic products	7.7	22.3	1.1	3.4	-1.0
341	Glass and glass products	6.7	38.6	1.6	8.8	12.9
389	Other transport equipment	1.1	3.8	0.6	1.9	-8.8
391	Furniture	6.1	48.1	1.0	14.7	10.2
392	Other manufacturing	21.3	48.7	2.3	8.0	12.2
	Total	4.9	18.5	1.1	5.9	6.7

Source: Industrial Development Corporation (IDC) and Statistics South Africa (2018:691) data

2.3.2.2 Domestic prices

These imports from other developing countries have been associated with downward price pressure on South African producers (Neneh 2011:179). Figure 2.5 presents the weighted average price of South African imports of manufactured goods from China relative to imports from other countries, based on unit values at the HS six-digit level. Imports from China are around 63 per cent of the price (unit value) of imports from other developing countries and only a third of the price of imports from developed countries (UN Comtrade 2012:586).

The vast differences in import unit values across countries within the disaggregated HS six-digit categories are suggestive of a high degree of within-product specialisation. Similar heterogeneity in import prices within disaggregated product categories is found for the United States (US) (Fontagné, Gaulier & Zignago 2008:70). One implication of this finding is that industry-level analyses such as this one may exaggerate the extent to which Chinese products compete with other imports and with domestically produced products (Schott 2008:42). By

specialising in different products, domestic firms can insulate themselves from import competition.

Nevertheless, the vast differences in relative prices imply that the shift in the composition of South African (SA) imports towards China will have contributed towards declining aggregate import prices at the product level. This, in turn, will have contributed towards lower producer and consumer prices (Nenzhelele 2009:109). This effect of imports on aggregate prices can be shown using the aggregate producer price indices for South Africa. For example, producer prices of imported manufactured goods rose by 3 per cent per year from 2000 to 2011, which was less than half the 6.3 per cent annual increase in the producer price of South African produced manufactured goods (Singh & Power 2009:193).

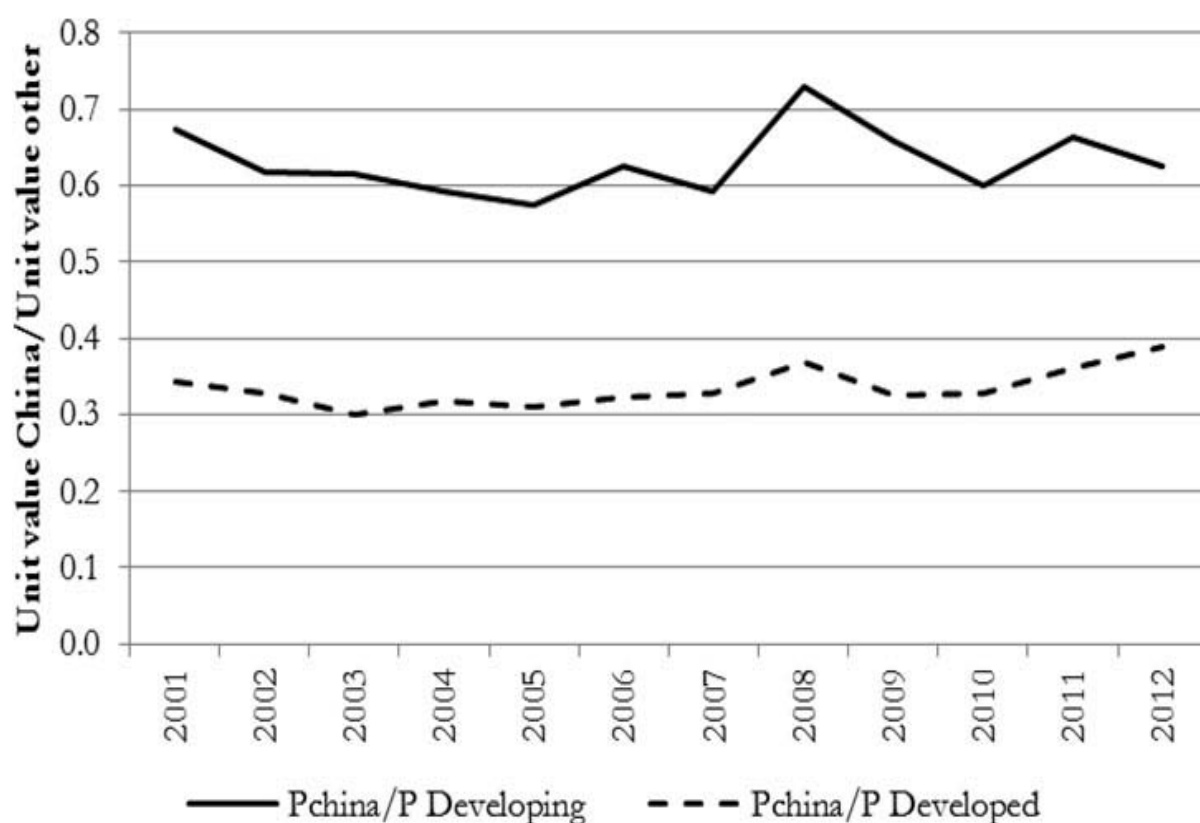


Figure 2. 6: Price Per Unit of Imports of Manufactured Goods from China Relative to Imports from Other Countries, 2001–2012

Source: UN Comtrade (2012:593) data

It is these price pressures and sharp increases in import penetration, particularly in the labour-intensive industries, that have given rise to significant concerns amongst domestic manufacturing firms and, in the case of clothing products, elicited the imposition of import

quotas on imports from China in 2007 and 2008 (Edwards & Rankin 2012:154). Were it not for these quotas, the level and increase in import penetration in clothing may have been even higher.

The fact that imports from China have increased their share of domestic consumption of manufactured goods in South Africa does not necessarily mean that they have displaced domestic production and employment (Edwards, Naughtin & Rankin 2011:92). In some cases, China may have replaced imports from other countries. Imports of intermediate and capital goods from China may have enhanced productivity and stimulated output growth in downstream industries (Edwards & Rankin 2012:214). In simple accounting terms, imports from China still represent a small proportion of overall domestic consumption, suggesting that domestic factors (such as demand or domestic factor prices) may dominate output and employment levels as well as trade flows, including imports from China (Jenkins 2008:75).

Although the threats and opportunities associated with bilateral trade with China receive considerable media attention, there are no detailed studies of the direct impact of China on South African manufacturing output and employment. There is some evidence that Chinese competition reduced prices of products in South Africa, particularly of clothing, leather products and footwear (Edwards & Jenkins 2013a:301; Morris & Einhorn 2008:369; Rangasamy & Swanepoel 2011:155). For example, Edwards and Jenkins (2013a:309) present econometric estimates of a producer price equation using 44 manufacturing industries (excluding tobacco) over the period 1993 to 2011. They estimate that Chinese import penetration reduced producer price inflation by around 0.3 per cent per year from 2005 to 2011 (Fedderke 2012:26).

Imports from China; therefore, moderated increases in consumer prices and helped to curtail production cost increases. However, the downward pressure on producer prices from imports from China will also have increased pressures on competing South African producers (Dunne & Edwards 2007:52). The implications of these price decreases for production and employment in the South African manufacturing sector has not been comprehensively explored. There are, however, several previous studies of South African manufacturing that have looked at the impact of trade liberalisation or globalisation more generally on production, trade and employment (Edwards 2001a:42).

2.4 THE ROLE OF THE MANUFACTURING SECTOR

The manufacturing sector has been central to the performance of many economies in the world as growth in this sector creates jobs that spill over into other sectors of the economy, thereby increasing a country's intellectual capital and innovativeness and driving growth in the demand for highly skilled workers and scientists (Deloitte 2010:211). Each dollar's worth of manufactured goods is reported to create another \$1.43 of activity in other sectors; this is twice the \$0.71 multiplier created by the services sector (Jonsson & Subramanian 2001:200). Furthermore, the trend of globalisation has created an increasing openness for the manufacturing sector where manufactured goods still account for the largest share of international trade (Organisation for Economic Co-operation and Development 2007:82).

The manufacturing sector has been the principal source of economic growth and recovery for the United States (US) after the 2008 financial crisis. In the first quarter of 2012, the country's growth output increased by 5.5 per cent (United Nations Industrial Development Organisation 2012:190). The sector was also responsible for restoring Japan's growth post its earthquake disaster where the country's manufacturing output increased by 2.6 per cent in the first quarter of 2012 (United Nations Industrial Development Organisation 2012:191).

The competitive landscape of the sector has changed rapidly over the last decade. The most competitive location for manufacturing now and in five years was reported to be Asia, more specifically with China holding the primary position, India revered as the second most competitive location for manufacturing and the Republic of Korea as number three (Ramanathan, Gunasekaran & Subramanian 2011:37). In effect, this shift has toppled the manufacturing superpowers of the 20th century, namely, the United States, Japan and Germany (Deloitte & the US Council on Competitiveness 2010:91). South Africa is currently ranked 22nd in the global manufacturing index but is expected to move to the 19th position in the next five years. South Africa would then surpass developed countries like the United Kingdom, Ireland and Italy (Helfat & Winter 2011:1246)

Dr Rob Davies, the Minister of Trade and Industry in South Africa, stated that the manufacturing sector is crucial to the long-term growth and economic well-being of South Africa (Davies 2012:69). While acknowledging the vital role the sector had to play in the South African economy, Dr Davies also expressed his concern over the less than satisfactory

performance of the sector since the mid-1970s. The minister positioned the increasing domestic input costs in the form of rapid electricity increases and labour costs as the main reasons the sector had experienced difficulties over the years (Davies 2012:70).

The manufacturing sector directly contributed to approximately 14.6 per cent of South Africa's GDP in 2011, making it the second-largest contributing sector to the South African economy after the finance, real estate and business services sector (Lamprecht 2012:121). The sector also contributed 31 per cent to South Africa's R1.6 trillion turnover in the fourth quarter of 2011 and had been recognised as the fourth largest employer in South Africa, absorbing 14 per cent of the country's total employment (Statistics South Africa 2012:98).

The multiplier effect of R1 investment in the manufacturing sector in South Africa is reported to lead to an R1.13 in overall output, an R0.13 increase in total exports and an R0.35 increase in government fiscal revenues (Pan-African Investment & Research Services 2011:233). The manufacturing sector has further been reported to attract the highest priority for South Africa where a projected 10 year forecast in the manufacturing GDP with a baseline average growth of 3.4 per cent per annum would generate R184 billion in output, 158 000 new employment opportunities, R116 billion in investments and R52 billion in exports (Pan-African Investment & Research Services 2011:234). This highlights the perception of the significance of the manufacturing sector to the world economy and more particularly, South Africa.

2.5 THE REGULATORY FRAMEWORK

The intricacy of the regulatory environment and a large number of bureaucratic needs are some of the challenges that are facing manufacturing firms. As noted by Ndlovu (2002:100), the procedure for registering a firm, attainment of the needed licences and the cost of compliance can be a significant deterrent for entrepreneurs, which are the processes that start from the formation of the business, reporting processes and the tax requirements.

Whilst the regulatory structures are required for the functioning of businesses; overregulation is a global problem to the competitiveness of the commercial industry. As indicated in the Global Economic Small Business Monitor (GESBM) (2010:523) survey, government policies are one of the key factors constraining the development of manufacturing firms. Although there is some progress in improving the tax regime for firms, it can be argued that, in order for the

manufacturing industry to play a more significant role in job creation, more can be done to improve the tax regime for firms.

Inefficient government bureaucracy, red tape associated with starting up and managing a firm, in particular, time and cost of compliance, and restrictive labour regulations continue to be cited as areas of concern. Labour regulations are currently ranked as one of the most problematic factors for doing business in South Africa, especially in the manufacturing sector as its highly dependent on labour (Ramanathan & Muyldermans 2010:342).

South Africa has hugely restrictive labour policies and the new labour regulations being promulgated have been stated as being even more restrictive than the existing problematic policies currently in place. As cited in the Report on Doing Business (2011:523), labour legislation should work towards balancing worker protection against employment restrictions and it should not only favour the employed but should be flexible enough to allow the unemployed the ability to successfully seek employment, as well as allowing businesses to grow and expand without the fear of punitive or overly burdensome sets of laws.

In the past, firms were exempted from several government regulations, but things have changed to the degree that the identical regulations faced by more prominent companies are now applicable to small firms (Gligor & Holcomb 2012:307). Regulations governing the establishment of businesses are incredibly intricate and conflicting, which is why firms find it so complicated to conform to them, as the South African government has invented new methods of bureaucracy that are considered as the most critical hindrance for firms to conduct or establish businesses in South Africa (Small Business Project 2003:176).

The South African (GESBM) Report (2009) indicates that the South African government's over-emphasis on Black Economic Empowerment (BEE) initiatives is one of the factors hampering entrepreneurship, particularly concerning young black South Africans (Nieman & Neuwenhuizen 2011:218). Analysts argue that BEE does not create entrepreneurs, but takes political leaders and politically connected people and gives them assets that they are unable to manage (Hollensen 2007:33). Taking assets from people who were managing them and merely giving them to people who cannot manage them does not add value. In fact, value is destroyed, and instead of creating a wave of new entrepreneurs, BEE creates a class of idle rich politicians (Chopra & Meindl 2013:258).

The former president of South Africa, Mr Thabo Mbeki, once argued that the conglomerates are developing a culture of entitlement, while South Africa needs a culture of entrepreneurship (Mbeki 2011:153). The current debate on crucial business issues, including nationalisation of crucial businesses, especially in the mining sector, raises a cause of concern for entrepreneurs in the manufacturing industry as they rely mainly on natural resources as factors of production (Blome, Schoenherr & Rexhausen 2013:1271).

Firms are always tempted to avoid registration and formal compliance with regulations because this requires time, effort and money in terms of fees and, sometimes, legal assistance. As noted in the Global Insight Report (GIR) (2009:47), a high proportion of entrepreneurs are short of the skills to abide by the legal and tax requirements facing registered firms. Manufacturing firms are hindered by the enormous administrative and cash flow burden that registration adds to the firm (Mangan, Lalwani, Butcher & Javadpour 2012:2366). Each firm has to act following a range of regulations, which includes attaining the necessary permits and licences as well as complying with the health and safety regulations (Wells & Hungerford 2011:166).

Whilst it is essential generally for the well-being of the entire population, this proves to be encumbering to some of the manufacturing firm owners in terms of time and money that could have been spent growing the business (Gyau & Stringer 2011:132). Environmental regulations, workplace rules and the paperwork associated with tax compliance contribute to most of the burden. The research revealed that manufacturing firms hiring fewer than 20 workers have an upper annual regulatory problem per worker than firms employing more than 500 employees (Bellamy, Ghosh & Hora 2014:366). A disproportionate quantity of authoritarian work has to be completed by the firms and other owners, which leaves less time for administration of the firm that would produce healthier results for the company (Henrekson & Johansson 2010:965).

The other factors that need to be taken note of by manufacturing firms are the country's taxation regulations and legal structure. The South African legislation makes starting up and running a firm arduous as owners must comply with various legislative requirements (Ndlovu 2002:111). International evidence suggests that the regulatory environment has a significant influence on the survival and growth of firms. As quoted in the GIR (2009:50) report, compliance costs in South Africa amount to 8.3 per cent of turnover for non-manufacturing firms with annual sales of less than R1 million and 0.2 per cent of turnover for the manufacturing firms with sales of

R1 billion or more. According to GIR (2010:109), this showed that regulatory compliance costs in South Africa in 2008 were about R79 billion or 6.5 per cent of GDP.

As indicated by the Global Competitive Index (GCI) (2010:524), South Africa's restricted employment regulations are regarded as one of the most significant regulatory burdens to industry growth, especially in the manufacturing sector. Policies that are not necessarily related to the firms' industry and which have a notable effect on the efficient and effectiveness of the business were also mentioned, for example, the government's unproductive policies on crime, poorly conceptualised and implemented educational policies and the mismanagement of initiatives, such as the Skills Education and Training Agencies (SETAs) (Ei-Gohary 2012:1234).

2.6 THE BENEFITS OF THE MANUFACTURING SECTOR

Many studies (Vivarelli 2004:46; Stam & Schutjens 2005:351; López-García & Puente 2009:88; Daunfeldt, Elert & Johansson 2015:3; Minola, Vismara & Hahn 2017:59.) have identified the benefits of high growth firms (HGFs), namely, job creation, high levels of innovation, human capital, growth ambition, market orientation, teamwork and networking, export-orientation, inter-nationalisation, spill-over effects, amongst others. This study only focuses on some of these.

2.6.1 Job Creation

While the manufacturing sector remains a crucial player in the creation of jobs in most countries (Henrekson & Johansson 2009:717), prior empirical evidence has highlighted the fact that it is a small number of high-growth, high-quality manufacturing firms that account for a significant percentage of jobs created by this sector. Autio (2005:213) in the GIR report on "high-expectation entrepreneurship" also elucidated that 80 per cent of total job creation was generated by manufacturers who represented less than 10 per cent of nascent and new entrepreneurs.

In the UK, it has been established that over 50 per cent of jobs created by all new firms ten years later in this sector, is generated by only 4 per cent of new start-up survivors (Chopra & Meindl 2013:262). This statistic clearly propounds that job creation is not merely a numbers game depending on the number for new firms in an economy but rather a significant effect on

job creation can be achieved by increasing the number of high-growth, high-quality manufacturing firms. Henrekson and Johansson (2009:72) highlight that these high-growth firms make up for the deficiency in job and wealth creation by the typical new firm. Since it is evident that only a limited number of so-called high growth manufacturing firms make up the bulk contribution to job creation (Schreyer 2000:494; Fritsch & Weyh 2006:247), understanding and identifying these firms in an economy has become a key policy measure in most countries.

Robert E. Litan, the vice president of research and policy at the Kauffman Foundation, proposed that "since fast-growing young manufacturing firms account for a disproportionate share of net job creation, policymakers who are worriedly poring over unemployment projections might instead seek to foster the creation of more high-growth firms" (Chuttur 2009:42). High growth manufacturing firms generally exhibit some key characteristics. Some of these features that have been widely acknowledged include innovation, networking, market orientation, teamwork, human capital, organisational structure, firms' growth ambitions (Wells & Hungerford 2011:166).

2.6.2 Innovation

O'Sullivan and Dooley (2008:54) define innovation as "the process of making changes, large and small, radical and incremental, to products, processes and services that results in the introduction of something new for the organisation that adds value for customers and contributes to the knowledge store of the organisation". According to Lee and Hsieh (2010:134), Drucker (1985:68) defines innovation as resources' new ability to create wealth, which can be trained and learned. Mitusch and Schimke (2011:7) identified innovation activities to be amongst the key drivers of the establishment of a healthy stock of high growth firms, which they termed 'gazelles'.

Empirical studies by the Organisation for Economic Co-operation and Development (OECD) (2002:561) point out that innovation is a driving force in high-growth firms and that most high-growth firms respond to their customers' needs in novel and precise ways, maintain especially close relations with their clients and innovate to respond to their specific requirements and are more heavily committed to research and development. It is further established that a firm's growth is tightly bound up with its ability to innovate and that the durability of growth is related

to a firm's skill at creating an upward spiral of innovation (Gligor & Holcomb 2012:352). Continual innovation encourages steady or regular product, production or organisational inventiveness.

Findings from a study by Vincent and Van Mil (2004:141) point out that firms can overcome the negative impact of competition on performance through creative innovation and invention. Innovation is the specific tool of firms as it is a means of exploiting change to accomplish different businesses or services (Mirela 2008:300), and is also an essential factor in a firm's survival, development and business success (Utterback 1996:22). Krotowski (2012:61) asserts that about 1/3 of economic growth is influenced by technological change, which thus explains why innovation and technological advances are vital to the survival of every economy.

Branscomb and Auerswald (2002:101) propound that incremental technological advances alone are not enough to ensure sustained growth and economic security, but that sustained economic growth will only occur when radical technological innovations and inventions are present (continuous introduction of genuinely new goods and service that will disrupt the markets and, in return, create new industries).

2.6.3 Human Capacity

The OECD (2001:293) defines human capital as the "knowledge, skills, competencies, and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being". Fatoki (2011:111) states that the concept of human capital implies an investment in people through education and training. Human capital can be divided into general and specific human capital (Ganotakis 2010:78). General human capital refers to the acquisition of inclusive formal education and training that is relatively transferable across firms and industries (Carrera 2003:287).

Specific human capital refers to skills pertaining to a specific job (or position) that does not affect the productivity of employees working in other firms (not transferable to other occupations). The Department for Business, Enterprise and Regulatory Reform (BERR) (2008:249) found that high growth firms in the United Kingdom and the United States had higher levels of human capital and skills than lower growth firms. Furthermore, the BERR (2008:258) study also established that high growth firms tend to have founding entrepreneurs

and management teams with higher educational attainment and skills levels than their lower growth counterparts.

Bruderl and Preisendorfer (2000:67) explicitly emphasise that firms owned by entrepreneurs with more educational background were more likely to experience fast growth. Chandler and Hanks (1994:178) established that high human capital employees facilitate firm growth by enabling management and owners to implement their growth goals. Likewise, López-García and Puente (2009:219) point out that high-growth firms spend more time and money on staff training and on hiring more qualified workers than the low growth firms. Additionally, another study by Enterprise Information Management (EIM) (2006) identified human capital to be the critical success factor for Europe's most dynamic entrepreneurs in the 1980s.

2.6.4 Growth Ambition

Friar and Meyer (2003:150) assert that high-growth firms contribute more to economic growth than lower growth firms and start-ups in general. Empirical research by Schreyer (2000:168) accentuates that it is not merely the creation of new firms that is the key to job creation but rather the relatively small number of fast-growing new firms that account for the lion's share of net new job creation. Wiklund and Shepherd (2003:1923) found the growth intentions of entrepreneurs to be positively related to actual firm growth. In identifying the possible determinants of growth ambition, Verheul and Van Mil (2008:340) identified the individual-level determinants such as socio-demographic factors (gender, age, and education), personality characteristics (opportunity, perception, risk attitude, entrepreneurial self-efficacy) and start-up motivation to be important in the pursuit of firms' growth.

Other studies (Vivarelli 2004:4; Stam & Schutjens 2005:357) identified factors such as opportunity-based entrepreneurship, the availability of a massive information set, and a spatially broad market orientation in the start-up phase to be factors that distinguish entrepreneurs of future high growth ambitious firms from entrepreneurs of low growth ambitious firms. Wiklund and Shepherd (2003:1930) further elucidate that the effect of growth motivation on realised growth is moderated by the level of education and experience of the entrepreneur, the dynamism of the environment in which the firm operates: education, experience and environmental dynamism magnify the effect an entrepreneur's growth motivation has on the realisation of firm growth. Fischer and Reuber (2003:346) established

that networking among peers and mentoring by experienced entrepreneurs/managers is an effective and efficient mechanism to improve the growth of new firms.

2.6.5 Market Orientation

Ferrell (2010:29) defines market orientation as "an organisational culture, which provides norms for behaviours that focus on assessing and acting on customer's needs and anticipating and responding to competitor's 'actions'". A prior study by Hult and Ketchen (2001:902) postulates that market orientation is an excellent source of competitive advantage for firms. Kotler and Kruger (1995) propound that market orientation is a prerequisite for business success because it results in sustainable competitive advantage.

Competitiveness is an essential construct of economic development and affects a firm's ability to create jobs. Mason (2011:384) notes that high-growth firms always have a robust market orientation and customer engagement philosophies. Market orientation has been widely established to have a positive and significant effect of firm performance (Chuttur 2009:69). This possibly explains the superior performance of high growth firms.

2.7 REVIEW OF SOME KEY INNOVATION NOTES IN THE SOUTH AFRICAN MANUFACTURING SECTOR

A lack of innovation has been identified as one of the impediments to the growth and survival of manufacturing firms in South Africa. A study by Krause, Schutten and du Preez (2012:205) found that many firms in South Africa were still in the early stages of open innovation rollout. Krause (2011:253) identified the lack of open innovation, in many respects, as an untapped opportunity for South African firms and that innovation is especially relevant for manufacturing firms since it has been internationally quoted as one of the key drivers in firm success. Additionally, another study by Nenzhelele (2009:119), on the factors influencing the productivity of firms in South Africa, established that up to 53 per cent of manufacturing firms do not reward their employees for excellent innovations, which accounts for one of the reasons, amongst others, as to why the level of innovative ideas in firms is slow.

Neneh (2011:228) found that only 50 per cent of firm's practices innovation and that innovation and firm accuracy are the two capabilities that are seen to affect firm practices. Likewise,

Neneh and Smit (2012:3049), in their study, established that only 36.75 per cent of manufacturing firms are innovative in South Africa. Therefore, given the low level of innovation identified in most researches in South Africa, it becomes imperative to enhance the level of innovation as an essential factor in a firm's survival, development and success (Utterback 1996:90) and also a key driver for the establishment of a healthy stock of high growth firms (Mitusch & Schimke 2011:42). The manufacturing sector in South Africa suffers a crisis of low human capital. Toomey (1998:220) elucidates that the unemployed in South Africa are mostly unskilled or semi-skilled individuals.

The lack of skills is a critical concern, especially for manufacturing firms, as the likelihood of creating employment might not have any positive marginal effect on productivity as skill levels are low. This suggestion is in line with the growth theory that propounds that a firm's growth rate is associated with the growth rate of output per person, which is a consequence of the person's human capital (Solow 1997:230). Therefore, with a high number of unskilled or semi-skilled unemployed people in South Africa, it will be more feasible to first increase their education and training before adopting them into the formal economy through employment in the manufacturing sector. A study by Herrington (2009:397) established that the lack of human capital (education and training) is the highest cause of new manufacturers' failures in South Africa.

Labuschagne (2010:123) is of the view that South Africa's under-achieving human capital is the main reason for its low level of competitiveness. In the 2011 Competitiveness Index, South Africa dropped from 44th position to 52nd position out of 59 countries in the 2011 IMD World Competitiveness Yearbook. In an OECD (2008:106) review of national policies in South Africa, it was identified that the enrolment and graduation patterns in higher education were very low, especially in the fields of mathematics, science and technology. This OECD analysis elucidates that the higher education system in South Africa was far from accomplishing its function "in terms of producing the high-quality human capital needed to propel and sustain the social and economic development of South Africa."

Education has been established as one of the five key priority areas by the South African government (Department of Government Communication and Information System 2012:218). However, over half of the job-seeking population still lacks some primary education, as highlighted in the second quarter labour force survey by Statistics South Africa in July 2012.

The report (2012:108) elucidates that of a total of 4.5 million people looking for work in the second quarter of 2012, 58.6 per cent of the job seekers did not have matriculation. This indicates the lack of human capital in South Africa and poses a severe problem for manufacturing firms seeking skilled workers in specific domains.

The Grant Thornton survey in the second quarter of 2012 identified the lack of a skilled workforce as one of the biggest obstacles to economic growth in South Africa (SAinfo 2012:244). Pitot (2012:176) and also notes that a lack of skills, experience and knowledge are some of the critical factors limiting entrepreneurship. How then do we expect manufacturing firms to achieve their role of fostering economic growth and development, while the necessary skills to drive business success are not available? A couple of studies of this sector in South Africa have identified the positive impact human capital has of the growth and performance of firms (Rogerson 2008:341). However, Pitot (2012:184) highlights that even the manufacturing owners in South Africa lack the skills, experience and training associated with the firms they create.

Kleynhans (2006:57) also notes that the level of education in South Africa needs to be generally increased as low levels of literacy amongst entrepreneurs and unskilled workers hamper trainability. Human capital can, therefore, be used to improve the job creation ability of South African manufacturing firms in two ways. First, increasing the human capital of the manufacturing owners will increase their ability to identify and act on opportunities, thus shifting the curve from high necessity to great opportunity entrepreneurship in South Africa. Secondly, raising the human capital of the job seekers will make them employment ready and boost their ability to increase the per person output of firms. It should also address the critical skill shortages in the South African economy, thereby increasing the likelihood of absorbing the unemployed into the economy.

Concerning the growth ambition of manufacturing firms in South Africa, Mirescu (2010:45) points out that the South African economy is characterised by a low growth rate, high inflation and a high rate of unemployment. Fatoki and Garwe (2010:5) propound that despite the great efforts by the South African government, new firms have achieved limited growth. These researchers further assert that the real issue in new firm growth is that new firms in South Africa do not move from the first stage (existence) to other stages such as survival, success, take-off and resource maturity and, as such, do not provide their benefits to society. The Accelerated

and Shared Growth Initiative South Africa (2009:301) drew attention to the fact that on average, a growth rate of 5 per cent between 2004 and 2014 was needed to achieve the social objective of the government and expected firms to contribute significantly to the expected growth rate.

Nevertheless, Fatoki and Garwe (2010:10) elucidate that most firms in South Africa do not always contribute towards the promotion of economic growth as most small firms do not grow at all since they mostly exist as necessity entrepreneurs rather than opportunity entrepreneurs. Neneh (2011:149) established that manufacturing firms in South Africa are necessity entrepreneurs. Vivarelli (2004:49) proved that firms created by necessity entrepreneurs had inferior performance to those of opportunity entrepreneurs. The high rate of unemployment of 27 (Statistics South Africa 2012:199), as is the case in South Africa, forces people into necessity entrepreneurship because they believe no other options for employment are available for them.

As such, measures should be put in place to help necessity entrepreneurs create sustainable manufacturing firms as a means to help alleviate poverty and reduce unemployment. A study by FinMark Trust (2006:11) reckons that one of the best ways to address this high rate of unemployment is to leverage the employment creation potential of small firms in the manufacturing sector of South Africa.

2.8 GOVERNMENT SUPPORT AND INCENTIVES IN THE MANUFACTURING SECTOR

The Department of Youth Development, Gender and Employment Creation established a Policy Document for the support of the manufacturing industry, which was approved by Cabinet in July 2002 (Terziovski 2010:975). The document maps out strategies to address various obstacles facing the manufacturing industry's operation. This policy document is aimed at providing a shared vision by all stakeholders in advancing the cause of firms and providing an enabling environment for them to realise their full potential. In a bid to strengthen the manufacturing sector, the South Africa government has set up a manufacturing sector bourse to promote their activities so that firms will be listed on the Johannesburg Stock Exchange (JSE) (Gogo 2013:1140).

Despite the importance of the manufacturing sector, various barriers to entry have been identified. These barriers range from a hostile regulatory environment, limited access to finance, and inadequate management and entrepreneurial skills. The manufacturing sector policy of the South African government maps out measures to address these constraints. It is recognised that although various initiatives have been put in place to support this sector, there is a need for an integrated, coherent policy and strategy for the development of this sector in South Africa (Nyoni 2002:73).

The main objective of the manufacturing industry policy is to generate sustainable employment, reduce poverty, to stimulate economic growth and generate foreign currency earnings, thus contributing to the economic well-being of all South Africans. It also aimed to create an enabling environment to double the number of firms in South Africa by the year 2007 (Cao & Zhang 2011:172). The policy, furthermore, also attempted to define how the government of South Africa, the private sector and other stakeholders could encourage and create an enabling environment for firms in this sector to grow and enhance the contribution of this sector to economic development (Blome, Schoenherr & Rexhausen 2013:1299).

The focal points of the South African government's manufacturing industry policy include ensuring the coordination of the different policies and programmes at the national level to provide an appropriate institutional mechanism to facilitate firm development efforts (Danese, Romano & Formentini 2013:132). The policy is committed to firm growth over the long term rather than dependence on any quick-fix solutions by prioritising firms and appropriately, allocating limited public resources. Lastly, the policy wants to rationalise support programmes and coordinate resource mobilisation strategies through the delegation of tasks, responsibilities and accountability (Nyoni 2002:75).

The South African government has made its position quite clear, in that it is relying on small medium and micro-enterprise (SMME) development and growth to provide the more significant part of the solution to unemployment in South Africa (Discussion Document 2002:8). The South African government has delegated the task of coordinating all government efforts in SMME development to the Department of Trade and Industry, which has consolidated its SMME strategy into the Integrated Strategy on the Promotion of Entrepreneurship and Small Enterprises (DTI 2008:2005). Therefore, the responsibility for the design and coordination of interventions belongs to the DTI, albeit that the delivery mechanism

could very well be resident in several different government departments or parastatal organisations. However, there is no apparent coordination, even though the document detailing the DTI strategy clearly indicates it to be their responsibility (DTI 2008:2005).

The government also believes that Chambers of Commerce, corporates and banks have to participate in the process of SMME development, and specifically names them in the strategy document (DTI 2008:2006). This expectation in respect of corporates and banks does not state whether this is expected over and above the requirements with the relevant Financial Services Charter and the Broad-Based Black Economic Empowerment (BBBEE) Scorecard requirements. This is looked at in the section that reviews the South African selective interventions.

In this section, the research reviews the different functional incentives executed by the South African government.

2.8.1 Functional Incentives in South Africa

The South African government has implemented many functional interventions in an attempt to improve the overall economic environment in South Africa to stimulate economic activity. These are tax relief, access to finance, market penetration, technology and infrastructure support, entrepreneurial management and development, targeted support, relationships and partnerships, and institutional reform (Curran & Storey 2012:203).

2.8.2 Tax relief

The manufacturing sector in South Africa receives tax relief from the government, that is, is it not subject to the full rate of tax. This implies that manufacturing firms have a lower corporate and capital gains tax threshold. Firms are also given a five-year grace period on taxation during their start-up phase (Kim 2014:330). This tax incentive is also used as a transitional process to encourage the graduation of small businesses from the informal to the formal sector and to widen the tax base. The South African government has also introduced tax breaks for companies that subcontract to firms or that earmark funds for the industry, such as 'business angels' (Kirchoff 2011:89).

2.8.3 Access to finance

The two principal constraints currently affecting the manufacturing sector in South Africa are limited access to finance and the high cost of finance. The secondary restrictions of manufacturing firms are the absence of security and the lack of a track record. To lessen these financial constraints on firms in this sector, the South African government has put the following measures in place, namely, credit finance, credit guarantee, and risk capital (Hinton, Mokobi & Sprokel 2006:17).

2.8.4 Market penetration

Access to markets, both local and foreign, remains a significant constraint facing manufacturing firms. Many firms in South Africa have failed to operate successfully because they do not have sufficient information and intelligence on market opportunities and market trends (Bharadwaj 2000:171). The manufacturing sector is also not geared for exports, and most entrepreneurs find the costs and complications of exporting to be onerous. To counter the market penetration challenges being encountered by manufacturing firms, the South African government has come up with the following strategies for intervention: market intelligence, business linkages, marketing and distribution support, quality assurance, and trade facilitation (Prajogo & Sohal 2003:113).

2.8.5 Technology and infrastructure support

Manufacturing firms are unable to identify sources of technologies appropriate to their specific activities due to a lack of knowledge. This technology will enable firms to service their clientele; however, they end up investing in costly technology that sometimes might not be suitable for their operations (Daft 2000:302). A lack of knowledge about information technology also hampers the development and growth of this sector in South Africa since it results in an increased cost of production, which minimises the viability of firms (Narasimhan & Kim 2002:289). The South African government has put in place various incentives that are aimed at assisting firms in their quest for growth and development. These include technology information, provision of workspace, business incubators, a national productivity centre and electronic commerce (Karedza & Sikwila 2016:33).

2.8.6 Entrepreneurial management and skills development

A lack of management skills and expertise is a significant constraint impeding the progress of the manufacturing sector in South Africa. Several studies suggest that entrepreneurs in the manufacturing sector attach a low priority to training and are often unwilling to participate in programmes that require them to finance even a small proportion of total training costs (Richardo & Wade 2001:26). The areas of weaknesses identified the range from cash management to marketing strategies and finance.

Business start-ups lack technical skills, such as designing and producing quality products, but also expertise in implementing growth strategies for their enterprises (Manyani, Onias, Hove, Mudzura, & Chiriseri 2014:131). For the South African government to address these challenges, skills development and training are being provided at the shop floor, management and entrepreneurial level (Zuppo 2006:18). Under these strategies of incentives, the main focus is entrepreneurship development, business management and support, technical skills training, information and advice (Gombarume 2014:53).

2.8.7 Targeted support

The focus of targeted support is on how best the culture of manufacturing firms can be encouraged. The South African government is paying particular attention to the growth and development of this sector through initiatives such as the cluster-based development, gender dimension, youth development and rural focus (Zindiye, Chiliya & Masocha 2012:660).

2.8.8 Relationships and partnerships

To equip manufacturing firms to deal with the new economic environment, they need technical and managerial knowledge over a wide range of business areas (Prajogo & Sohal 2003:114). A large proportion of firms in this sector have a limited range of skills, managerial knowledge and scarce resources to deal with these new challenges, such as the emergence of global competition (Van der Vaart & Van Donk 2005:52). Manufacturing firms are being encouraged to network and establish partnerships and joint ventures at local, regional and international levels with large businesses. These partnerships will facilitate the provision of capital injections, market access, managerial expertise and the transfer of technology (Daft 2000:302).

This will increase the survival rate of firms and result in them being successful and competitive in a global environment (Wagner, Fillis & Johnson 2003:343).

2.8.9 Institutional reform

The existing institutional infrastructure for manufacturing firms' support in South Africa is fragmented and needs to be rationalised to ensure better coordination. The applied strategies to enhance capacity will be through organised training programmes, attachments, hands-on technical assistance and study tours (Bharadwaj 2000:172). Capacity building programmes will include policy formulation techniques, research methods, advocacy skills and business consultancy techniques. Structures to establish an institutional framework that facilitates the growth and the development of the South African manufacturing sector will be developed (Curran & Storey 2012:206).

Government efforts to make the manufacturing sector vibrant in South Africa are being recognised, and both public and private institutions have joined hands with the government to make the industry a success. These role-players also want to achieve the objectives of generating employment in South Africa and to stimulate the economic growth rate of the country (DTI 2012:182).

2.9 NON-GOVERNMENT ORGANISATIONS' (NGOs) SUPPORT FOR THE MANUFACTURING SECTOR

There is a combination of forces, paradoxes and ambiguities related to the origin and reasons for the establishment of non-governmental organisations (NGOs). The paradoxes and ambiguity bring forth the questions as to whether NGOs have or are really playing a role in facilitating the development of the manufacturing sector in Africa thus far (Helfat & Winter 2011:1259).

The birth and growth of NGOs can be attributed to the democratisation, economic liberalisation processes and technological transformation experienced over the past two decades (Wernerfelt 2007:209). According to Habib and Taylor (1999:80), cited in De Beer and Swanepoel (2012:6), liberalisation of South Africa's government policy during the apartheid government of P.W. Botha allowed the NGO sector in South Africa to emerge and grow in the field of advocacy and socio-economic development, while at the same time making fundraising,

especially from foreign donors, very difficult. In the 1980s, the then South African government under Botha established a Community Development Committee, which made a study of community development in the homelands. The committee had representatives from various departments, but excluded people from the homelands (Ramos & Ford 2014:480).

The role of NGOs has been of tremendous significance in the developmental endeavours of both international and local communities since the outset of manufacturing. According to Chapter 1, Section (1), subsection (a) and (b), of the Non-Profit Organisation (NPO) Act 71 of 1997, NGOs are defined as either a trust, company or associations of persons established for the public purpose and income and property which is not distributable to its members or office bearers, except as a reasonable compensation for the service rendered (Tsai *et al.* 2010: 300). NGOs are also commonly known as NPOs (Non-Profit Organisations). Furthermore, NGOs are established and regulated by Chapter 3 Section 12(1) and (2) of the NPO Act 71 of 1997, which stipulates both the administrative conditions and registration requirement as an NGO (Edwards *et al.* 2008:101).

Most of South Africa's manufacturing activities are in private hands, both domestic and foreign (Creamer 2010:66). Most NGOs are small in this sector. They operate alongside several large businesses with very few medium-sized firms (Stonehouse & Pemberton 2002:860). The growth of NGOs in the manufacturing sector is sluggish, and the rate of failure high, particularly amongst the smallest NGOs. The main regional variation has to do with foreign ownership of this sector, which is more pronounced in South Africa.

In terms of ownership structure, most manufacturing firms are privately held sole proprietorships or limited liability companies. With few exceptions, most of the NGOs are involved in the processing of natural resources or the production of essential consumer goods. Most of them are either technologically efficient or involved in foreign trade (Renee 2007:53). Investment in NGOs has been marginal over the last several decades. As in other private sector activities of South Africa, most NGOs rely heavily on internal or informal sources of finance, with little access to banks and other financial institutions (Susanti 2011:210).

NGOs have the potential to play a more significant role in South African economic growth. First, manufacturing carries a higher multiplier effect than other sectors, and economies that rely more heavily on manufacturing usually generate higher per capita income. Secondly,

productivity is generally higher in manufacturing than in those sectors. As a result, overall productivity and per capita income increases as labour migrates from lower-productivity activities to manufacturing. Thirdly, manufacturing offers more significant opportunities for innovation and technological progress, which, in turn, translates into faster capital accumulation, as new generations of equipment tend to involve the latest technologies. Finally, manufacturing generates more significant spillover effects (Sheppard 2011:44).

2.10 SUMMARY OF THE CHAPTER

The main focus of this chapter includes: theoretical aspects of the concept of the manufacturing sector of South Africa and globally; conceptualisation, with specific reference to the role of the manufacturing sector in the economy; the demographic determinants of South Africa; the import and export in this sector; and government support to the manufacturing sector in South Africa. The chapter provides a review of the literature relating to the manufacturing sector and its continued decline over the years. Sadly, factors highlighted five to eight years ago are still evident as ones holding back the competitive advantage endeavours of the manufacturing sector of South Africa.

One of the essential characteristics of a flourishing and growing economy is a booming manufacturing sector. South African has undergone a remarkable transition to democracy. This transition has not been smooth, and the country suffers from several socio-economic problems. The manufacturing sector is particularly strong and is a significant employer. The country has the opportunity and capability to develop its manufacturing industry and to lead the other nations on the African continent. The manufacturing environment has changed dramatically and irreversibly over the past few decades. The focus has shifted from inward-looking import substitution, with substantial protection, to a globally-oriented open economy.

The next chapter focuses on the dynamic capability theory, resource-based review theory, and supply chain network theory of the previous literature. A conceptual research is developed, based on the literature, and the hypothesis statement is posited.

CHAPTER 3

THEORETICAL REVIEW

3.1 INTRODUCTION

In the previous chapter, the literature review was carried out on the manufacturing sector of South Africa. This chapter establishes the theoretical perspectives (Resource-Based View, Dynamic Capability, and Supply Chain Network theories). A literature review on supply chain network design is discussed into detail, focusing on problems, risk management, observations, evolution and trends in the supply chain.

3.2 THEORETICAL FOUNDINGS

3.2.1 The Origins of the Research-Based View Theory (RBV)

The resource-based view (RBV) explains how a company uses its firm-specific resources/capabilities, which are based on the internal strengths and weaknesses of the company to gain sustained competitive advantages (Souma, Fujiwara & Aoyama 2012:396). These resources/capabilities are distributed heterogeneously among companies and are difficult to imitate and transfer (Azma, Mostafapour & Rezaei 2012:95). Thus, RBV demonstrates that the differences in competitive advantages among different companies are owing to their various resources and capabilities. Considering supply chain resources in today's competitive environment, internal resources/capabilities only are not sufficient enough to ensure competitive advantages. Nevertheless, a company's internal resources/capabilities can enhance its ability to acquire and exploit external resources/capabilities (Lai, Shah & Schroeder 2012:678).

The resource-based view of firms describes a firm as a specific collection of resources and capabilities that can be deployed to achieve competitive advantage (Barney 1991:110). Firm resources are defined as all assets (tangible or intangible) and capabilities belonging to or controlled by a firm that can be used to implement competitive strategies (Barad & Sapir 2011:155). A firm's combination of resources forms the basis of competitive heterogeneity, where the scarcity of resources results in maximum rent generation (Bearden, Netemeyer & Haws 2011:538). Firm-specific resources and capabilities must be protected and made difficult to transfer, imitate, or replicate (Braunscheidel & Suresh 2010:119). By safeguarding their valuable resources against imitation or substitution, firms can sustain existing advantages. As

resources drive and constrain the growth of the firm, these resources play a significant role in the firm's process of capability development. It is therefore crucial for firms to acquire, accumulate, and divert resources to assemble an effective resource portfolio, thereby ensuring that they are capable of reacting, adapting, and responding to changes in volatile environments.

Resources, broadly understood, are any assets that a firm might draw upon to help achieve its goals or perform well on its critical success factors (Buvik & Haugland 2010:41). Resources include primary resources and higher-order resources (Madhavaram & Hunt 2012:69). Higher-order resources are understood as bundles of primary resources and are made up of combinations of tangible and intangible primary resources that fit together coherently in a synergistic manner to enable firms to meet their goals. They are also usually referred to as competences and/or capabilities (Evans, Joas & Sundback 2006:699). Competencies and capabilities, therefore, connote a subset of resources and consist of abilities, sets of actions, technologies, or processes that help a firm perform well against important goals or critical success factors (Meehan & Menzies 2016:3). For instance, money, experts, methodologies, specialised knowledge, reputation, and trust are all resources which are basic order resources/competencies.

RBV has been used to understand the conditions for sustainable competitive advantages. It posits that the firm's resources are the predictors of firm performance (Kearns & Lederer 2001:4). RBV provides a robust framework for analysing the relationship between supply chain competence and firm performance. To compete amid the uncertainty and changes in a business environment, a firm should develop core competencies and capabilities that may help it survive the competitive environment. Cuadros and Dominquez (2014:176) posit that "competence emphasises technological and production expertise at specific points along the value chain while capabilities are broadly based and encompass the entire value chain".

3.2.2 The Origin of the Dynamic Capability Theory (DC)

The resource-based view of the firm, initially developed by Penrose (1959:1023), proposes that a firm's competitive advantage is in large part determined by its unique resources and capabilities. A basic premise in this theory is that those firm capabilities which are rare, inimitable, and difficult to trade form the basis for sustainable competitive advantage (Barney 2010:50). Subsequent researchers have highlighted the importance of intangible resources,

such as knowledge and scientific capabilities, to competitive advantage (Henderson & Cockburn 1994:63; Petraff 2012:179). These resources are tacit, complex, and firm-specific, rendering them inimitable to rivals (Reed & DeFillippi 1990:88).

The dynamic capabilities theory (DC) approach to understanding the business enterprise builds upon the basic assumptions of resource-based view theory through its assertion that these unique firm capabilities develop over time. This accumulation of capabilities is driven by organisational learning and is moulded by path dependencies, complimentary assets, and industry opportunities (Teece, Pisano & Schuen 1997:521). This approach emphasises that it is not only the bundle of resources which matters but also the mechanisms through which firms accumulate these skills and the contingencies which constrain their direction. Teece (2010:174) characterises organisational capabilities as depending on three factors: (1) coordination/integration, learning and reconfiguration of organisational and managerial processes/routines; (2) firm-specific strategic position as defined by the firm's asset structure and resource configurations; and (3) firm history, which accounts for the path-dependent nature of capabilities.

In general, capabilities and resources evolve as firms learn and adapt to change. The evolution consists of three stages that begin with the founding stage, followed by the development stage, and finally, the maturity stage, where capabilities become more embedded within the firm's routines. Interestingly, research suggests that the type of capabilities a firm develops depends on the level of market dynamism within the external environment. For instance, capabilities developed in high-velocity markets in which uncertainty and unpredictability abound, are based on simple processes developed through rapid, iterative, and experience-based learning.

A firm's strategic approach is crucial to the development of capabilities that would best enhance the firm's competitive status (Venkatesh 2013:281). Therefore, studying organisational learning mechanisms that relate firm knowledge to capability development is crucial for understanding how dynamic capabilities evolve in response to feedback and stimuli from the external environment (Kannan 2010:207). The path-dependent nature of dynamic capabilities suggests that repeated practice and incremental learning from small mistakes will ultimately lead to capabilities that are complex, difficult to imitate, and responsive to change.

Scholars suggest that DC represents the meditational pathway through which operational capabilities affect firm performance (Ambrosini & Bowman 2009:29). There is accumulating evidence for the significant impact of operational capabilities on performance (Crook, Ketchen, Combs & Todds 2013:1141). However, when considering environmental volatility, the strategic value of operational capabilities would be primarily reduced if DCs are ignored (Wu 2010:27). DC is concerned with firm change, strategic renewal, and adaptation (Teece, Pisano & Shuen 1997:509). DC uses existing operational capabilities to exploit and seize emerging opportunities by reconfiguring and creating qualitatively superior capabilities. Through constant and purposeful creation, extension and modification, operational capabilities can be continually aligned with new market requirements and a firm's strategic needs (Griffith, Noble & Chen 2006:56; Lin & Wu 2014:407).

Concerning the relationship between DC and firm performance, however, extant DC literature is divided into two main streams (Helfat & Peteraf 2015:835). Some researchers have proposed a direct link between DC and firm performance, arguing that DCs are difficult-to-imitate combinations of resources and should, therefore, be conceived as a source of sustainable competitive advantage (Drnevich & Kriauciunas 2011:254).

On the other hand, others argue for an indirect link, because the value of DCs for competitive advantage lies in the resource configurations they create, not in DCs themselves (Zhao, Carvugil & Cavusgil 2013:203); and the value of future resource configurations varies with time and circumstance (Chen & Paulraj 2012:199). In addition, because DCs are highly patterned and repetitious organisational processes, the effort to build, exercise, and maintain DCs can be substantially expensive (Wilden & Gudergan 2015:181). Therefore, the value of DC is determined by the quickness, acuteness, and preciseness of building new resource bases (Pavlou & El Sawy 2011:235).

According to DC theory, firms accumulate knowledge, expertise, and skills through organisational learning. Learning enables firms to perform their activities in improved ways (Day 2011:184). Organisational learning occurs as individuals interact with each other and develop common codes of communication and co-ordinated search procedures. Moreover, organisational learning is not limited to internal activity but also results from assimilating and utilising knowledge generated outside the firm (Andriopoulos & Gotsi 2010:366). Learning capability describes a firm's operation to create competitive advantages through a learning

mechanism based on executive experiences and the absorption of external information and resources (Cohen & Levinthal 1999:130). Additionally, a firm needs to reconstruct or transform existing resources to deal with competition and to adapt to markets (Chapman, Moore & Thompson 2010:353).

There is evidence that some have used RBV and DC as a combined tool to investigate the different factors affecting firm performance (El-Gohary 2010:214). However, researchers working with RBV and DC have discovered a similar relationship between the two theories. This similarity is apparent between “sustainable competitive advantage” and “environmental change” from one side (RBV), and “resources” and “capabilities” on the other side (DC). In choosing the primary constructs for this research study, the research work by El-Gohary (2010:215) is cited. It stipulates the three main elements comprising supply chain network design, supply chain information competency, and supply chain integration.

RBV strategy seems to be not enough to support significant and sustained competitive advantage, especially in rapidly changing environments. The problem with RBV is that the view of the firm as a bunch of resources is very static and limited and does not provide explanations on how successful firms endure over time with an increasingly competitive environment (Grewal & Slotegraaf 2007:455). Nevertheless, those firms that have sustained good positions seem to demonstrate timely responsiveness and rapid adaptation to the environment through internal changes in their structure and resources. According to Chandra and Grabis (2007:745), DCs follow the theory of RBV of the firm. In fact, DC can be seen as a complement to the RBV approach. According to Cao, Gan and Thompson (2013:142), when referring to RBV in Ambrosini and Bowman (2009:30), this “is not only the bundle of resources that matter, but the mechanism by which firm’s learn and accumulate new skills and capabilities, and the forces that limit the rate and direction of this process”.

Recent strategic management explanations of firm performance therefore indicate that while valuable, rare, inimitable, and non-substitutable resources may be beneficial to firms that possess them, firms also require complementary capabilities in order to deploy available resources in ways that match the dynamic market conditions they face to drive business performance over time (Helfat & Raubitschek 2011:977). Nonetheless, DC theory extensions to the RBV indicate that both resources and capabilities are essential in explaining inter-firm

performance variations and that resources and capabilities also interact with one another in determining firm performance outcomes (Makadok 2011:1320).

In current information technology (IT) business value research, scholars increasingly regard supply chain capabilities (SCC) capabilities as lower-order capabilities that enable the development of higher-order capabilities, such as supply chain agility, knowledge management, as well as new product development dynamic and operational capabilities rather than higher-order capabilities in themselves (Kirchoff 2011:339). Rai and Tang (2010:7) contend that a firm's supply chain capability "represents a lower-order capability that can be leveraged to develop a higher-order process capability, which is a source of significant and sustained performance gains for the firm." Similarly, Wong, Lai, and Cheng (2012:173) propose that SC capabilities are antecedents of higher-order business capabilities, including knowledge management and agility capabilities. Following this logic, the current study proposes supply chain capabilities as lower-order capabilities that can be leveraged to develop higher-order capabilities (i.e., supply chain agility) that, in turn, directly affect firm performance.

3.2.3 The Origin of the Supply Chain Network Theory (SCNT)

The supply chain network theory (SCNT) focuses on the communication exchanges among firms that could improve their capabilities to leverage resources and skills effectively (Rabinovich, Knemeyer & Mayer 2007:662). Supply chain network theory requires firms to adopt different strategic links within the individual relationship with single suppliers as well as the entire supply chain network (Roseira, Brito & Henneberg 2010:925). The SCNT offers firms the potential to achieve low transaction costs, complementary relationships, exceed customers' requirements and provide quality products as well as quality service (Lin, Huang, Lin & Hsu 2012:450).

Despite the significance of supply chain networks for modelling complex adaptive systems, the literature has few examples of the application of the latest developments in SCNT specifically to supply chains (Stam 2014:186). Previous efforts have, in the main, adopted a relational exchange view of a network (Halldorsson Kotzab, Mikkaloa & Skjott-Larsen 2010:289) or retained the oversimplified dyadic/linear view. Instead, a supply chain can be modelled as a network by a set of "nodes" that represent autonomous business units as firms

who can exercise autonomous choices, and a set of “connections” that link them together to create quality products or services (Zheng 2011:130). Connections between firms represent exchange relationships and the underlying contract if present. When modelling exchange relationships, numerous connection types can be considered, but the critical connection types are the presence of contracts, and various flow types, including material flows, information flows and financial flows (Xie, Zhou & Wang 2010:1683).

Material flows refer to the transfer of physical products, information flows refer to the transfer of co-ordinating data, and financial flows refer to the transfer of monetary resources, all relating to the exchange of products or services. Simon (2012:764) stated that when modelling a supply chain, a unique network potentially emerges for each connection type analysed. Accordingly, graphical representations of a network based on the same set of firms, but analysing different connection types should produce different network topologies. Indeed, research conducting simultaneous analysis of separate connection types (materials flow and contracts) in various automotive supply chains has been undertaken recently by Kim, Choi, Yan, and Dooley (2011:200). They found that in one time period, different patterns of connections exist amongst the same set of firms for each connection type analysed.

Previous empirical research into other real-world networks such as: social (Newman 2010:193), business (Souma, Fujiwara & Aoyama 2012:400), ecological (Sole´ & Montoya 2012:2039), biological (Podani, Oltvai, Jeong, Tombor, Baraba´sí & Szathma´ry 2012:54), neurological (Bullmore & Sporns 2011:186) and communication systems (Jeong & Baraba´sí 2012:130) highlight a number of key, seemingly universal network properties derived from self-organising processes. These properties (Baraba´sí 2014:412), as evident in inefficient real-world networks, are a short characteristic path length; and the presence of a power-law connectivity distribution. There is sufficient argument and empirical evidence to show that these two properties are also present in inefficient supply chain systems (Rubinov & Sporns 2010:1059). Definitions and arguments for each of these properties are provided below within the context of supply chains.

First, the characteristic path length refers to the average distance between any two nodes chosen at random. As a property, the characteristic path length of a supply chain indicates the average number of firms or tiers that must be traversed between any two firms selected at random (Ravasz, Somera, Mongru, Oltrai & Baraba´sí 2013:1551). For instance, the most extended

path length in material flows would likely be between initial suppliers and final consumers, as material flows must traverse through a potentially large number of intermediary firms. A short characteristic path length demonstrates what is termed the “small-world” property, as originally defined by Milgram (1967).

An efficient supply chain would possess a short characteristic path length as there would be a relatively low number of traverses required to connect any two firms selected at random (Pathak, Dilts & Mahadevan 2012:54). Conversely, inefficiencies in a supply chain would be inferred where a longer than expected characteristic path length is present. Therefore, shortening the characteristic path length or making long-distance connections is beneficial as it would increase the efficiency of the system (Kajikawa, Takeda, Sakata & Matsushima 2010:168). A short characteristic path length in information flows indicates that the supply chain can diffuse and circulate information rapidly throughout the entire system, which facilitates more efficient material and financial flows (Mitchell 2011:289).

Secondly, a connectivity distribution refers to the average number of connections possessed by each node in the network. A power law connectivity distribution is a heterogeneous connectivity distribution indicating the presence of a small number of highly connected nodes or hub nodes (i.e., hub firms), and a large number of nodes with a low number of connections (i.e. peripheral firms) (Li, Humphreys, Yeung & Cheng 2012:117). A network whose distribution of connections among the nodes that follow a power law is known as a “scale-free” network (Barabási & Albert 2013:509).

The presence of a power-law connectivity distribution and hub firms is empirically observed in material flows in various automotive supply chains (Kim et al. 2011:209), in the UK where five major supermarket chains (for example, Sainsbury and Tesco) account for 75 per cent of all grocery sales (Ball 2004:534), and in South Africa, where Woolworths Holdings has three times the product sales of its closest rival (Gosman & Kohlbeck 2016:179). Moreover, simulations of business communication systems indicate information flows within supply chains that also demonstrate a power-law connectivity distribution, further indicating the presence of hub firms (Wang, Mo, Wang & Jin 2010:712).

Even though the complexity of modern supply chains prevents centralised control by authoritative structures, it remains true that the network leader firm can exert influence and

provide opportunities and motivation for other firms to align themselves with its own specific objectives (Cowan & Jonard 2011:93). Indeed, without the network leader firm, supply chains are unlikely to co-ordinate, self-organise, and lower transaction costs (Achrol & Kotler 2013:146). A lack of coordination in supply chains leads to firms behaving out-of-unison with one another, resulting in many inefficiencies, duplications, and an inability to adapt to change.

The SCNT helps in understanding the influence of supply chain network as a strategy to generate increased revenue growth, reduce time-to-market, lower cost, improve customer satisfaction and provide quality products and services (Zheng 2013:129, Lorentz, Kittipanya-Ngam & Sarai 2013:221). The SCNT extends the focus of this study from the single firm to a network, while also focusing on the strategic relationship and interactions with the network. A firm's competitive advantage emanates from its relationship with its own supply chain network.

3.3 SUPPLY CHAIN NETWORK DESIGN

Supply chain network design (SCND) is a collaborative relationship between individual firms for the benefit of information exchange, complementary ideas, and knowledge sharing (Chakraborty, Bhattacharya & Dobrzykowski 2014:676). Supply chain network design creates a collaborative environment that allows firms within the networks to work in a mutual relationship on ways to survive and reduce uncertainty in the competitive environment. This collaborative effort helps individual firms maximise profits and customer satisfaction (Musa & Abdullah 2014:267).

Chan (2012:329) adds that the ultimate benefits of the implementation SCNDs by firms are efficient inventory control and returns, superior customer service, improved supplier relationships, and reduced operating costs. In theory, SCND means a proactive relationship and integration among various tiers in the chain (Trkman 2013:49). Supply chain network design is a proactive strategy to cope effectively with competitive turbulences and the increasing changes in consumers' demands (Wieland & Wallenburg 2013:300). Thus, supply chain network designs are about independent firms and the relationships that connect them.

The practice of designing supply chain networks is relatively new because, historically, the design of supply chains evolved in response to changes in the business environment (Fawcett et al. 2010:222). SCND will, however, become a vital source of firm performance with the shift

from competition between firms towards competition between supply chains (Reeve & Srinivasan, 2013:50). It not only is a critical factor in determining the efficiency and effectiveness of a supply chain network (Sezen 2011:234) but is also extremely important due to the commitment of resources over long periods (Santoso, Ahmed, Goetschalckx & Shapiro 2010:97). The role of SCND in providing an optimal platform for efficient and effective supply chain management and acting as a bridge to connect supply chain strategy and the supply chain flows (Sharifi, Ismail & Reid 2006:1083) is strategic, and the importance of effective SCND has been well recognised by both academics and practitioners alike (Pangburn & Stavroulaki 2014:177).

However, from a strategic point of view, SCND thus refers to the process of determining all required components of the supply chain, including its structure and operations aligned to customer requirements and supply chain strategy (Sharifi et al. 2010:1083). SCND is a complicated task. It involves aligning customer needs with supply chain capabilities. It determines the right supply chain members and tasks that each should perform. It involves coordinating the three supply chain flows to improve responsiveness and efficiency. In doing this, SCND ensures that all these activities create value for the end customer and profitability for all supply chain partners (Fawcett 2010:216).

Through SCND, firms design their supply chain and decide what the supply chains configuration will be, how resources will be allocated and what processes will be performed at each stage (Chopra & Meindl 2010:25). From this, it can thus be derived that SCND decisions ultimately determine the capabilities and limitations of the supply chain (Taylor 2012:259) and find the best structure for it. This includes deciding on the number of supply chain members, its length, breadth, locations, systems used, and relationships (Waters 2013a:44).

In general, the idea that firm performance is influenced by the SCND is accepted (Moon 2013:20) and changes in the network design of the supply chain may improve the chain's performance (Cigolini, Pero & Rossi 2011:5919). The lack of a formal SCND can lead to a dysfunctional supply chain network when it comes to reaching goals for growth and profits (Ayers 2015:56). If firms do not design their supply chain network and merely allow their supply chains to evolve through a series of processes and choices that are made independently, a firm can expect (Fawcett 2010:216), amongst other problems, to have to deal with:

- Poor coordination of efforts;
- Incompatible information systems;
- Long-time cycles;
- Communication problems;
- Customer service issues;
- Excessive waste and environmental degradation;
- Relatively high inventory for the level of customer service achieved; and
- Lower than optimal profit.

These problems occur because of a supply chain network design that lacks transparency. Decisions have to be made independently to optimise firm results without considering the effects on the rest of the supply chain. It can be argued that a firm's key to success is its ability to design and manage the supply chain network in an agile way, assembling the 'right' supply chain of capabilities as the operating environment changes (Lu & Ramamurthy 201:97).

SCND thus includes the identification and bringing together of a group of firms with complementary competencies (Wheeler & Sayers 2011:421). The basic principle is to match the supply chain network design to its requirements. This match does not just happen, and many analyses can help (Waters 2011a:200). From literature, it can be concluded that SCND mostly consists of the three primary phases that are illustrated in Figure 3.1. In phase one, it is necessary for the supply chain network to gain an understanding of the nature of the needs of its end customers (Taylor 2010:259) and how they can be met by some value proposition (Christopher 2010:57). Firms must know how they can contribute value to meet the demands of their supply chains' end customers (Christopher 2005:57; Byrne 1998:222).

In phase two, firms must select a supply chain strategy to be able to deliver value to their end customers (Zhang 2010:279). In phase three, the SCND needs to be configured (Jacobs 2011:789). This includes deciding which supply chain partners to partner with, assigning roles and responsibilities to each of the supply chain members and establishing key performance indicators. This third phase is referred to as scoping the SCND (Barnes & Liao 2012:890). Phases two and three have to be aligned towards meeting the first phase, which is meeting the end customers' needs (Baloyi 2010:1078). SCND and supply chain configuration implies the same concept because the configuration is generally defined as the harmonic interaction of a

firm's variables focusing on strategy, design, process, and environmental aspects, which all form part of SCND (Klaas & Delfmann 2011:12).

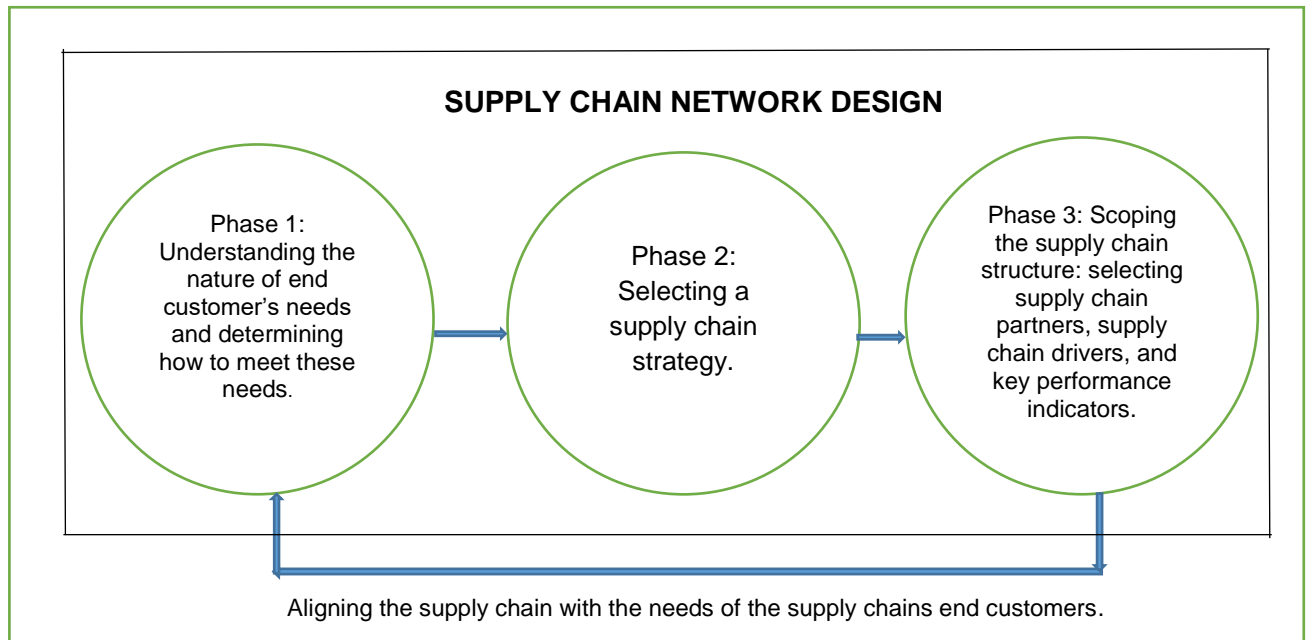


Figure 3. 1: The Three Phases of Supply Chain Network Design

Source: Christopher (2005:57) and Taylor (2004:284).

Firms need to respond to the turbulent business environment, and the success of its supply chain network design will be defined by its ability to adapt to the changes by reconfiguring existing SCNDs or assembling (or designing) new ones (Carter, Carter, Monczka, Blascovich, Slight & Markham 2007:44). Firms that have aligned the needs of their end customers with their SCND have had exceptional results. However, this alignment is too often overlooked as a source of firm performance (Andersson & Stahl 2011:670).

3.3.1 Risk Management in SCND

3.3.1.1 What is a risk?

Risk is usually defined as the probability of an unpleasant event occurrence. Whereas some areas like project management consider both positive and negative risks, often negative aspects of risk are highlighted in the literature. Risk management is identification, assessment, prioritisation, monitoring, and control of risk and uncertainty. Some believe that to manage

risk; we need to consider phases like preparation, prevention, mitigation, etc. In addition, to address the definition of risk, it is important to discuss its association with uncertainty. Rosenhead, Elton, and Gupta (1972:413) outline the concept of risk and uncertainty by dividing the decision-making environment into three main groups: certainty, uncertainty, and risk.

Uncertainty occurs in situations where it is not possible to attribute the probability of a decision's outcome (Venkatesh 2013:28). On the other hand, in a hazardous environment, the probability distribution of a decision's outcome is known. However, besides probability distribution, there are some other ways (such as fuzzy sets and possibilities) to model the likelihood of a decision outcome (Klibi, Martel & Guitouni 2010:283). As a result, the proposed distinction between risk and uncertainty is not accepted by all researchers. Uncertainty results in risk, because the risk is inherent in uncertain information, models, and situations. Interested readers can refer to Baghalian, Rezapour, and Farahani (2013:199) to see a comprehensive review about risk, uncertainty, and robustness with the focus on supply chains.

3.3.2 Risk management in SCND literature

Many research publications in the field of supply chain network design consider different sources of uncertainties in their modelling. Some of them only optimise the expected value of objective functions (stochastic SCND models), but there are research papers which also consider the performance of the chain in each realisation of the uncertain part of the model and mainly focus on decreasing the deviation between the performance of the chain in different situations, which lead to robust supply chains (Lin & Wu 2014:410). Many studies have been done in the literature in the field of managing demand-side uncertainty in SCND. The following are some of the recent research reviews done.

Qi and Shen (2010:829) introduced an unreliable supply in a supply chain (SC). They considered a multi-period problem in which the retailers of the chain order a certain product from the existing supplier in each period, and the supplier responds to orders via his facilities. The delivered amount of ordered product to the chains of each retailer includes a probabilistic shortage. Because some portion of it is lost, mistakes and damages are possible. They modelled the delivered amount as the ordered amount and a random variable associated with the supplier's facility, which serves the retailer. The objective of their model is maximising the SC

profit. They considered the given product retail price, facility location, inventory, and safety stock costs, as well as transportation and penalty costs for retailers. They used a bisection search and outer approximation algorithm to solve the model.

Yu, Zeng, and Zhao (2012:788) considered an order splitting problem in a two-tiered SCN that consists of a manufacturer and two available suppliers with disruption probability. The first available supplier has a lower price but is more prone to disruption and in contrast, the second supplier has a higher rate but lower disruption probability. Schmitt and Snyder (2010:850) considered the optimal ordering and determining the reserve quantities of a two-tiered SC, which involves a firm and its suppliers. One of these suppliers is prone to disruption and has yielded uncertainty, whereas the second one is entirely reliable and always available, but more expensive. They modelled and compared this problem in two cases: single-period and multi-period, and discussed the advantages of multi-period consideration in comparison to the other. They use the Branch and Bound technique to solve this problem.

Pan and Nagi (2010:668) formulated a robust optimisation model for the problem of SCND when customer demand is uncertain. They assume that there is an organisational web of partners wishing to work as an optimal SC and respond to an existing opportunity in the market. This SC produces a single product, and the operation time of each company is a one-time period. The model tries to choose one partner for each echelon and decides on the production plan, inventory level, and amount of backorder. The objective function minimises total costs (including cost variability, and a penalty for infeasibility).

Nickel, Saldanha-da-Gama, and Ziegler (2012:511) considered the uncertainty of the demand and interest rates in a multi-period multi-commodity stochastic SCND with financial decisions and risk management. The objective of their model is to minimise the total cost (considering the investments made, the revenues, and the transportation costs).

Klibi, Martel, and Guitouni's (2010:283) article is one of the most recent review papers in the field of uncertainty in SCND. They introduce SCND as determining location, number, and capacity of production-distribution facilities in a chain. The paper posits that there are several sources of uncertainty affecting the design of supply chain networks and categorises them from a supply chain network viewpoint in three main groups that include endogenous assets, SC partners and exogenous graphical factors. Klibi *et al.* (2010:290) stated that as the result of

these potential uncertainties, the deterministic SCND models could not guarantee the expected performance of future SCs. In addition, they state that under an uncertain environment, the level and quality of available information could vary.

Depending on the available information when making decisions, three main types of uncertainties occur randomness, deep uncertainty, and hazard. According to these articles, although there are some papers on the two first groups, there is currently no SCND work on hazard. These researchers also argue that to ensure long-term profitability and sustainable future value creation for all stakeholders, it is not sufficient to evaluate the performance of a SCN by considering static operational and financial criteria, such as economic value added (EVA), service level, market share, etc. As a result, when designing a SCN, the SC future performance needs to be evaluated by considering its robustness, responsiveness, and resilience.

3.3.3 Observations of risk management in SCND literature

In the literature, SC risk management is only considered from the perspective of the costs that can result. There is no study which investigates the advantages of risk management for a chain's competitiveness and profitability.

Several strategies are used by SCs to mitigate the negative effects of disruption in physical flows, such as having substitutable production and distribution facilities in the chain, having strategic reserves in different tiers of the chain, and keeping extra capacity of the facilities (Helfat & Peteraf 2015:840). Imposing these strategies needs some consideration that should be planned in the network design stage. A decision about the number, capacity, and location of facilities and the production flow throughout the network are made in the SCND stage (Gligor & Holcomb 2012:295).

On the other hand, the ability of a SC to supply the demand to the customers under all conditions, even in crisis, can increase customer loyalty and the attractiveness of the chain in competitive markets (Bernardes 2010:562). Being a pioneer in risk management can help a firm be able to use a crisis condition to capture the market share of the other competitors which do not have any plan to supply their customers in these conditions (Richter & Ellis 2012:439). Quantifying the risk mitigation ability as a competitive advantage, which influences SC's

ability to capture market share is the first step for competitive SCND with risk mitigation considerations. However, there is a lack of sufficient, precise, and practical means to quantify risk and its effects (Wade & Hulland 2004:130).

3.3.4 Evolution of SCND within the South Africa context

Just as the focus increased on global competition, increased attention on marketplace requirement, innovation, and verbal exchange technology have pressured the global firms to revolutionise their supply chain networks, South African firms are also stricken by those international changes and have to evolve in terms of length, shape, coordination, management, and control. New supply chains have emerged for numerous reasons – for example, in reaction to a technological breakthrough inclusive of bendable presentations (Lee & Cheng 2013:10), the emergence of a brand new product, marketplace niche (Hahn 2015:2), or new geographical markets including those emerging in Africa for numerous consumer products (Russo, Russo, Sun-Basorun & Van Wamelen 2012:542).

It can be argued that fundamental financial concerns are in the end the determinant of supply chain parameters, figuring out shape, length and the nature of trade (Casson 2013:9) but, other forces might also have fundamental effects on the configuration, operation and coordination of a supply chain network design through the years. Not only are financial and technology drivers influencing SCND but regulatory frameworks (Woody 2012), sustainability agendas (MacCarthy, Blome, Olhager, Srai & Zhao 2016:1697), political elements (Gereffi 2014:10), and strategic picks (Maestrini, Luzzini, Maccarrone & Caniato 2017:301) also influence the shape and configuration of supply chain networks.

International sourcing techniques have modified the configuration of supply networks considerably (Jia, Lamming, Sartor, Orzes & Nassimbeni 2014:285). Firms can also proactively re-engineer their networks to pursue a manufacturing and marketing technique to better serve their consumers (for example, Gasparro 2015). A variety of financial, technological, environmental and strategic elements can potentially have an impact on who participates in SCND, in which value-adding activities take place, how they're coordinated and controlled, and the way they develop and succeed in the business environment (Mol 2015:155). This technique of SCND facilitates South African firms to obtain their goals and objectives in phrases of attaining high overall performance through customer satisfaction. This means that

they ought to facilitate critical approaches such as supply chain planning, purchasing orders, monitoring, and tracking delivery, and at the same time enhance the overall efficiency of the processes (Balan, Rukshanda, Piyush & Vipul 2019:3).

These factors will enable South African firms to create a synergistic strategy to meet diverse customer demands and in turn create a seamless, synchronised supply chain network design that will lead to increased responsiveness and lower inventory costs for manufacturing firms (Mondal 2019:2).

3.3.5 Trends driving supply chain network design (Development or Movement)

The following trends driving supply chain network designs may have a positive impact on the success of firms if adhered to and are well integrated. The complexity and development of these trends cause firms to realise the need for supply chain network design. They may not survive the present and emerging competitive rivals if not part of a supply chain network.

3.3.5.1 Customer relationship management

The customer relationship management (CRM) could be a concept that tries to develop a relationship by considering two vital factors of marketing and customers (Kotler & Keller 2012:352). It is a communicating procedure between the associate firm's service and its customers so as to draw in and additionally keep the firm's true customers (Sandell & Lagrosen 2015:63). CRM implementation is a very important step in any supply chain network strategy, which, if prospering, leads to improved performance (Li, Huang & Song 2019:394). Since within the 21st era everyone and everything is obtained online, society is affected so much by the internet, a new revolution is created (Jafari Navimipour & Zareie 2015:475) and technology is seen as crucial and effective component (Zareie & Navimipour 2016b:2).

Likewise, firms are empowered to trace their online behaviour and performance, and alter costs, communication, administration and products and catch new customers by the Internet's innovation Soltania, Zareieb, Milanic & Navimipour 2018:237). Firms must precisely comprehend the requirements of customers to give information, services, and items to customers through their supply chain network arrangements (Jafari Navimipour & Soltani, 2016:1054). Since the environment of doing business has changed its concentration from product-orientation to customer-orientation, it is seen that improving relations with customers

prompts the productiveness and sustainable growth of income for firms. A research study by Sivaraks, Krairit and Tang (2011:143) demonstrates that customer-to-firm connections has been decidedly influenced by relationships built up between supply chain partners and customers.

Coordinating supply chain network design and CRM empowers firms to accomplish various enhancements in their financial and performance measurements. Be that as it may, most firms rarely consider these two notions simultaneously (Limp, Rezende & Versiani 2018:101). Liu and You (2011:3) expressed that the CRM is drawn closer from an established perspective and should be considered through supply chains. International challenge requests for the requirement for a linkage among suppliers, internal processes and customer to encourage an information stream of inbound and outbound progression of information and products/services (Sivaraks, Krairit & Tang 2011:143). This therefore, may enable firms to turn out to be progressively effective in minimising operation cost and amplifying revenue (McDougall & Levesque 2000:393).

3.3.5.2 Collaborative relationships

In the previous two decades, firms have recognised that their competitiveness could be progressed by partnering deliberately with their fundamental customers or suppliers (Lummus & Vokurka 1999:12; Kohli & Jensen 2010:3). Alongside strategic approaches, a collaborative relationship has turned into a developing subject in the literature (Yunus 2018:351). Manufacturing firms are under the strain to give quality products at the least cost inside the conceivable minimum delivery time, even during unpredictable economic conditions. Because of rivalry like improved customer service and cost reduction, firms are searching for inventive ways to create competitive advantage, and one such way is through collaborative relationship (Salam 2017:299), which can be characterised as a business procedure whereby at least two firms work together towards shared objectives (Simatupang, Wright & Sridharan 2004:58). Meanwhile, different researchers who have concentrated on the relationship aspect, characterise collaborative relationship as the arrangement of a long-term relationship whereby a firm shares information, resources, benefits and risks with its partners to achieve better performance (Ramanathan & Gunasekaran 2014:253).

Collaborative relationship is an answer when firms and organisations cannot alone discover answers for common problems to accomplish anticipated performance indicators (Allaoui, Guo & Sarkis 2019:762). Internationalisation and competitive pressures have expanded requests on firms to satisfy their customer needs everywhere throughout the world on time (Al Zaabi, Al Dhaheri & Diabat 2013:896). Supply chain management (SCM) literature demonstrates a developing enthusiasm for collaborative relationship (Kaliani Sundram, Chandran & Awais Bhatti 2016:1446). The collaborative relationship between supply chain partners has turned into a typical practice in numerous advanced supply chains (Ramanathan, Gunasekaran & Subramanian 2011:857), when conflicts and false impressions can be minimised by understanding and overseeing collaboration practices among supply chain partners.

In addition, the collaborative relationship of various actors prompts an inter-organisational relationship that likewise lessens clashes and provides the correct conditions to apply various techniques along the supply chain network (Kumar & Rahman 2016:837). Collaborative relationship can adjust a firm's internal arrangement of capabilities and lead to new technological and key strategic resources on both levels, externally and inside the supply chain (Rodriguez-Diaz & Espino-Rodriguez 2006:484; Zacharia, Nix & Lusch 2011:592). At the point when collaborative relationship is coordinated and synergistic, it is conceivable to exchange knowledge, create innovative capabilities, and produce reciprocal resources, and in this manner expand the possibility of significant value creation for the whole supply chain network (Neutzling, Land, Seuring & Do Nascimento 2018:3449).

3.3.5.3 Information technology

Numerous scholars have highlighted that information technology (IT) is basic for the firm's survival and development, and that IT is important to get an upper hand in the business environment (Mata, Fuerst & Barney 1995:488; Palvia 1997:230; Kou, Chiang & Chiang 2018:870). As per the RBV, IT can be characterised as a resource and a capability. As a resource, IT alludes to a firm's utilisation of ITs, for example, hardware, software, networks, data management and IT support services. As a capability, IT is a blend of IT resources to acquire, process and transmit information to support decision-making, streamline business processes and facilitate communication and coordination within a business as well as with external members (Wang, Dou, Zhu & Zhou 2015:1929). Recent literature proposes that the

advancement of an IT capability can possibly empower knowledge collaboration effort and innovation (Randhawa, Josserand, Schweitzer & Logue 2017:1319).

IT is a significant factor in supply chain network on the grounds that it gives information sharing and coordinates communication infrastructure that enables supply chain practices (Fawcett, Wallin, Allred, Fawcett & Magnan 2011:39). Multi-level communication that is open, frequent, balanced, and operates two ways among supply chain partners is one of the key qualities of a collaborative supply chain relationship. This correspondence enables members to build trust, commitment, interdependence, shared vision and cultural similarity, which sets the ground for the exchange of information to help supply chain partners (Gunasekaran, Irani, Choy, Filippi & Papadopoulos 2015:154). A powerful IT-empowered supply chain system can encourage information exchange between supply chain partners (Prajogo & Olhager 2012:515), which has been revealed to improve inter-firm coordination and integration between supply chain networks (Kim, Jean & Sinkovics 2018:496).

In addition, just-in-time distribution, vendor managed inventory (VMI), efficient customer response, electronic data interchange and collaborative planning, forecasting and replenishment are additionally a portion of IT initiatives that empower activities, which organisations have adopted to collaborate with their supply chain partners (Afshan, Chatterjee & Chhetri 2018:2497). Henceforth, the efficiency of numerous supply chain processes can be amplified by information exchange which eradicates errors and rework, and discharges resources for more value-added activities (Alsaad, Yousif & AlJedaiah 2018:215).

Researchers like Zhu and Kraemer (2005) emphasise that the carefully empowered integration capability of IT can bring down coordination costs in supply chains (Xu & Zhu 2009:62; Zhu & Kraemer 2005:19; Alsaad *et al.* 2018:215). By exchanging key information of products and market requests, firms will probably react to vulnerabilities in a business environment, for example, changing customer requests and fluctuating orders (Wong, Lai & Cheng 2012:162). A noteworthy advantage of exchanging real demand information within the supply chain is lessening the bullwhip effect which alludes to amplifying variations in ordering of products as they flow to the upstream of the supply chain (Fosso Wamba, Akter, Coltman & WT Ngai 2015:934). With all the day to day business challenges, firms depend on IT for support and furthermore to accomplish business goals and objectives. (Esteves, Santos & Anunciacao 2012:599).

3.3.5.4 Supply chain transparency

Supply chain transparency includes answering to and speaking with key partners to give traceability with regard to the history of the product and visibility about current activities all through the supply chain network while likewise incorporating a partner's feedback for supply chain improvement (Carter & Rogers 2008:361; Carter & Easton 2011:47). This conceptualisation fuses supply chain traceability and visibility as empowering influences of transparency that give product provenance to a wide audience of partners (Moi 2015:155). Supply chain transparency can diminish negative market flag by giving an open correspondence about how the firm is addressing delicate topics, for example, ecological or social difficulties (Gold, Seuring & Beske 2010:231).

Research work by Eggert and Helm (2003) revealed that supply chain transparency intensifies customers' discernments of value and fulfilment with the provider. For instance, process transparency is related to intensified service quality and efficiency (Kim & Davis 2016:1897). In addition, supply chain transparency empowers firms to divert product assessments beyond the final product to incorporate the whole procedure involved with creating and bringing products for sale to the public (Morgan, Richey Jr & Ellinger 2018:960). However,, transparency among supply chain members can likewise have negative results that develop as firms attempt to utilise transparency for gain at the expense of other partners (Morgan *et al.* 2018:960).

Supply chain transparency can be an approach to make willful firm supply chain responsibilities increasingly meaningful (Laudal 2010:64; Doorey 2011:588). Supply chain transparency has been professed to be significant in light of the fact that firms are frequently reluctant to deliberately assume accountability for supply chain sustainability. Moreover, increased supply chain transparency can help change the sustainability of commodity production systems. Furthermore, supply chain transparency can demystify complex supply chains, and help various members distinguish and minimise risks and improve conditions on the ground and inform whether and where an advance is being made (Gardner, Benzie, Börner, Dawkins, Fick, Garrett, Godar, Grimard, Lake, Larsen & Mardas 2018:254).

3.4 SUMMARY OF THE CHAPTER

This chapter concludes the theoretical literature review on the resource-based view, dynamic capability, and supply chain network theory. It also presents the literature review that regards supply chain network design. The day-to-day running of firms depends heavily on their ability to generate more profit for the firm and also depends on the ability to provide value-added goods and services that can satisfy or exceed customer requirements and expectations.

Exceeding customer requirements and expectations requires that firms should be more strategic, flexible and responsive. It also further requires that they network with other firms in order to overcome uncertainties successfully, both within and outside business environments. In addition, the information-sharing benefits, knowledge transfer benefits, complementary advantages as well as collaborative advantages that may result from supply chain network design require an integration strategy for achieving competitive advantages and business performance.

The next chapter discusses the literature review on supply chain information competency, supply chain integration, supply chain agility, and firm performance.

CHAPTER 4

SUPPLY CHAIN AGILITY AND FIRM PERFORMANCE

4.1 INTRODUCTION

In the previous chapter, the literature perspective was carried out on the resource-based view (RBV), dynamic capability (DC), and supply chain network theory (SCNT). This chapter's focus areas include theoretical aspects of the concept of supply chain technologies (supply chain information competency and supply chain integration), definitions of the concepts, challenges, and layers. The following concept was also analysed; namely, supply chain agility enablers, framework, and analysis and interpretation. This chapter also reviews the existing literature on firm performance in the manufacturing sector.

4.2 SUPPLY CHAIN INFORMATION COMPETENCY

Defining the concept of supply chain information competency is not straightforward because this subject has been studied by several disciplines and from different approaches (Cooper & Schindler 2010:170; Green Jr, Inman, Birou & Whitten 2014:125). However, there seems to be a consensus to treat information capability as a set of facts that fuse/integrate computer literacy, media capability, information ethics, critical thinking, and communication skills. An effective supply chain information competency package is one that enables partners to recognise the value of information and use it to make informed choices in their business environment. Supply chain information competency is essential in helping to foster a firm's competitive advantage (Peteraf & Bergen 2003:1027; Stacey & Ashton 2010:389; Van Wyk & Adonis 2013:1632).

Possessing a variety of information resources is also vital for developing a firm's supply chain information competency (Prahalad & Hamel 2012:81). Several studies confirm this view empirically (Walsh & Linton 2010:63; Swierczek 2013:246). Typically, most of these studies focused on the relationship between research and development (R&D) intensity (defined as R&D expenditures divided by sales) and innovation (defined as several patents). Consideration of the effect of various sources of supply chain information competency on a firm's agility is what is often missing (Zhao, Carvugil & Cavusgil 2013:1058).

To enjoy a lasting competitive advantage in a dynamic market, firms must nurture the ability to innovate (Jacobson 2011:782). How they do so is perplexing, given the somewhat piecemeal

list of factors identified as central in shaping a firm's supply chain information competency. These include technological opportunities (Freeman & Perez 2014:204), commitment to R&D (Caloghirou, Kastelli & Tsakanikas 2010:29), co-ordination competency (Bowman & Ambrosini 2010:289), core technology (Schumpeter 2010:183), R&D work climate, such as autonomy of R&D decision (Bock, Zmud, Kim & Lee 2009:87), and the attitudes of the top management team (TMT) toward information competency (Anand & Goyal 2010:440).

Supply chain information competency has a positive association with environmental dynamism (Kocoglu, İmamoğlu, İnce & Keskin 2011:1630). Anderson and Tushman (2010:679) propose an extended study of supply chain information competency diffusion by incorporating the effects of competitiveness on the diffusion process. Prior studies by Frambach (2010:22) and Gligor and Holcomb (2012:439) argue that the adoption of innovation by a firm has a positive correlation with the degree of competitiveness of the industry. Firms responding to supply chain information competency opportunities expect that these opportunities will provide a competitive advantage in transforming their products and/or their production processes (Klein & Rai 2010:735).

However, competency opportunities come in two primary forms, namely, competency-enhancing-improvements in the specification or performance of the supply chain that rely on existing know-how, and competency-destroying new knowledge that is fundamentally different from previous information (Idar & Mahmood 2011:3). Knowing how firms acquire the competency that underpins this supply chain information is essential. Following Penrose (1959:304), underutilised resources create managerial incentives for new capability creation. The accumulation of information competency, therefore, determines the possibility of responding to supply chain opportunities (Youssef 2010:4). As a result, the accumulation of supply chain information competency, manifest through outputs such as patents, can refer to a firm's position regarding dynamic capabilities, which provides an ability to respond to environmental opportunities.

A firm's co-ordination capability is another important factor influencing its supply chain information competency. Tzabbar, Aharonson, and Amburgey (2013:42) posit that internal communications between the teams working on information sharing, components, and systems are critical for a firm's information competency. Co-ordination capability is essential for a firm, not only to communicate with internal units but also external groups, such as suppliers, buyers,

or competitors (Hamel, Girard & Atkinson 2011:63). Better coordination may reduce a firm's transaction costs (Williamson 2010:26). Furthermore, some studies emphasise the importance of network resources toward a firm's supply chain information competency activities (Doz, Olk & Ring 2012:239; Filatochev, Wright, Uhlenbruck, Tihanyi & Hoskisson 2003:331). Therefore, co-ordination with external networks is vital to firms.

Moreover, Grindley and Teece (1997:8), and Lambert, Cooper, and Pagh (2010:3) suggest that a better co-ordination process allows firms to quickly respond to fast-changing environments. In a rapidly changing and technology-intensive environment, the ability to coordinate diverse capabilities, both inside and outside the firm, in response to changing environmental conditions, technological competencies and dynamic capabilities become intertwined. Roh, Seol, Park, Lee, Lee, Kim, and Aryanfar (2014:106) claim that increased supply chain responsiveness to volatile customer demands will enhance customer value and competitive advantage over the long-term.

The contrary view is that managers will always be sceptical about sharing information with trading partners due to the perceived complexities, risks, and costs (Kembro & Näslund 2014:179). As such, willingness to exchange information becomes a "trade-off between efficiency and the responsiveness of the information resources," particularly when sophisticated information systems are used (Du, Hu, Shi, Ma, Cheng, Chen & Ruan 2012:354).

Therefore, willingness to share commercially sensitive information with trading partners is crucial if end-customers are to be completely satisfied and the total costs to the supply chain minimised (Ellinger, Shin, Northington, Adams, Hofman & O'Marah 2012:249; Yu, Jacobs, Salisbury & Enns 2013:4545). However, the risks associated with information competency across supply chains are still not well-defined and await rigorous investigation (Baker, Polovina & Howell 2007:277; Du et al. 2014:358). As such, academics and supply chain managers have an interest in gaining a deeper understanding of the critical success factors for information competency across supply chain interfaces.

4.2.1 Supply Chain Information Competency Challenges

Marquez and Gust (2013:33) argue that supply chain information competency includes real-time, two-way data exchanges on different aspects of operations management (material flow,

order entry, shipping, and billing), as well as forecasts and plans with supply chain partners (Louw & Venter 2010:158). By sharing information, each participant receives undistorted, accurate, up-to-date information that is useful for making timely production, inventory, and logistics management decisions (Bargshady, Ahmadi, Abdulrazzaq & Zahraee 2014:8).

At the same time, data integration potentially enables supply chain partners to offer extra value to consumers and experiences an equal distribution of benefits to every supply chain actor (Kwon & Suh 2010:26). For example, a well-established benefit of supply chain information competency is its ability to reduce the bullwhip effect (Levary 2000:24; Macduffie 2010:198; Mahbub, Hasin, Aziz & Sharin 2017:236). Mason-Jones and Towill (2010:137) highlight how information competency is a strategic asset that can enrich upstream supply chain actor decision-making. Timely demand information enables reduced reliance on forecasting and buffers stocks, allowing smooth and seamless supply chain operations (Vera & Trujillo 2013:579). Extra emphasis is, therefore placed on the downstream partners of the chain to share market information in a timely and efficient manner with less knowledgeable upstream partners (Vanpoucke, Boyer & Vereecke 2009:1213).

Despite the many substantial benefits claimed for supply chain information competency, firms are often reluctant to divulge accurate or complete information. They face multiple challenges and security risks related to the reliability and security of the data exchanged (Torabi & Hassini 2008:193), and also fear adverse competitive implications (Barkataki & Zeineddine 2015:691).

4.2.1.1 Technical aspects of effective supply chain information competency.

Decisions regarding type, amount and frequency of information shared with supply chain partners are often complex and the design and implementation of information systems costly (Samaddar & Kadiyala 2006:192; Varma & Khan 2014:2). Despite contemporary information communication technology (ICT) being able to offer real-time capture, transmission and sophisticated analysis of supply chain data (Mentzer, Dewitt, Keebler, Min, Nix, Smith & Zacharia 2010:3), poor data quality or a lack of information competency can result in operational problems. These have costly repercussions for every supply chain partner (Madenas, Tiwari, Turner & Peachey 2015:1158). Therefore, Chiang, Wu, Liu, and Gerla (2014:197) posit that effective supply chain information competency requires consideration of technical and social aspects of information sharing in equal measure.

Van Weele (2010:319) highlights that ICT-related challenges exist in the data exchange process itself, with different impacts on business operations depending on the type of threat. As such, confidence in the perceived security of supply chain information systems determines the willingness and capability of a firm to share confidential data with trading partners (Zhang & Sharifi 2010:496). This results in there being a clear relationship between integration level and ICT threat level from internal security issues, employee abuse, and threats from external sources (Yuan, Zhongfeng & Yi 2010:300). Therefore, managers should consider the trade-offs between the benefits of information competency and the ICT threat level when they develop their supply chain information strategy (Zhu 2011:247). The challenges associated with inter-organisational information competency can escalate as the volume of exchanged information increases, and as automated systems require the reduction/removal of company firewalls (Anand & Goyal 2009:284; Tan & Zhang 2015:2713).

Despite well-publicised news events, top managers and system administrators, in particular, are often blind to the types of ICT challenges that can cause a dramatic loss of profit, market share and credibility (Khan & Burnes 2007:199; Kavoura & Stavrianea 2015:318; Tan & Chan 2018:123). Such challenges include degradation in information quality and leakage of private information, both within the focal firm and across the wider supply network (Madenas et al. 2015:1193; Whitman 2004:584). If inter-organisational systems are not sufficiently protected, this can lead to reduced trust by supply chain partners (Zhang et al. 2010:500). The reason for this is that the effect of a security breach may be able to propagate into the wider supply chain and impact its competitiveness (Bandyopadhyay, Mehta, Kuo, Sung, Chuang, Jaehnig & Fiedler 2010:1385). Therefore, Kolluru and Meredith (2013:233) propose that automated ICT-oriented security solutions are essential for assuring confidentiality and privacy of information when coupled with authorised and authenticated access to each partner's database.

Arguably, data integration involving different levels of integration deserve varying levels of security. Mckone, Schroeder, and Cua (2012:126) propose a three-stage model of supply chain information competency, as indicated in Table 4.1 At Level 1, the focus is on simple communication and coping with threats to integrity, loss of privacy or repudiation of transactions. Firms that manage to achieve Levels 2 and 3 states face additional unauthorised access and denial of service risks.

Leakage of proprietary information is often referred to as the dark side of data integration across the supply chain (Zhang 2012:4; Wisner, Tan & Leong 2014:2720). Unintentional disclosures of confidential information to unauthorised parties (Zhang et al. 2011:147) may be deliberate or unintentional (Anand & Goyal 2010:438). Moreover, direct disclosure happens when confidential information is being exchanged (Naim & Gosling 2010:404), whereas indirect disclosure occurs when sensitive business data are inferred from non-confidential and exchanged information because of “the inherent engineering relationships” among different parts of the information.

Intentional leakage may happen via firm inducement (for example, a cash award, technology acquisition or reputational gains) or personal inducement that is more readily detectable (Tu & Yang 2013:2137). However, firms can remain ignorant of the effects on daily operations when “proprietary information and knowledge are accidentally or forcibly transferred to any unauthorised parties either through verbal or written communications” (Wisner et al. 2014:622).

Table 4. 1: Supply Chain Information Competency Levels and Types of Risks

	LEVEL 1 Asynchronous one-way	LEVEL 2 Asynchronous and synchronous	LEVEL 3 Synchronous communication
Relationship Technologies	Transaction Simple methods: phone, e-mail, fax.	Collaboration Complicated methods: advanced planning, ERP.	Partnership Interconnected IS: EDI, collaborative planning, forecasting, and replenishment.
Risks	Threats of integrity, spoofing, privacy, lost transactions, lack of trust and commitment, information leakage.	Unauthorised access and denial of services, information leakage.	More complex regarding unauthorised access and denial of services in highly interconnected networks, information leakage.

	LEVEL 1 Asynchronous one-way	LEVEL 2 Asynchronous and synchronous	LEVEL 3 Synchronous communication
Risk Mitigation	Identification and authentication, data confidentiality, data integrity.	Access control, authorisation, auditing.	Trust management, a delegation of credentials across multiple tiers and across supply chain interactions.

Source: Kolluru and Meredith (2010:233)

Assurance of three primary security goals; namely, confidentiality, data integrity, and availability are essential for guaranteeing accuracy and fairness of data exchange processes within the supply chain (Stoneburner, Goguen & Feringa 2011:30). Confidentiality refers to accidental or intentional disclosure of information, whereas data integrity requires that information be secured against unauthorised modification (Tappen 2011:195). The objective of availability is the assurance of accessible and uninterrupted information at every node within the supply chain since the implications of interruptions due to degraded ICT system availability can be a dramatic reduction in market responsiveness for the focal firm and broader supply chain.

4.2.1.2 Social aspects of effective supply chain information competency

Barkataki et al. (2015:619) highlight the close link between trust level and type of technology-enabled co-operation in a supply chain. Successful data integration requires parties to strongly commit to creating and maintaining a consistent and enduring relationship that is based on mutual trust (Kwon et al. 2005:26; Kocoglu et al. 2011:1630). An absence of trust and commitment hinders information competency and may lead to considerable increases in transaction costs, ineffective communication, low productivity and a higher perceived risk of opportunistic abuse in the supply network (Sridharan & Simatupang 2013:76).

Supply chain trust can be defined as “a primarily dispositional or an individual attribute or psychological state but is constructed from a set of inter-personal behaviours or a shared identity. These behaviours are underpinned by sets of institutional rules, laws, and customs”

(Ruel, Shaaban & Wu 2018:59). Trust and long-term partnerships positively influence the enhancement of seamless information flows within the focal firm and among supply chain partners (Kolluru & Meredith 2013:233; Cheng 2014:2). However, even when a firm has sufficient capability to exchange information, managers are often unwilling to release sensitive information to partners when there is a lack of trust (Fawcett & Magnan 2012:339).

Most researchers appear to favour the concept of supply chain integration and inter-firm information exchanges (Balsmeier & Voisin 1996:24; Fine 2000:213; Kembro & Näslund 2014:179). However, there are many downsides; for example, requiring supply chain partners to reduce security walls around their ICT assets and making business processes more accessible can create issues and adverse consequences for performance (Tachizawa & Gimenez 2010:214). Therefore, researchers and practitioners are interested in understanding the risks associated with supply chain integration and the process of data exchange (Narula 2004:154).

It is currently not well understood how managers perceive and evaluate risk in the context of supply chain information competency. Similarly, few scholarly articles explore how firms deal with specific risks related to the use of ICT applications during the data exchange process (Modares & Sepehri 2010:40; Carmigniani, Furht, Anisetti, Ceravolo, Damiani & Ivkovic 2011:341). Recent studies tend to examine the aspects of supply chain risk management and information competency separately (Lau, Yam & Tang 2010:20; Nagati & Rebolledo 2012:611; Kembro et al. 2014:179).

Manager perceptions of associated threats and the strategies used to mitigate them are considered. For example, Table 4.2 indicates how Whitman (2011:381) classified ICT risks into 12 major groups based on their likely consequences, a feature that helps managers set appropriate levels of security investment. According to Wisner et al. (2014:687), although deliberate attacks (virus, worms, and hackers) are the top ICT hazards, intentional acts of information extortion are the most frequent.

Table 4. 2: ICT Related Risks

NAME OF CATEGORIES	EXAMPLES
1. Act of human error or failure	Accidents, employee mistakes

NAME OF CATEGORIES	EXAMPLES
2. Compromises to intellectual property	Piracy, copyright infringement
3. Deliberate acts of espionage or trespass	Unauthorised access and /or data collection
4. Deliberate acts of information extortion	Blackmail of information disclosure
5. Deliberate acts of sabotage or vandalism	Destruction of systems or information
6. Deliberate acts of theft	Illegal confiscation of equipment or information
7. Deliberate software attacks	Viruses, worms, macros, denial of services
8. The forces of nature	Fire, flood, earthquake, lightning
9. Quality of service deviations from service providers	Power and WAN service issues
10. Technical hardware failure or errors	Equipment failure
11. Technical software failure or errors	Bugs, code problems, unknown loopholes
12. Technical obsolescence	Antiquated or outdated technologies

Source: Whitman (2011:383)

4.3 SUPPLY CHAIN INTEGRATION

In recent years, supply chain integration (SCI) has received significant attention from both practitioners and researchers and is considered critical to business success (Van Der Vaart & Van Donk 2008:46). SCI refers to the degree to which a firm can strategically collaborate with its supply chain partners and collaboratively manage the internal and external processes to realise the effective and efficient flows of products and services, information, capital and decisions to provide the maximum value to the customer at low cost and high speed (Huo 2012:596). Moreover, Stevens and Johnson (2016:20) define SCI in lines of suitability, connectedness, coordination of people, processes, information, knowledge, and strategy, with all the members of the supply chain. Supply chain management (SCM) researchers have studied how SCI enhance financial performance (Childerhouse & Towill 2011:441; Huo 2012:601).

These scholars suggest that building SCI allows a focal firm to gain access to and leverage resources and capabilities residing in the supply chain. They also stressed that SCI could be regarded as internal and external integrative capabilities that improve financial performance directly or indirectly. The SCI's dimensions consist of its internal integration within an organisation, and its external integration with customers and suppliers (Wong, Boon-itt & Wong 2011:605). Internal integration refers to intra-firm collaboration and the information-sharing activities that occur via interconnected and synchronised processes and systems (Schoenherr & Swink 2012:100). Customer integration reflects the close collaboration and information-sharing activities with key customers that provide the firm with strategic insights into the market's expectations and opportunities (Schoenherr et al. 2012:100).

Supplier integration involves coordination and information-sharing activities with key suppliers that provide the firm with insights into the suppliers' processes, capabilities, and constraints (Perdana, Ciptono & Setiawan 2019:187). This taxonomy emphasises the "importance of conceptualising SCI as a multidimensional construct to examine its effects on firm performance" (Liu, Wei, Ke, Wei & Hau 2016:15). As such, prior studies have examined a number of organisational factors in SCI, including trust, leadership, power, commitment, justice, culture, knowledge, and communication (Zhang & Huo 2013:545; Cao, Huo, Li & Zhao 2015:25; Huo, Flynn & Zhao 2017:89). However, although all these factors contribute to the establishment of SCI across firm boundaries, they play distinct roles in influencing SCI. Among these factors, the literature has identified trust, commitment, and power as the three most influential organisational factors in enabling SCI (Wu, Chuang & Hsu (2014:123).

Trust and commitment are vitally crucial for SCI because they provide a foundation for all cross-boundary SCM activities (Wang, Kang, Childerhouse & Huo 2018:1171). SCI has four key components, namely, information integration, synchronised planning, operational coordination, and strategic partnership (Lee & Whang 2011:111). Information integration reflects the extent to which a firm shares information about various supply chain activities with channel partners (Rai & Tang 2010:516), such as information on sales, inventory holding, production, and delivery schedules across the supply chain (Kulp, Lee & Ofek 2012:431).

Synchronised planning refers to the extent to which a firm collaborates with channel partners in designing plans (Paulraj, Chen & Lado 2012:227). This component ensures the synchronisation of future supply chain activities and the requirements for continued joint

efforts (Ramanathan 2012:696). Operational co-ordination denotes the extent to which the firm streamlines and automates its supply chain processes with channel partners (Sanders 2010:1332). Strategic partnership refers to the extent to which a firm establishes long-term relationships with channel partners to achieve strategic goals (Maloni & Benton 2013:56).

4.3.1 The Layers of Supply Chain Integration

Historically, integration of logistics management was identified as the primary challenge of the 1990s to gain and maintain customer loyalty and a competitive advantage (Bowersox, Closs & Cooper 2010:219). More recently, the scope of integration has broadened considerably from a logistics perspective to a supply chain integration perspective as academia recognised the potential savings to be gained from integrating the management of the various actors in a supply chain (Vickery, Jayaram, Droge & Calantone 2012:523).

Nowadays, supply chain integration is also perceived as the degree to which an organisation manages intra and inter-organisation processes to achieve effective and efficient flows of products, services, information, money, and decisions, with the objective of providing maximum value to its customers (Naylor et al. 2010:107; Frohlich & Westbrook 2011:185). Hence, most supply chain literature considers supply chain integration as the collaborative effort in linking internal functions, suppliers and customers (Lambert, Cooper & Pagh 2010:5; Romano 2011:201; Pagell 2013:460; Wong & Boon-itt 2014:239). Table 4.3 presents, in chronological order, key findings in the field of supply chain integration.

Table 4. 3: Supply Chain Integration Findings

Author	Methodology	Key findings
Steven (1989)	Conceptual paper	The author identified a progressive four-stage supply chain integration model starting with baseline integration, functional integration, internal integration and external integration.
Stank, Daugherty & Ellinger (1999)	Quantitative	The analyses identified that customers, and internal integration are the most significant differentiators of overall firm performance.
Whipple & Frankel (2000)	Quantitative	The authors identified that the largest barrier to external integration success is organisational (e.g. culture and the need to re-engineer the

Author	Methodology	Key findings
		business process) rather, than technical or financial.
Frohlich & Westbrook (2011)	Quantitative	Organisations with the greatest arch of external integration had the largest rates of supply chain performance improvements.
Childerhouse, Towill & Disney (2010)	Quantitative	The authors carried out detailed case studies on 20 supply chains from the European automotive sector. They found 80% progressing towards internal integration, with the remainder advancing further, towards external integration.
Vickery, Jayaram, Droge & Calantone (2012)	Quantitative	The study shows that the more a company has invested in integrated information technologies infrastructure, the more likely it is that the company will achieve internal and external integration.
Van Dock & Van der Vaart (2013)	Quantitative	Higher complexity in business conditions requires higher levels of integration. In cases of lower complexity, the authors identified lower levels of integration practices.
Cagliano, Caniato & Spina (2012)	Quantitative	Results show that the adoption of the lean production model has a strong influence on the integration of both information and physical flows along the supply chain, while no significant influence emerged from the adoption of ERP.
Pagell (2004)	Quantitative	The author identified that the key drivers for internal supply chain integration are company structure and culture, rewards system and communication.

Source: Böhme (2014:29)

As highlighted in Table 4.3 above, the relevance of supply chain integration has been widely discussed and supported on an empirical basis. Most of the quantitative studies presented in Table 4.3 also identified a positive relationship between the level of integration and the

performance of the focal firm. However, there was little consistency among the authors in the basic definitions of supply chain integration and the variables applied in carrying out the research. Van Der Vaart *et al.* (2013:42) came to a similar conclusion in their critical review of current supply chain integration literature.

One possible explanation for the inconsistency of the supply chain integration definition and research variables is the confusion that surrounds the supply chain integration topic. Some scholars understand supply chain integration as the integration with customers and suppliers only (Frohlich *et al.* 2011:2; Van Der Vaart *et al.* 2013: 45), while other scholars also take internal functional integration into consideration (Childerhouse *et al.* 2010:7441; Vickery *et al.* 2012:523). Hence, academia lacks a unified view of supply chain integration. Thus, the exclusion of internal integration creates the first layer of confusion over the concept of supply chain integration.

Supply chain practices in different industries show that integration is understood differently, and Table 4.4 presents examples of various industries explaining their dominant supply chain integration practices.

Table 4. 4: Different Supply Chain Integration Research Streams

Integration Stream	Key Authors	Focus
Organisation with suppliers/customers	Frohlich & Westbrook (2011:185)	These studies take an external view of supply chain integration only.
R&D with manufacturing	Stevens (1989:4); Morash & Clinton (1997:6); Koufteros <i>et al.</i> (2005:99)	The focus is on the processes used to create new products, often with an emphasis on moving from a traditional “functional silos” approach to a more co-ordinated or concurrent approach including suppliers/customers.
Marketing with manufacturing	Pagell (2004:460); Walters (1999:196)	These works tend to examine ways in which companies can increase their profitability by co-ordinating marketing with manufacturing. These studies often emphasise moving toward a more

Integration Stream	Key Authors	Focus
		coordinated and less functional way of management.
Integration of IS within a company	Narasimhan & Kim (2001:52); Gunasekaran & Ngai (2004)	These studies often examine the ways that a common technology platform can help various functions work more closely together.
HR with manufacturing	Youndt <i>et al.</i> (1996:837)	The authors explored the relationship between human resource strategy and manufacturing strategy.
Marketing with logistics	Ellinger (2000:86); Stank <i>et al.</i> (1999a:12).	These works tend to examine ways in which companies can increase their profitability by co-ordinating marketing with logistics.

Source: Own work

The conclusion that can be drawn from Tables 4.3 and Table 4.4 is that integration as a concept is ill-defined and not well understood (Frohlich et al. 2011:30), which leaves the concept of integration in serious scientific doubt. Van Der Vaart and Van Donk (2013:62) are among a small group of authors who doubt the concept of supply chain integration. They argue that integrative practices should have greater exploitation in the circumstance of high demand uncertainty. The practices can then be limited to physical flow and stock management when customer demand is known to be relatively uncertain (Monczka, Handfield, Giunipero, Patterson & Waters 2010:106). They also comment that integrative practices are hardly possible, or feasible, in circumstances of shared resources and limited capacity (Van Donk, Akkerman & Van Der Vaart 2015:220).

Finally, Awaysheh and Klassen (2010:1246) argue that integration also depends on business characteristics. Arguing along the same lines, De Teville, Shapiro, and Hameri (2013:615) conclude from their research that demand integration is only warranted when there is sufficient demand variability. Also, supplier and customer integration has been particularly scrutinised. Cox (2011:310) argues that not all relationships should be fully integrated. Indeed, the relationship type adopted should be matched to supplier and customer dependency. Swink,

Narasimhan, and Wang (2010:150) show how four different forms of strategic integration have both advantages and disadvantages. Mann, Kumar, Kumar, and Mann (2012:83) argue that the structures of monolithic organisations and global supply chains are similar and that, consequently:

- Wealth is being globally redistributed (for example, changed labour wage structures across the globe as jobs shift from country to country).
- Political institutions are being affected (for example, Wal-Mart, as a dominant and most visible face of the biggest supply chain, is more powerful than the majority of nation-states).
- Life chances are being influenced (for example, supply chains that span national borders result in lost jobs or reduced availability of jobs, loss of local culture, the death of local businesses and crafts).

It is important to emphasise that the debate in the literature is not about full integration versus zero integration. Instead, it is about how much integration is justified and under what circumstances. The answer to this question depends very much on the nature and purpose of the supply chain. For example, it is difficult to envisage any circumstances in which internal material and information flow optimisation will not prove essential for competitiveness. Therefore, the proponents clearly outweigh the opponents. Maloni *et al.* (2013:49) provide a list of potential benefits for supply chain integration:

- Reduced uncertainty for customers in (a) material costs, (b) quality, (c) timing and lead times, and (d) availability and responsiveness;
- Reduced uncertainty for suppliers in (a) market, (b) understanding of customer need, and (c) product/material specifications;
- Reduced uncertainty for both in (a) convergent expectations and goals, (b) reduced effects from externalities, (c) reduced opportunism, (d) increased communication, and (e) shared risk and reward;
- Cost savings from (a) decreased administration costs, (b) decreased switching costs, and (c) integration of processes and technologies; and
- Enhanced responsiveness from (a) joint product and process development, (b) faster time to market, and (c) improved cycle time.

This section has examined the confusion that exists around the concept of supply chain integration. However, Ho, Au, and Newton (2011:4420) point out that the development of supply chain management theory begins with the establishment of a clear conception of its meaning. Therefore, it is crucial to clearly define the author's view regarding supply chain integration, which is presented next.

4.3.2 Other views on supply chain integration

Not only has the supply chain integration construct been used to study several different organisational phenomena, but it has also been defined in a number of different ways. Additionally, many authors who have studied integration offer no formal definition of the construct. The end result is that this commonly researched construct does not have a single, accepted definition (Pagell 2013:461). However, from the literature, it emerges that integration can support firm processes at two different levels, namely, internal and external. Internal integration aims at overcoming the functional silo boundaries. The goal is an interdepartmental collaboration that brings departments together into a cohesive firm (Kahn & Mentzer 2010:55).

External integration aims at overcoming the individual firm boundaries and advancing integration to an overall supply network integration. Figure 4.1 depicts the author's view of supply chain integration. This is the perspective adopted for the remainder of this thesis, which is in line with that of many other authors (for example, Lee 2000:32; Bowersox *et al.* 2010:521; Fawcett & Magnan 2012:340).

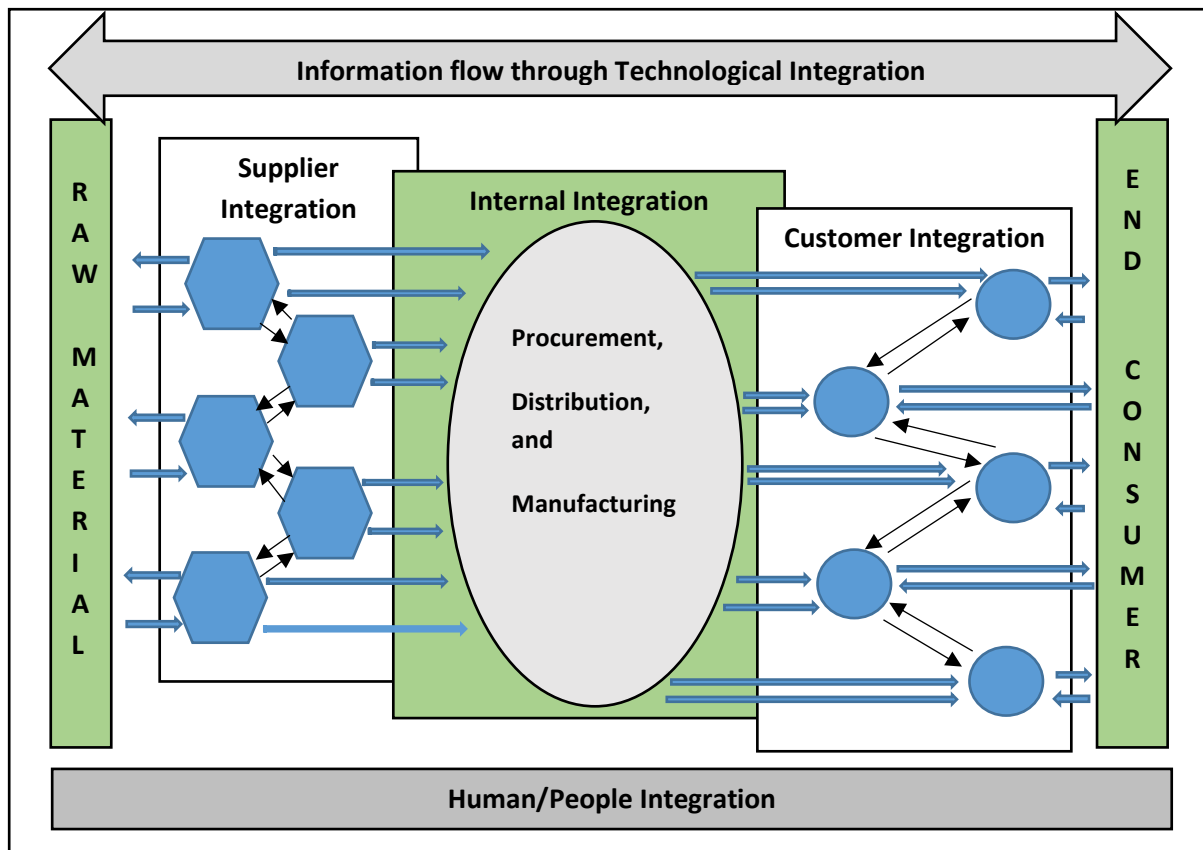


Figure 4. 1: Supply Chain Integration

Source: Fawcett & Magnan (2012:340)

The supply chain integration shown in Figure 4.1 represents a simplified supply chain network structure. The enterprise in the middle is referred to as the focal firm. Figure 4.1 further highlights the information and product flow, and the critical supply chain business processes penetrating functional silos within the focal firm and the various corporate silos across the supply chain (Lambert *et al.* 2010:3; Bowersox & Daugherty 2012:68). Figure 4.1 presents the need for internal integration of critical functional areas such as engineering, sourcing, logistics, and operations. External integration with customers and suppliers through a distribution network is highlighted. The end consumer purchases products based on cost, quality, availability, maintainability, and reputation and hope they satisfy requirements and expectations.

Internal and external integration aims at more effective use of the combined resource base, together with better-integrated information and material flows. However, external integration is often viewed as partnerships and strategic alliances (for example, Spekman, Kamauff &

Myhr 1998:635; Kim 2006:244; Droge, Jayaram & Vickery 2013:558), which is somehow contradictory to the initial aim of optimising material and information flow. Therefore, Gimenez (2014:99) focuses solely on the maturity of the vendor managed inventory (VMI) practices in a focal firm to identify the level of supplier integration.

Others have focused on advanced information systems such as electronic data interchange (EDI) to identify the degree of external integration (Vickery *et al.* 2012:523). Frohlich et al. (2011:185) likewise place most emphasis on information flow and communication channels when investigating “arcs of integration.” Therefore, it can be argued that partnerships and strategic alliances go beyond internal or external integration and the pure optimisation of material and information flows.

Supply chain integration is an essential requirement for supply chain network maturity, improvement, and continuous development (Prajogo & Olhager 2012:516). SCI is divided into internal and external integration and is discussed in the following sections.

4.3.3 Internal integration

It is acknowledged that a well-integrated supply chain (internal and external) brings about improved firm performance (Basnet 2013:153). Internal integration alludes to coordinating various activities within a firm to bring any item to the customer (Prajogo and Olhager 2012:514). Additionally, Zhao, Huo, Selen and Yeung (2011:17) characterise internal integration as how much a firm can structure its very own organisational strategies, practices, and techniques into a collective and synchronised process to meet customer requirements. It involves tasks including sharing information between internal capacities, strategic cross-functional partnership, and working together across functions (Huo, Qi, Wang & Zhao 2014:369). It accentuates the various functions within a firm to work as an incorporated process rather than some isolated silos.

Supply chain management stretches over more than a few organisational functions, including operation, marketing, sales, manufacturing, and information frameworks. These functions for the most part work in isolation, and these 'silos' can cause internal clashes (Chelariu, Asare & Brashear-Alejandro 2014:332); conflictingly, internal integration demonstrates that the functions in a firm must cooperate in an integrated manner and that the obstructions that cause

departments to work in 'silos' should be broken down (Zhao *et al.* 2011:19). Lacking internal integration will cause weak communication, diminish cooperation between teams and increase intracompany conflict, in this way, making communication and internal integration troublesome (Huo 2012:604).

At the point when firms incorporate internal integration endeavours in their strategy, SC integration endeavours are fortified, customer service levels are improved, and there is a noteworthy improvement in the firm's bottom line (Basnet 2013:153). Changes in a firm's market environment (for example shorter lead times, stronger price competition and export growth) and an emphasis on value-adding procedures ought to propel firms to improve their integration endeavours (Jie *et al.* 2013:208).

Internal integration can help departments to use each other's resources and capabilities to jointly design items, guarantee item quality and lessen duplicated tasks (Flynn Huo & Zhao 2010:58; Schoenherr & Swink 2012:99). Moreover, internal integration can likewise improve customer loyalty in numerous angles. First, with internal integration, customer prerequisites are surely known by the entire firm using information transfer from marketing/sales divisions to different departments. Secondly, integrated customer request fulfilment processes, in which all activities, functions, and departments associated with fulfilling the request are integrated, can abbreviate production time, decrease development expenses, and increase the speed to markets, which improves customer loyalty (Zhao, Huo, Sun & Zhao 2013:115). For instance, when a firm requires to introduce another item, the marketing division should initially express the customer's needs to decide the item that will be added, and expertise from the R&D division collaborates with the marketing and manufacturing division to develop the item configuration to satisfy the customers' requirements.

Lately, the development of cross-functional teams that tend to focus on their process requires a seamless flow of resource and applicable information in supply chains and removal or minimisation of obstructions between functional boundaries to surmount the deficiencies of specialisation (Seo, Dinwoodie & Kwak 2014:733). A non-appearance of internal integration and heterogeneity of each team's point may cause repetitive work and waste resources, which undermine quality and cost performance (Barratt, Choi & Li 2011:329). Moreover, internal integration cultivates significant knowledge and information sharing (Peng & Lai 2012:467). By sharing knowledge relating to value-adding activities across cross-functional teams, they

can encourage modern supply chains, which thus advance more noteworthy integration of suppliers and customers (Wong, Boon-itt & Wong 2011:604).

In conclusion, this means that through internal integration, all departments are responsible for the overall supply chain and business performance (Olavarrieta & Ellinger 2013:562). As such, the success of internal integration with suppliers and customers depends on the standard of internal integration within the focal firm (Omuruyi 2015:77).

4.3.4 External integration

As the competitive environment is becoming increasingly challenging, firms are embraced endeavours to contend along different fronts. In any case, numerous firms find it hard to contend in the market by depending on their internal resources and competencies alone (Uwamahoro 2018:5). Henceforth, firms are concentrating on external integration to acquire information and corresponding resources which they can convey to build a competitive advantage (Zhao *et al.* 2011:18). External integration alludes to how much a firm can partner forces with its key SC individuals (suppliers and customers) to structure their inter-organisational strategies, practices, procedures, and practices into collaborative, synchronised, and sensible procedures to satisfy its customers' prerequisites (Huo 2012:598).

External integration includes supplier and customer integration. A large number of activities between a focal firm and supplier underpin supplier integration, including information sharing and collaboration in planning and joint production advancement in managing with inter-organisational limits (Seo, Dinwoodie & Kwak 2014:735). Kim (2013:75) defines supplier integration as "a hierarchical procedure of buying firms and suppliers sharing and applying operational, financial, and key learning to create mutual benefits."

Also, Vanpoucke, Vereecke, and Muylle (2017:510) characterises Supplier integration as the degree to which a manufacturer partners with its suppliers to structure inter-organisational strategies, practices, and processes into collaborative and synchronised processes. Similarly, Kim (2013:75) characterises customer integration as the hierarchical practices of recognising, clarifying, and utilising customers to deliver specific items as per their needs and in so doing amplifying their desires and fulfilment.

Supplier integration produces explicit knowledge and resources that positively affect the effectiveness and adaptability of the focal firm (Danese 2013:1027). Furthermore, vendor management inventory is a form of supplier integration, which is demonstrated to positively affect the supplier's capacity to provide raw materials in a timely manner (Mittal, Abbasi & Pareek 2012:56). The SC performance of the focal firm is controlled by the abilities and resources of the supplier (Teller, Kotzab, Grant & Holweg 2016:109). Competitive advantage can be increased by advancing compelling correspondence and improving individual associations with suppliers; along these lines, firms need to assess their supplier relationships and build long-term relationships.

This should be possible through meeting and offering information to suppliers, to guarantee that joint strategies are created (Danese & Romano 2010:221). Guan and Rehme (2012:187) showed that vertical integration with suppliers is an antecedent to supply chain integration, and (Simon *et al.* 2014:286) reasoned that supplier relationship management is an essential strategy, which needs more consideration from firms. Firms are bound to take part in synergistic supplier integration due to the norms that have been set by leading companies; for example, Toyota and General Motors (Jie *et al.* 2013:209).

Supplier integration likewise improves customer integration endeavours, firm efficiency, and effectiveness, although customer integration alone does not influence efficiency (Danese & Romano 2010:222). Customer integration enhances market desires and opportunities, prompting progressively precise and fast reactions to customer needs (Flynn *et al.* 2010:59). A higher level of customer integration impacts firm performance more decidedly than supplier integration because of firms being rewarded by the customer, who concludes more sales transactions. Hence, Lau, Yam, and Tang (2010:20) expressed that the main person who can settle on a choice and assess an item is the customer, on the grounds that the customer has potential buying power, and all things considered is a decision-maker from a marketing perspective. In addition, Lotfi, Mukhtar, Sahran, and Zadeh (2013:298) highlighted that customer integration included customers' opinions being incorporated into the production process, by making the relationship between the customer and the producer a lot simpler.

Knowing the firm's goals, expectations, and strategy can diminish uncertainty in the psyches of customers. The advantage of clarity may, in some cases, be exceeded by the loss of closeness and flexibility in exceedingly formalised structure types (Koufteros, Verghese & Lucianetti

2014:313) However, so as to accomplish the most conceivable dimension of firm performance, all integration dimensions must be created (Huo 2012:605). Meanwhile, customer integration is identified with knowledge collaboration with key customers with regard to market information (Srinivasan & Swink 2015:823).

The firm's competitive advantage additionally relies upon its ability to integrate knowledgeable information that is sourced from supplier integration (Tzabbar, Aharonson & Amburgey 2013:482). The absence of information resource and capability makes it hard for the firm to capture and report information (Forslund 2014:205). External integration requires integrated IT as well as skilled people to dissect and interpret the information (Kocoglu et al. 2011:1631). Both types of integration are essential to guarantee enhanced value in supply chains.

In conclusion, the external integration may be different across different firm size, ownership, and types but efforts should then be made to examine the differences in the relationship between supplier and customer integration across different firms. This will no doubt, lead to achieving a competitive advantage over competitors. (Swierczek 2013:359).

4.1 SUPPLY CHAIN AGILITY

Supply chain agility (SCA) has been explored in several studies. It has been defined with respect to an agile enterprise (Jagdev & Browne 1998:216; Goranson 1999:109; Whitten, Green & Zelbst 2012:28), products, workforce (Breu, Hemingway, Strathern & Bridger 2002:23), capabilities (Yusuf, Gunasekaran, Adeleye & Sivayoganathan 2004:380), virtual teaming (Bal, Wilding & Gundry 1999:71) and the environment (Robertson & Jones 1999:14). The early proponents of agility defined it as a system with exceptional internal capabilities to meet the rapidly changing needs of the marketplace with speed and flexibility (Juneho 2017:465).

The internal capacities of the firm include hard and soft technologies, human resources, educated and highly motivated management, and information and communication technologies (Leedy & Ormrod 2010:237). A system that shifts quickly (with speed and high responsiveness) among product models or between product lines is said to be flexible. Flexibility often implies responding to customer demand almost in real-time (Youssef 2010:14).

Goldman, Nagel, and Preiss (1995:294) define agility as a dynamic, context-specific, aggressive change that embraces and pursues growth, success, profits, market share, and customers. Gehani (1998:19), and Gligor and Holcomb (2012:438) contend that an agile organisation can quickly satisfy customer orders, can introduce new products frequently in a timely manner, and can speedily get in and out of strategic alliances with its trading partners. In this case, the nimbleness of alliance and partnership formation also constitutes agility, which underscores that the notion of agility is context-specific (Whitten *et al.* 2012:31). From a manufacturing perspective (Miles & Snow 2011:63), agility can be defined as the successful adoption of competitive bases (speed, flexibility, innovation proactivity, quality and profitability) through the integration of reconfigurable resources and best practices in a knowledge-rich environment to provide customer-driven product and services in an uncertain market setting.

While there is no single accepted definition of supply chain agility, the current definitions share common terms and themes, suggesting that a certain degree of consensus exists. Sharp, Irani and Desai (2010:157) conceptualise supply chain agility as the ability of a supply chain to rapidly respond to changes in market and customer demand, while Ismail and Sharifi (2013:433) describe it as the capability of the supply chain and its members as a whole to rapidly align the network and its operations to dynamic and turbulent customer requirements.

Both of these definitions are similar to those for manufacturing and organisational agility in that they emphasise the capacity to rapidly respond to changing customer needs. Li, Chung, Goldsby, and Holsapple (2012:410) suggest that agility is the result of integrating alertness to internal and external environmental changes that present both opportunities and challenges, with a capability to use resources in responding (proactively/reactively) to such changes, all in a timely and flexible manner.

4.3.5 Primary Perspective of Supply Chain Agility

After reviewing the papers that specifically addressed supply chain agility, each was classified according to its primary perspective. Table 4.6 indicates that most of the research in the area of supply chain agility has been done through the lens of manufacturing, with most articles exploring the role of manufacturing in achieving supply chain agility. These findings reinforce

the importance of the comprehensive review of agile manufacturing conducted earlier by researchers such as Soontiens (2002:712), Stefanovic, Stafanovic and Radenkovic (2009:746), and Stuart, Verville and Taskin (2013:395) in order to fully understand the concept of idea and supply chain agility. Although a few articles address the concept of supply chain agility from a logistics perspective, it was done from a rather narrow functional approach. An example is a research study by Baker (2010:210 & 2012:27), which explored the design of distribution centres for agile supply centres. The results support the need for research that would address the broader role of logistics capabilities in achieving supply chain agility from a holistic conceptual perspective.

Table 4. 1: Supply Chain Agility Articles by Domain Focus, 2002-2012

Domain	Number	Percentage
Manufacturing	21	37
Logistics	8	14
Information technology	6	11
Other	22	38
Total	57	100

Source: David, Gligor and Holcomb (2013:438)

4.4.2 Enablers of Supply Chains Agility

Understanding the enablers of supply chain agility is a very important step in establishing the role of capabilities in achieving this goal. An overall assessment shows that much of the early research on supply chain agility has focused on identifying ways to achieve this capability. Christopher (2010:37) identified three key enablers of supply chain agility, including:

- The quality of supplier relationships;
- A high level of shared information; and
- A high level of connectivity between firms in the supply chain.

The last requirement implies an exchange of information on demand and inventory levels as well as collaborative working relationships at all levels.

Building on Christopher's research, Van Hoek, Harrison and Christopher (2012:128) suggested that in order to be truly agile, a supply chain must have knowledge and information about the marketplace and share that information across all supply chain members. A key to achieving supply chain agility is that all members must work together to achieve an integrated supply chain (Soni, Jain & Kumar 2014:14). Kocoglu *et al.* (2011:1635) expanded Christopher's research by identifying a total of 15 variables that characterise an agile supply chain. While several of the variables are similar to Christopher's, several new characteristics were added that encompassed internal and external aspects such as new product introduction and customer satisfaction.

Using interpretive structural modelling to analyse the data, the results from Agarwal, Shankar and Tiwari's (2011:216) study indicate that supply chain agility is mainly contingent upon seven factors, including customer satisfaction; quality improvement; cost minimisation; delivery speed; new product introduction; service level improvement; and lead time reduction. Moreover, Lin *et al.* (2013:285) offer a more comprehensive delineation of supply chain agility. They suggest four categories of supply chain agility enablers, including:

- Collaborative relationship (strategy);
- Process integration (foundation);
- Information integration (infrastructure); and
- Customer/Marketing sensitivity (mechanism).

Relationships, integration, and information are enablers that have been noted in other agility research. The last enabler – customer/marketing sensitivity – is a new dimension that entails a supply chain mechanism for sensing and responding to real customer requirements, providing the capability to deal with change and uncertainty (Giachetti, Martinez, Saenz & Chen 2014:50). Based on the classification above, a supply chain characterised by a high level of collaborative relationships, process integration, information integration and customer/marketing sensitivity will possess the following distinguishing capabilities or “fitnesses”, namely, responsiveness, competence, flexibility/adaptability and quickness/speed

(Jain, Benyoucef & Deshmukh 2010:6651). These, as well as several other common elements, are used to describe the concept of supply chain agility.

An underlying theme in the research is the critical role that integration plays in achieving supply chain agility. Previous research by Yusuf, Sarhadi, and Gunasekaran (2013:35) suggests that an integrated supply chain can be considered a dominant competitive advantage in today's business environment. Moreover, the integrated agile supply chain has been argued to be the twenty-first century's enterprise paradigm and the winning strategy to become a national and international leader in an ever-increasing market of fast-changing customer requirements (Zhang & Sharifi 2010:498). Yet the ability to build an integrated agile supply chain has developed more slowly than anticipated (Vinodh 2010:1017).

Li, Chung, Goldsby, and Holsapple (2012:410) suggest that business processes and structures, supply chain agility, and performance outcomes are inextricably linked. The core of business processes and structures is distinctive capabilities that consist of attributes, abilities, organisational processes, knowledge, and skills that allow a firm to achieve superior performance (Barney 2013:49). It is necessary, therefore, to examine the role that capabilities play in creating supply chain agility.

4.4.3 AGILE FRAMEWORK

Most of the literature on agile manufacturing and related issues either focuses on the strategies or techniques, rather than developing a framework through an integrated view (Gunasekaran 2010:87). Realising the importance of a framework for further research and application, Gunasekaran (2010:100) attempted to develop a conceptual model for the agile concept along four key dimensions, including strategies, technology, people and system issues. Yusuf *et al.* (2012:33) define the core concepts of agile manufacturing as a virtual enterprise, core competence management, and capability for reconfiguration and knowledge enterprises.

Meade and Sarkis (2011:243) developed a decision methodology and structure for manufacturing and organisational agility improvement, capturing dimensions such as mastering change and uncertainty, enriching the customer, leveraging the impact of people and information, and cooperating to enhance competitiveness. Another framework originates from Christopher's (2011:542) research work by researchers such as Vazquez-Bustelo, Avella, and

Fernandez (2012:1305) who characterised the agile concept as market sensitive, virtual, process integration and network-based. Based on these characteristics, Agarwal, Shankar, and Tiwari (2007:445) further develop the framework and define the dimension of market sensitivity and responsiveness, information-driven virtual integration, process integration and performance management, and network-based centralised and collaborative planning.

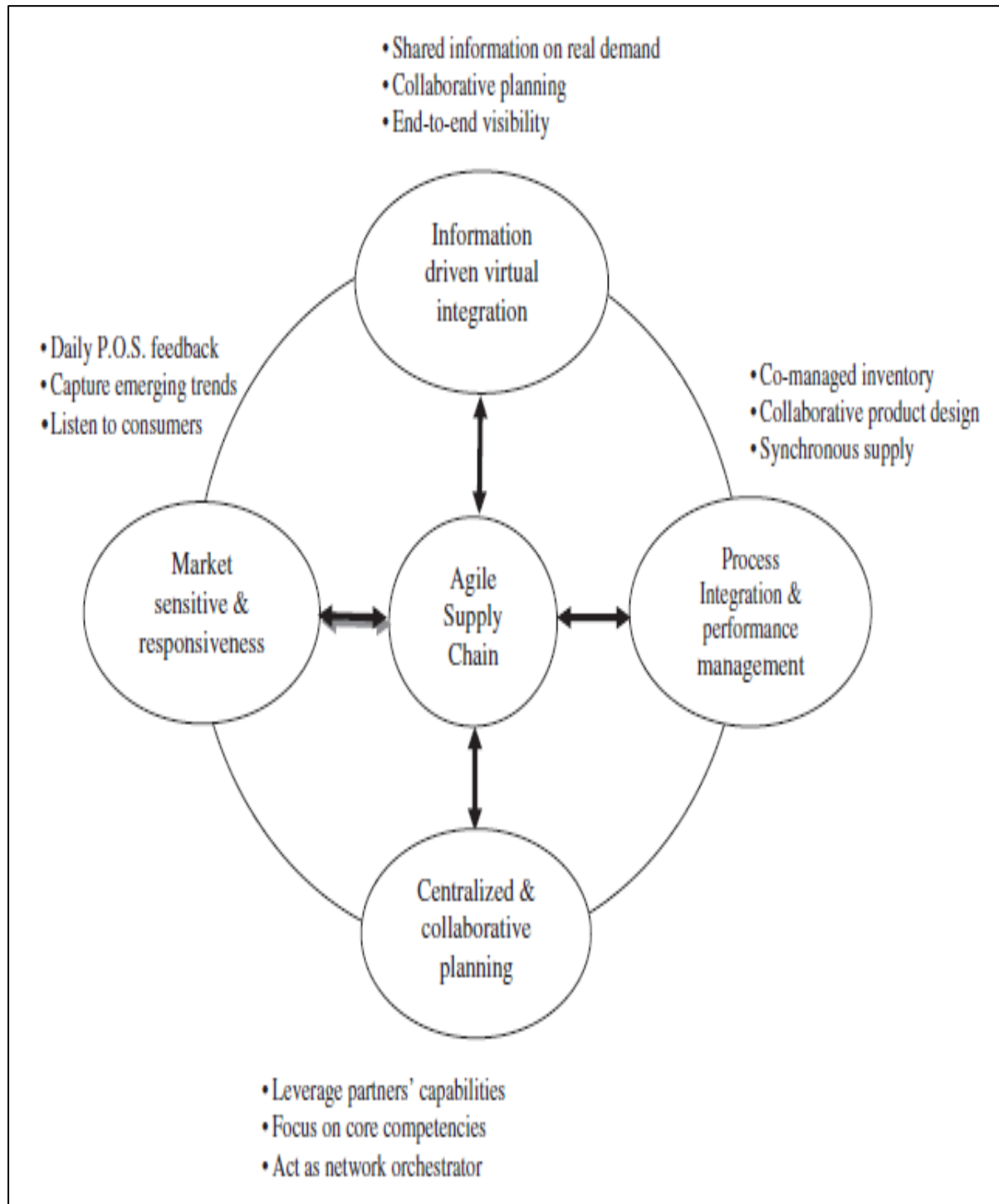


Figure 4. 2: The Agile Framework

Source: Cheng (2014:109)

Although different authors, such as Swamidass and Newell (2008:511), and Stratton and Warburton (2012:185) use various dimensions to establish a framework for the agile concept, certain similarities can be observed amongst these frameworks. First, the importance of technologies and information systems is emphasised. Secondly, information sharing and supply chain collaborations are necessary to sense the market and improve the responsiveness. Thirdly, process integrations are essential to level up the performance. Finally, customers have a central role in the agile concept. The four-dimensional model (Figure 4.2) of Christopher (2011) is further elaborated on in this section as it appears to be superior to other frameworks. This assumption is based on the fact that this model is frequently used by numerous authors (Agarwal *et al.* 2013:214; Harrison & Van Hoek 2014:194) in their studies and therefore is more robust and further developed compared to other frameworks.

According to Christopher (2011:546), the most crucial characteristic of an agile supply chain is market sensitivity. Market sensitivity means that the supply chain is capable of reading and responding to real demand (Cooney 2010:1130). This can be achieved by switching from being forecast-driven to being demand-driven. A demand-driven supply chain has the ability to hear the voice of the market by using efficient consumer responses (ECR) and other information technologies to sense the demand directly from point-of-sale and, subsequently, respond adequately to it (Sakris 2011:90). The forecast driven organisations, however, make forecasts and convert these forecasts into inventory because they are not able to acquire data on actual customer requirements (Upton 2010:7).

These forecasts limit the market sensitiveness of the supply chain since the estimates are based on historical data rather than real-time data. Agarwal *et al.* (2007:449) point out that the extent of the market sensitiveness is influenced by the level of collaboration amongst supply chain partners and the ability to use information technology tools. The definition by Christopher, Lowson, and Peck (2012:367) also suggests that market sensitivity is pointless without the ability to respond. An agile supply chain should, therefore, utilise the captured demand data as the basis of daily productions and operations. Dubois, Hulthen and Pedersen (2014:9) suggest three practices to improve market sensitivity and responsiveness, including providing regular point-of-sale feedback, listening to consumers, and capturing emerging trends.

Yusuf and Adeleye (2011:4547) suggest that a virtual supply chain provides the possibility to harness and coordinate the resources and skills, spread across different organisations, for manufacturing either simple or complex products very rapidly, and based on customer requirements. In comparison with the traditional supply chain, a virtual supply chain is an information-based rather than inventory-based (Womack & Jones 2012:142).

A virtual supply chain is, therefore, created by using information technology to share data between buyers and suppliers (Tan 2013:41). This is because the information is an essential part of a modern supply chain. Additionally, all supply chain partners should have access to the same information at the same time, to ensure adequate collaboration between supply chain partners (Strattong & Warburton 2010:183).

Also, informationally driven virtual integration is essential from the strategic point of view as it improves the responsiveness to market instabilities. There are three management practices proposed by Christopher *et al.* (2012:367) to promote virtual integration, including shared information on real demand, collaborative planning, and end-to-end visibility. Sharing information on real demand is necessary to adapt operations to changing demand. Collaborative planning ensures the successfulness of operations through resource and skill sharing amongst partners (Sok, O'Cass & Sok 2013:163). End-to-end visibility, in turn, contributes to collaborative planning, since it provides each supply chain member with the ability to be aware of vital information, such as requirements, challenges, and successes (Shy & Stenbacka 2013:94).

Moreover, Samson and Terziovski (2012:395) suggest that shared information between supply chain partners is achieved by process integration. Process integration refers to collaborative working, information sharing, joint product development, and common systems (Richard 2011:62). This form of process integration is beyond a firm's boundaries and without delays caused by buffers in process phases (Prince & Kay 2010:308). Osterman (2014:175) states that supply chain efficiencies can only be fully acquired if top management is committed to integration. These authors highlight co-managed inventory, collaborative product design, and synchronous supply as the three primary practices to promote process integration and performance management.

Co-management inventory refers to the collaborative management of supply chain stocks by all supply chain partners (New & Payne 2010:62). Collaborative product design is achieved by joint design, utilising the trends information from the point of sale amongst all supply chain partners. Synchronous supply involves the constant and consistent supply through the supply chain in a way that the supply chain activities are simultaneously taking place (McKone *et al.* 2012:124). These three practices contribute independently to process integration and performance management, and the ultimate goal is adapting rapidly to the changing demand (Shi, Song & Song 2014:111).

Consistently, Agarwal *et al.* (2012:215) provide three management practices to strive for centralised and collaborative planning, including leveraging partners' capabilities, focusing on core competencies and acting as network orchestrator. Leveraging partners' strength is essential in determining the success of the supply chain since it enables the supply chain partners to focus on their core competencies and, in turn, increases the strength of individual partners (Sekaran & Bougie 2010:384). Acting as a network, orchestration contributes to the success of the dimension through a positive impact on the performance of the other two practices. It allows organisations to benefit from leveraging partners' strengths as well as enabling the focus on core competencies among individual supply chain partners (Parzefall & Hakanen 2010:80).

4.5 FIRM PERFORMANCE

A review of the extant literature demonstrates that there is a wide scope of conclusions with respect to firm performance. Most investigations centre on firms' financial performance and use measures, for example, ROA, profitability ratio, and market esteem ratios as assessment criteria (Andersen 2009:352; Yang 2012:2005). In any case, different authors (for example, Jun & Rowley 2014) have stated that supply chain assessments based on financial performance may have a few impediments that render it hard to portray the performance of certain enterprise structures. Therefore, Samara and Berbegal-Mirabent (2018:149) define firm performance as a complex and multidimensional phenomenon.

Firm performance shows how viably a firm, maintains its business. It is a key measure used to assess the success or the remote chance of survival of a firm. Firm performance is a standout amongst the most applicable constructs in the field of business studies (Makadok, Burton &

Barney 2018:1530) and is often viewed as the final outcome of a business model (DuBois, Bruce, Reeves, Vandelandotte & Yakimakho 2019:381). Thus, the assessment criteria utilised in this field incorporates measures of operational performance and financial performance (Ou, Liu, Hung & Yen 2010:526), for example, customer loyalty, consumer satisfaction, service level, market share, and net profit before tax. The manufacturing sector assumes a crucial role in the performance of the supply chain as plenty of them serve the role of intermediaries and customers. Supply chain capabilities and agility techniques are coordinated towards improving firm performance for both internal and external situations.

In a very unstable environment, such as the manufacturing sector, firms strive to accomplish competitive advantages and unrivalled firm performance (Barreto 2010:256). Subsequently, extensive supply chain research has examined the critical role of supply chain management in improving firm performance, and all the more explicitly, the impact of supply chain integration in encouraging firm performance. Different researchers have connected this construct to financial performance (Flynn *et al.* 2010:62; Huo 2012:599), and some have connected it to market-based measures (Yen & Hung 2017:18). Supply chain management researchers typically view and measure firm performance as being made out of operational and competitive performance dimensions and have examined the basic role of supply chain integration in improving firm performance (Zhao, Feng & Wang 2015:162).

The extant literature on information sharing and supply chain management affirms that both internal and external information sharing to customer and supplier relationship improves performance (Islam, Ahmed, Hasan & Ahmed 2011:5900; Mortensen & Arlbjorn 2012:152). Rodriguez, Peterson, and Ajjan (2015:636) found that information sharing positively affected customer-facing activities and along these lines, its sales performance. Ferrer, Bousono, Jorge, Lora, Mirenda and Natalizio (2013:95) noticed that the adoption of information sharing emphatically influenced firms' capital, which thus influence performance. Both Wong (2012:52) and Kwok and Yu (2013:84) found that supply chain agility and sharing imperative information with supply chain partners positively affected SMEs' business performance. Hassan, Shiratuddin and Ab Salam (2015:18) also noticed that coordinating information and agility can significantly affect firms by essentially impacting purchasing decisions made by them.

Supply chain agility can also improve a firm's financial and operating performance in a few different ways. The utilisation of agility in supply chain enhances the coordination of internal and external firm activities, providing a more informed decision-making process (Qrunfleh & Tarafdar 2014:340). More specifically, the supply chain all in all gets profits from direct material flows with diminished number of stocking points, improved forecasting accuracy, higher item accessibility, and better stock management (Kale, Aknar & Başar 2019:276). This outcome in better performance on financial estimations, for example, a viable usage of assets and a reduction in production and total system costs (Mao, Zhang & Li 2017:354).

Kazemi and Zhang (2013:547) demonstrated that supply chain agility can accomplish better performance results, for example, higher total profit. Tallon and Pinsonneault (2011:463) found a positive and clear connection between agility and firm performance. Inman, Sale, Green Jr and Whitten (2011:343) reported a positive relationship between agile manufacturing and marketing performance, financial performance, and operational performance. Roberts and Grover (2012:579) tested the relationship between agility (customer sensing and responding capabilities) and firm performance. They found that, while customer sensing capability positively affects firm performance, customer responding capability does not. Shin, Lee, Kim and Rhim (2015:181) in their examination on Korean small and medium enterprises, found that strategic agility positively affects operational performance and customer retention, although it does not influence financial performance. Teoh, Lee and Muthuveloo (2017:222) demonstrated that strategic agility is a significant mediator between corporate risk management practices and firm performance.

In business, there are two major streams on the determinants of firm performance (Jeswal 2012:6). One is based primarily upon an economic tradition, emphasising the importance of external market factors in determining firm success (Rundh 2011:332). The other line of study builds on the sociological and behavioural paradigm or factors and sees organisational factors and their environment as the major determinants of firm success (Idar & Mahmood 2011:2). Within this school of thought, little direct attention is given to the organisation's competitive position (Buzzell & Gale 2010:258). Moreover, previous financial and non-financial literature has not come to a definitive conclusion as to what factors determine firm performance during any state of the economy (Rumelt 2011:333).

Altman (1968:589), and Stambaugh, Yu and Yuan (2012:288) developed different bankruptcy prediction models that determine factors that influence or affect firm performance during various economic times. Hawawini, Subramanian and Verdin (2012:2) stress that industry or external firm factors play significant roles in dictating the influence of firm performance. In contrast, other researchers, such as Opler and Titman (2010:1016) opine that internal factors of a firm stand as the major determinants of the operating performance, which are the major drivers for competitive advantage or success, crucial for surviving economic downturns of any developing country.

Fatoki (2011) evaluated the impact of social, financial, and human capital on the performance of firms in South Africa. Self-administered questionnaires were used as the method of data collection, and 332 questionnaires were distributed, but only 122 were returned. An ordinary least square method was used to test the hypotheses under study. The result of the research work revealed that there is a positive relationship between human, social, financial capital, and the performance of firms.

In a study conducted by Machirori (2012), the researcher identified the impact of networking on access to finance and firms' performance in Buffalo City Municipality, Eastern Cape. Based on the study, the performance of firms were influenced by the following factors or variables, which are entrepreneurial characteristics, firm characteristics, networking, and access to debt finance. The primary research instrument was a questionnaire, which was used to collect data, and regression analysis was used through SPSS to analyse the data.

The results reveal that the gender and education of firm owners and also the age, legal status, and size of firms are the entrepreneurial and firm characteristics that are positively related to networking by firms. Also, the result indicates that there was a positive and significant relationship between networking and access to finance and performance of firms. The result of this research work also indicates that access to debt finance slightly mediates the relationship between networking and performance of firms.

Mahmood and Hanafi (2013:23) conducted a research study to assess the entrepreneurial orientation and business performance of women-owned enterprises in Malaysia, where competitive advantage was the mediator. Entrepreneurial orientation and competitive advantage were the variables that influence business performance. The data used were collected

through a mail survey questionnaire completed by women owner/managers selected randomly from a sampling frame of registered companies, and the data was analysed through regression analysis in order to actualise the result of the study. The results of the study revealed that there is a significant correlation relationship between entrepreneurial orientation and business performance, while the competitive advantage was found to partially or slightly mediate the entrepreneurial orientation and business performance relationship.

Okoye (2014:613) determines the effect of business development services on performances of firms in Kenya. The researcher made use of market access, procurement services and infrastructure facilities as the variables that affected or influenced the performance of firms. A cross-sectional survey was employed in the study, and primary data were 150 enterprises in Nairobi, Kenya, while linear regression analysis was used to analyse the data obtained. The findings show that market access does not have any relationship with the performance of firms, while procurement services and infrastructure have a significant and positive influence on the performance of the enterprises.

Most recently, Deb, David, O'Brien and Duru (2019:186) conducted a research study to explore contingencies that moderate the association between problemistic search (i.e., search under conditions of attainment discrepancy) and performance in the United States. Based on the study, the researchers argued that certain cognitive, affective, and behavioural mechanisms triggered by performance shortfalls make managers more aware, attentive, motivated, and disciplined, resulting in adaptation, learning, and enhanced firm value. Questionnaires were used as the method of data collection, and 9329 questionnaires were self-administered between 1994 and 2013, and linear regression analysis was used to analyse the data obtained. The results show that there is a negative attainment discrepancy affecting the performance consequences of strategic investments.

4.5.2 Analysis and Interpretation of Firm Performance

Based on a review of the studies conducted by various researchers, it is clear that different researchers use different variables for predicting firm performance. Some of the researchers made use of variables that really capture or influence performance of firms, while others did not use suitable variables that actually capture, influence, or affect the performance of firms. The method of data analysis that was mostly used by the researchers was regression analysis,

and most of them did not make use of supporting theory or theories in their studies. Also, based on these findings, the researchers found different results.

4.4 HYPOTHESES DEVELOPMENT

4.4.1 Supply chain network design and supply chain agility (H1)

Researchers have indicated that supply chain networks can enable firms in the manufacturing sector to be more competitive and increase performance to customers (Bayraktar, Demirbag, Koh, Tatoglu & Zaim 2009:134; Chin, Hamid, Rasli & Baharun 2012:615). Firms can gain strategic business skills through communication exchange among supply chain partners within the supply chain network design, which may further enable firms to leverage limited resources and skills efficiently and effectively (Rabinovich 2007:662; Barnes & Liao 2012:888).

The results emanating from supply chain network design directly influence a firm's level of agility; for example, it reduces time to market and improves customer satisfaction (Hakansson & Ford 2002:134). The risks and challenges of doing business such as customers' changing demands, (Martelo *et al.* 2013:2043), meeting customers' specific requirements (Lai, Xie, Tan & Yang 2008:202), varieties of new products and on-time delivery of products and services through information technology may also become less challenging through supply chain agility (Chin *et al.* 2012:616; Cao, Gan & Thompson 2013:720).

An agile supply chain can be considered to be structured under the goals of satisfying customers and employees within which every firm can design its own business strategies, processes and information systems (Rai & Tang 2014:9). Agile supply chain concerns change uncertainty and unpredictability within the firm's environment and make appropriate responses to changes. In a dynamic environment, a firm requires the mechanism to help it go beyond the boundaries to search for additional resources and capabilities and the supply chain network design structure provides an appropriate means to obtain external resources and capabilities to sustain and enhance its competitive capability, including supply chain agility (Saeed, Malhotra & Grover 2011:26). Overby, Bharadwaj and Sambamurthy (2006:125) indicate that external resources, information, and knowledge are critical for increasing supply chain agility.

By maintaining a superior network design structure, a firm could exploit its elements, and network closure to access and acquire reliable, non-redundant, and valuable information content, integrated with internal resources, capabilities and information; it could create an inimitable and non-substitutable agility in response to unpredictable environmental changes (Venkatesh 2013:282). Given the various strategic values and benefits of a supply chain network design structure, this study assumes that an agile firm has the desire and makes an effort to expand its brokering ties on diverse and novel resources and capabilities inherent in disconnected contacts, to manage a superior supply chain network design closure with multiple connecting ties to obtain reliable, non-redundant resources and capabilities early.

Therefore, it can be claimed that enhanced supply chain network design by firms in the manufacturing sector can have a positive effect on supply chain agility.

4.6.1 Supply chain network design and firm performance (H2).

Supply chain network design has been recognised as an essential contributor to a firm's performance (Andersen *et al.* 2010:677; Jin & Edmunds 2015:745). First, the ability of a manufacturing firm to know what resources supply chain network members can devote to production and how well members' skills help to eliminate waste and defective products is heightened. Innovative product design and enhanced product quality are additional benefits of the increased flow of information. Secondly, network efficiency and better utilisation of network resources enables a manufacturer to reduce operational cost dramatically, achieve consistent quality, accelerate production and increase responsiveness to the changing environment (Novak & Eppinger 2001:192).

Thirdly, the ability to bring in a different supply chain member when a disruption occurs enables a manufacturing firm to maintain dependable delivery of its product. The shorter the disruption, the less damage a manufacturing firm will suffer (Tafti, Mithas & Krishnan 2013:210). Working with a well-designed supply chain network for the preparation of a long-term change in the environment is also essential, as an agile supply chain can improve firm performance because of less switching cost, consistent quality and reliable delivery (Kannan & Tan 2010:209). Lastly, the learning ability derived from knowledge about the local market where the supply chain network resides stimulates the manufacturing firm's innovation, flexibility and responsiveness, which helps a manufacturing firm adapt to the changing

environment (Lee 2005:416). In turn, this flexibility and adaptability can lead to improved firm performance.

It is expected that manufacturers with the strongest overall supply chain network design will have the best firm performance (Li & Calantone 2009:20). Supply chain network design plans that are concentrating on a close collaborative relationship with the suppliers can essentially improve the quality performance and therefore, improve the competitive gain of the buying firm (Tse, Zhang, Tan, Pawar & Fernandes 2019:291). Along these lines, supply chain partners can join reciprocal and related knowledge to accomplish supernormal innovation performance (Wang & Hu 2017:3). This will, in turn, lead to a better firm performance by the manufacturing firms.

Therefore, it can be claimed that enhanced supply chain network design by firms in the manufacturing sector can have a positive effect on firm performance.

4.4.2 Supply chain information competency and supply chain agility (H3)

Firms need internal information about their financial situation, the effectiveness of their products, their production costs, and so on, and they need external information about the environment in which they operate – competitors, customers, and suppliers who help them get to know their customers and satisfy them immediately and effectively, and so gain sustainable competitive advantages (Lin, Chiu & Chu 2006:289). Information competency can be defined as the extent to which a firm is knowledgeable about and effectively utilises or manages information within and outside the firm's environment (Tippins & Sohp 2003:755).

Supply chain information competency plays an essential role in enabling the sensing and response capabilities of a firm (Fink & Neumann 2007:448; Overby *et al.* 2006). As such, supply chain information competency provides vital support to supply chain agility. Numerous previous scholars, for example, De Groote (2011:267), investigated that firms could create and maintain a competitive advantage by increasing and leveraging information to sense and respond to market changes in order to improve supply chain agility. However, there are a few studies about the effectiveness of supply chain information competency on supply chain agility (Goldman, Nagel & Preiss 1995:183). Tafti, Mithas and Krishnan (2013:220) argue that the supply chain structure and the nature of interrelationships among firms in the supply chain may

also influence the impact of supply chain information competency on the agility of the supply chain.

Specifically, the firm's information competency is pictured as providing the fuel from which its capabilities can be quickly ignited and, in turn, indirectly impacts the competitive potential of the firm (Crawford, Leonard & Jones 2011:177). Supply chain information competency in conjunction with supply chain agility can generate a positive synergistic effect that is much more difficult for rivals to imitate or find a substitute for (Alvarez-Suescun 2007:768; Liang & You 2010:1142). Consequently, information literature has suggested the need to identify contingencies that may govern supply chain information competency performance relations (Sa'nchez-Rodri'guez & Marti'nez-Lorente 2011:838). Therefore, taking into account the importance attributed to information competency as an essential enabler of supply chain agility and the fact that both processes have been linked to firm performance (Mills & Smith 2011:158), it is expected that supply chain information competency will have a direct impact on a firm's performance via supply chain agility.

Synchronising all the essential information competency activities to achieve supply chain agility is crucial. Top management should actively engage in a strategic supply chain information competency plan for supply chain agility and measure its effect on supply chain performance. Previous researchers such as Venkatraman (1990:31), and Wong, Lai and Cheng (2012:182) are convinced that the firm's value of information competency is manifested in its contributions to supply chain agility. It enables a supply chain with a high degree of visibility, connectivity, responsiveness and flexibility. Among different information competency, IT integration and adaptability are deemed to provide the most prominent contributions to supply chain agility.

As such, it can be claimed that enhanced supply chain information competency of firms in the manufacturing sector has a positive effect on supply chain agility.

4.6.2 Supply chain integration and supply chain agility (H4)

Supply chain integration is an achieved capability that results from a set of interconnected systems and processes that facilitate decision-making processes (Schoenherr & Swink 2012:100). Supply chain integration can be described as the degree to which a firm

collaboratively deploys its resources and capacities with channel partners (Zhao, Huo, Selen & Yeung 2011:19), mainly involving the integration of data and information systems. Supply chain integration contains three elements, namely, information flow integration, physical flow integration, and financial flow integration (Rai, Patnayakuni & Seth 2006:225).

Such processes provide the infrastructure and guidelines for cross-functional information processing and joint decision-making. Information sharing also creates opportunities for increased supply chain agility (Katayama & Bennett 1999:43; Mondragon *et al.* 2004:642). Moreover, higher levels of supply chain integration and the ability to share information in a real-time manner helps a firm achieve higher levels of supply chain agility. As a result of supply chain integration, collaboration occurs between functional areas within the supply chain, thereby leading to goal alignment and improved performance (Schoenherr & Swink 2012:113).

Firms often seek supply chain agility to cope with the uncertainty of their business environments. A Delphi study conducted by Lummus, Vokurka and Duclos (2005:2791) shows that managers strongly associate accurate and timely visibility of customer demand and inventory information with greater supply chain agility. Participants in the study stated that such integration is necessary in order for firms to design appropriate reactions to change.

In addition, Li, Chung, Goldsby and Holsapple (2008:432) extend a framework proposed by Christopher, Lowson and Peck (2004:369), maintaining that demand information sharing and end-to-end integration are essential enablers of supply chain agility. They argue that these capabilities enable alertness to opportunities and challenges within the supply chain and the surrounding environment; such alertness is deemed to be an essential prerequisite to agility capability (Dove 2005:234). As noted by Reichhart and Holweg (2007:1483), the need for agility emanates from uncertainty. As a firm obtains higher quality information about demand and supply conditions from customers, suppliers, and various other sources, it can anticipate changes and thus be more responsive.

Yi, Ngai and Moon (2011:271) note that seminal studies on responsiveness treated it as the result of a single company's efforts on internal processes, while now scholars recognise that more participants are involved in physical and information flows across supply networks and, as a result, responsiveness can also be improved by involving suppliers and customers in

integration efforts. Therefore, literature agrees that SCI, both in terms of internal and external integration, can have a positive impact on supply chain agility (Kannan & Tan 2010:211).

Flynn, Huo and Zhao (2010:59) note that the two breakdown functional barriers and engenders co-operation in order to meet the requirements of customers rather than operating within the functional silos associated with the traditional compartmentalisation. In this way, internal conflicts are quickly resolved, order fulfilment information flows smoothly within the company, and customer needs are satisfied in a minimum amount of time (Gimenez & Ventura 2005:30). Inter-functional co-operation and working together play an essential role in the achievement of these results.

As such, it can be claimed that an enhanced supply chain integration by firms in the manufacturing sector can have a positive effect on supply chain agility.

4.6.3 Supply chain integration and firm performance (H5)

Supply chain integration is regarded as a collaboration between various value chain entities to achieve a seamless flow of products and information from supplier and on to the customer (Sundram, Chandram & Bhatti 2016:1462). There are also numerous papers suggesting the introduction of SCI mechanisms to improve the flow of goods and information across and within the supply chain (Exon-Taylor 1996:18; Koufteros, Vonderembse & Jayaram 2005:101; Lee, Kwon & Severance 2007:52). This implies that SCI is one of the possible tools to enhance a firm's competitiveness and delivery of performance. Similarly, such efforts can improve the firm's performance (Priem & Butler 2011:34). The increasing competition has driven firms to not only improve their internal operations (such as process control and inventory management) but also focus on integrating their suppliers and customers into the overall value chain processes. The contribution of suppliers in delivering value to customers and, hence, building competitive capabilities (quality, delivery, flexibility, and cost) has been well recognised (Vorhies & Morgan 2014:88).

The essence of supply chain integration is a well-coordinated flow of materials from suppliers, which allow firms to have a smooth production process (Frohlich & Westbrook 2010:189). Such co-ordination produces a seamless connection between firms and suppliers in such a way that the boundary of activities between the two parties is getting blurred (Stock, Greis &

Kasarda 2014:548). It has been argued that having solid supply chain integration will reduce various problems, such as the bullwhip effect (Lee, Padmanabhan & Whang 2000:491; Geary, Disney & Towill 2012:10). Integration also allows firms to adopt lean production systems that are characterised by reliable order cycles and inventory reduction (Cagliano, Caniato & Spina 2006:288; Schonberger 2009:411). By and large, integration allows firms and their supply chain partners to act as a single entity, which results in improved performance throughout the chain (Tan, Kannan & Handfield 2013:8).

In other words, through supply chain integration, firms can have the potential benefits of vertical integration (quality, dependability, planning and control, and lower costs) without having it in the physical sense (La Londe & Masters 2009:40). Improved integration between supply chain partners yields a number of operational benefits, including reduction in costs (Nooteboom 2011:339), lead time (Liu, Zhang & Hu 2013:451), and risks (Clemons, Reddi & Row 2015:15), as well as improvement in sales, distribution, customer services and service levels (Seidmann & Sundararajan 2014:120), and customer satisfaction (Kim 2014:332). The majority of empirical surveys on supply chain integration report a positive relationship between integration and firm performance (Van Der Vaart & Van Donk 2010:49).

De Toni and Nassimbeni (2011:600) found that better-performing plants exhibit a higher level of supply interactions. Frohlich and Westbrook (2009:191) found that the widest arcs of integration had the strongest association with performance improvement. Sheu, Yen and Chae (2012:31) found that higher levels of integration result in operational efficiency in the supply chain system, and finally Li, Yang, Sun and Sohal (2009) found that supply chain integration is significantly related to firm performance.

As such, it can be claimed that enhanced supply chain integration by firms in the manufacturing sector, and their partners can have a positive effect on firm performance.

4.6.4 Supply chain agility and firm performance (H6)

Supply chain agility enables firms to improve their daily operations and customer service, which can result in differentiation and increasing profitability. Improving supply chain agility requires reducing the product development cycle and manufacturing and delivery lead time, increasing the level of product customisation in manufacturing and improving customer

service, delivery reliability, and responsiveness to market needs (Swafford, Ghosh & Murthy 2006:171; Swafford, Ghosh, & Murthy 2008:290). Supply chain agility is all about customer responsiveness and is essential in ensuring a firm's external competitiveness (Van Hoek, Harrison & Christopher 2001:131) that enables effective and efficient responses to operational changes, including procurement, manufacturing, and delivery (Liu, Ke, Wei & Hua 2013:1441).

Therefore, supply chain agility focuses on customer responsiveness with speed, influencing customer service, and differentiation capabilities rather than cost leadership capabilities. Agility ensures responsiveness to customer requirements, services, resource efficiency and high business performance, and cost sensitivity to improve competitiveness, such as differentiation in volatile business environments (Hiroshi & David 1999:48; Agarwal, Shankar & Tiwari 2006:223). An agile supply chain is necessary to respond to volatile customer demand and high customer needs for product variety (Agarwal *et al.* 2006:223).

Agile firms can quickly satisfy customer orders, introduce new products frequently in a timely manner, and speedily achieve a strategic alliance with their partners (Gligor & Holcomb 2012:439). Therefore, supply chain agility acts as a valuable operational capability, which is crucial to improving firm performance (Chiang *et al.* 2016:52). Tse, Zhang, Akhtar and MacBryde (2016:142) support the notion that supply chain agility positively influences firm performance.

As such, it can be claimed that supply chain agility by firms in the manufacturing sector has a positive effect on firm performance.

4.7 CONCEPTUAL FRAMEWORK

Drawing on the emerging body of knowledge of supply chain capabilities, and given the dearth of empirical evidence on the effect of supply chain agility on firm performance, the following conceptual framework is postulated (Figure 4.3).

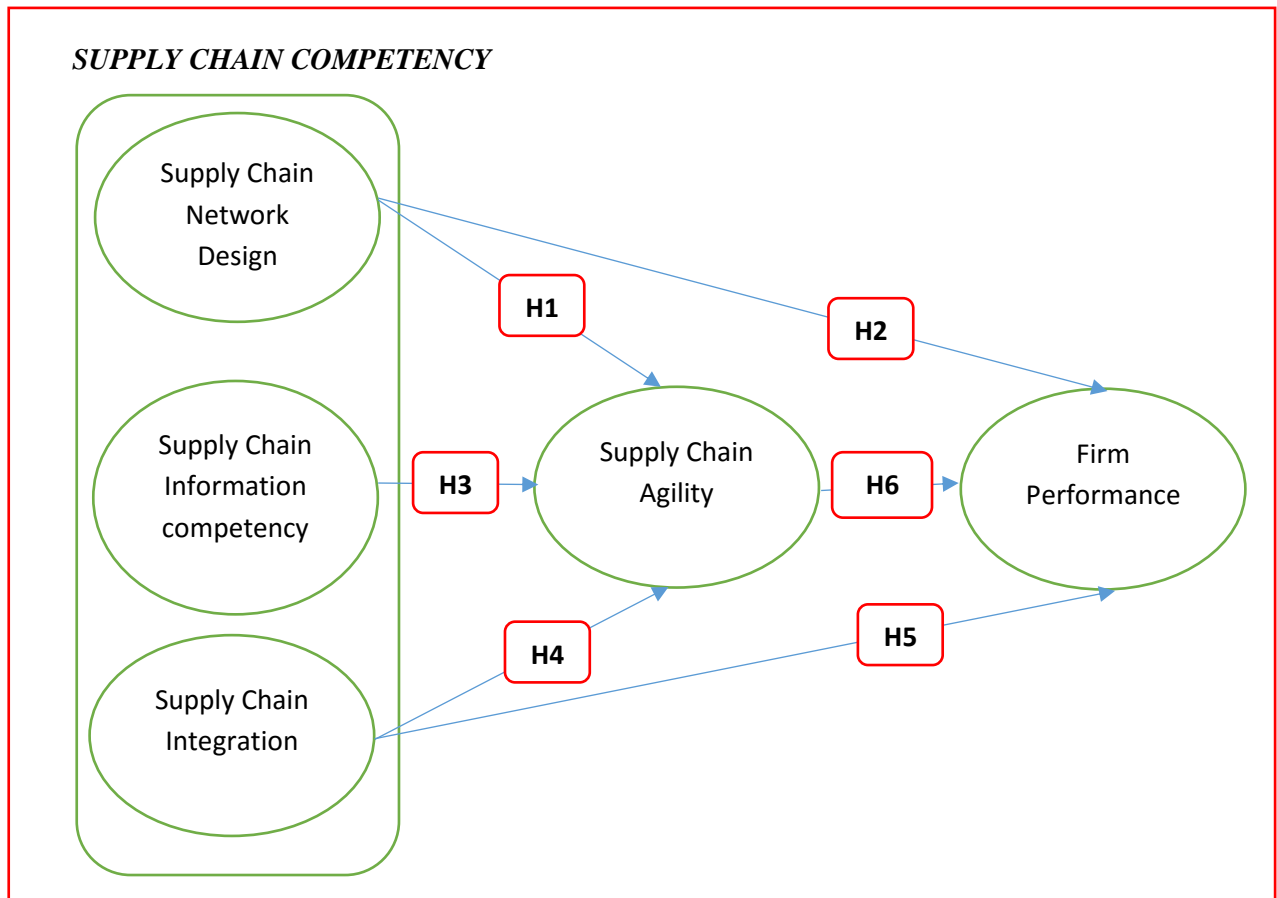


Figure 4.3: Conceptual Framework

Source: Own work

Figure 4.3 above illustrates the influence of supply chain capabilities (supply chain network design, supply chain information competency and supply chain integration) and supply chain agility on firm performance.

4.8 SUMMARY OF THE CHAPTER

This chapter concludes the literature review with regard to supply chain capability (supply chain information competency and supply chain integration) and supply chain agility with various view on different definitions provided by numerous researchers in the field of supply chain. The relationship between supply chain technologies and supply chain agility has been analysed and the literature evidence showed positive correlation between these two variables.

Firm performance has been reviewed and the literature proved that there is a relationship between this outcome variable with supply chain capabilities and supply chain agility. Despite conflicting reports from various studies on these relationships, the literature has attested to the formulated hypotheses on these variables.

CHAPTER 5

RESEARCH METHODOLOGY

5.1 INTRODUCTION

In the previous chapter, the literature review on supply chain capabilities (supply chain network design, supply chain information competency, and supply chain integration) and supply chain agility was provided, together with different definitions provided by various researchers in the field of supply chain. The relationship between supply chain capabilities and supply chain agility was analysed, and the literature evidence showed a positive correlation between these two variables. Firm performance was also reviewed, and the literature consulted showed that there is a positive relationship between supply chain network design, supply chain information competency, supply chain integration, supply chain agility and the outcome variable, which is firm performance.

This chapter focuses on the research approach and research methodology. The areas to be addressed include the design, the population, the sampling method and procedure, data collection, layout and administration of the questionnaire, statistical analysis, and ethical issues.

5.2 RESEARCH PARADIGM

Paradigms play a fundamental role in science. The origin of the term paradigm is to be found in Thomas Kuhn's book, *The structure of scientific revolutions* first published in 1962 (Mouton 1996:203). When Kuhn published the second edition of his book in 1970, the idea of a paradigm was already extant, and it drew particular attention to the role of paradigms in the history of the natural sciences. Researchers and authors, like Mouton and Marais (1990:150), Turner (2010:750), Collis and Hussy (2009:55), Babbie (2010:33), as well as Neuman (2011:94) were already using the term, and the supporting theory of paradigms has had a major impact on the philosophy and methodology of research.

In general, a paradigm is best described as a whole system of thinking (Neuman 2011:94). In this sense, a paradigm refers to the established research traditions in a particular discipline (Mouton 1996:203), or a philosophical framework, as Collis and Hussey (2009:55) opine. More specifically, a paradigm would include the accepted theories, traditions, approaches, models,

frames of reference, the body of research and methodologies, and it may be seen as a model or framework for observation and understanding (Rubin & Babbie 2010:15; Babbie 2011:32). There are numerous paradigms used to guide research studies.

Positivism, interpretivism and realism approaches are paradigms known to underpin quantitative, and qualitative research, respectively (Petty, Thomson & Stew 2011:269).

5.2.1 Positivism

Babbie (2011:35) states that the root of positivism can be traced back to Auguste Comte, who saw human beings as a phenomenon to be studied scientifically. Therefore, positivism may be seen as an approach to social research that seeks to apply the natural science model of research as the point of departure for investigations of social phenomenon and explanations of the social world (Denscombe 2011:120). Moreover, Glicken (2003:20) propose that positivism entails a belief based on the assumption that patterns (trends), generalisation, methods, procedures and cause-and-effect issues are also applicable to the social sciences. This view of positivism maintains that the objects of the social sciences, namely people, are suitable for the implementation of scientific methods.

The positivist researcher maintains that it is possible to adopt a distant, detached, neutral, and non-interactive position (Morris 2006:3). A position such as this would enable the research to assume the role of an objective analyst, making detached interpretations about those data that have been collected in an apparently value-free manner. For the same reason, positivism prefers an analytical interpretation of quantifiable data (Druckman 2005:5). In addition, positivism entails a belief that valid knowledge can only be produced on the basis of direct observation by the senses, and this would include the ability to measure and record what would be seen as knowledge. Observation, in this sense, means accepting only empirical evidence as valid evidence. Moreover, it should be quite obvious that things that cannot be seen (observed) (Bryman 2005:15).

5.2.2 Interpretivist

In contrast, the interpretivist tends to view the world in quite a different manner, requiring a different response from researchers. As Bryman and Bell (2011:62) state, interpretivists take the view that the subject matter of the social sciences - people and their institutions - is

fundamentally different from that of the natural sciences. The study of the social world, therefore, requires a different logic of research procedure. The interpretive approach operates under the assumption that access to reality is only possible through social constructions such as language and shared meanings. It has its philosophical base in hermeneutics (Walsham 2010:25). Interpretive approaches give the research more enormous scope to address issues of influence and impact, and to ask questions such as ‘why’ and ‘how’ particular trajectories are created (Deetz 1996:191).

As a way to improving the quality of research conducted from the interpretive perspective, Klein and Myers (2001:220) proposed a set of principles based on the hermeneutic orientation. The set of principles is as follows: (1) the hermeneutic circle; (2) contextualisation; (3) interaction between the researcher and the subject; (4) abstraction and generalisation; (5) dialogical reasoning; (6) multiple interpretations; and (7) suspicion. Tustin, Ligthelm, Martins and Van Wyk (2010:155) recommend that researchers must work out for themselves ‘how’ and ‘which’ principle may be applied in any particular situation. They also believe that this set of principles may not be used mechanically since the importance and relevance of each principle is partly derived from the manner in which the other is applied to the collection and interpretation of the field materials.

If this set of seven principles is used, the research work can become more plausible and convincing to its target audience. As such, the main aim of this set of principles is to improve the plausibility and cogency of the research.

This study developed a theoretical model with a proposed hypothesis that is quantitative as they are measurable on a five-point Likert scale. Therefore, the positivist research paradigm is suitable and adopted in this study. The objectivity of the chosen positivist approach was realised by evaluating the reliability and validity of the research instruments used for the research. Table 5.2 presents some of the main principles of the positivist paradigm, together with some assumptions.

5.2.3 Realism

In addition to these two paradigms, there is also the realism approach. Realism is a research philosophy sharing the principles of positivism and interpretivism (Blumberg, Bramlett,

Kogan, Schieve, Jones & Lu 2013:19). More specifically, realism accepts the existence of reality independent of human beliefs and behaviour. However, it also concedes that understanding people and their behaviour requires acknowledgment of the subject inherent to humans. In the realists' view, there are social processes and forces beyond the control of humans, which affect their beliefs and behaviour (Saunders *et al.* 2009:114). The processes and forces operate at the macro-level. At this level (that is, at the micro-level of individual human beings), individual subjective interpretations of reality are essential for a full understanding of what is happening.

These subjects' interpretations are not unique, and people share similar interpretations, partly because of the external forces at the macro-level influence everyone. Therefore, research requires the identification of external factors, as well as the investigation of how people interpret and give meaning to their situations.

Flynn, Hou and Zhao (2010:58) explain the social world in relation to three crucial interrelated, philosophical assumptions that underpin the different paradigms, namely, ontology (what do we believe), epistemology (the science of knowing) and methodology (the science of finding out). According to Cohen and Golan (2007:420), researchers who view their world realistically generally accept the basic principle of the natural and the social sciences to be the same. Empirical evidence serves as proof for valid knowledge, but in itself, it is not sufficient. The main objective of realism is thus to go beyond a description of relationships and to discover how such relationships come to being. Realists believe and are convinced that the social world has to be understood in its totality. That is to say, all parts of the social world are affected by the other parts. In conclusion, Starkweather (2012:4) proposes the use of focus groups or in-depth interviews to collect reliable and valid data for a study, in accordance with the realism paradigm.

For the purpose of this study, a positivism paradigm was adopted to guide the researcher in philosophical assumptions about the research and in the selection of tools, instruments, participants, and methods used in the research study.

Table 5. 1: Research Paradigms

	Positivism	Realism	Interpretivism
Ontology	Naïve realism: social reality is real and knowable (as if it were a thing).	Critical realism: social reality is real but knowable only in an imperfect and probabilistic manner.	Constructivism: the knowable world is that of meanings attributed by individuals. Relativism (multiple realities): these constructed realities vary in form and content among individuals, groups and cultures.
Epistemology	Dualism-objectivity. True results. Experimental science in search of laws. Goal: explanation, Generalisations: natural immutable laws.	Modified dualism-objectivity. Results probabilistically true. Experimental science in search of laws. Multiplicity of theories for the same fact. Goal: explanation, generalisations: provisional laws open to revision.	Non-dualism, non-objectivity. Researcher and object of study are not separate but interdependent. Interpretive science in search of meaning. Goal: comprehension. Generalisations: opportunity structures, ideal types.
Methodology	Experimental-manipulative. Observation, Observer-observed detachment. Mostly induction. Quantitative techniques. Analysis by variables.	Modified experimental manipulative. Observation. Observer-observed detachment. Mostly deduction (disproof of hypotheses) Quantitative techniques with some qualitative. Analysis by variables.	Empathetic interaction between scholar and object studied. Interpretation observer-observed interaction. Induction (knowledge emerges from the reality studied) Qualitative techniques. Analysis by cases.

Source: Quinlan (2011:13)

5.3 RESEARCH APPROACH

According to Yin (2009:40), the researcher should choose a research strategy as a function of the research situation since each research strategy has its own specific approach in collecting and analysing empirical data. Currently, there are two recognised and well-known research approaches, namely, quantitative and qualitative approaches (Fàbregues & Molina-Azorín 2017:2847). The distinction between quantitative and qualitative research is based on different research paradigms. Fisher and Smith (2011:325) state that “gathering intelligence about the marketplace is the purpose of conducting research of all types.” However, while quantitative research focuses on obtaining market data by means of numbers and statistics, qualitative research aims at providing an answer to why things are how they are, thus, emphasising market understanding.

Qualitative data is generally difficult to measure and quantify, yet it can reveal valuable attitudes and perspectives that can hardly be accessed through a traditional quantitative approach. The exploratory character of qualitative market research permits the gathering of new information on specific areas of research, very often through an intensive dialogue between the interviewer and the respondent (Naderer & Balzer 2007:351).

Since fieldwork is done without predetermined categories of analysis, qualitative studies provide depth and detail. In contrast to quantitative research, which can statistically measure and evaluate the reactions of a high number of people, thanks to a limited set of questions and standardised answer categories, a qualitative study can never reach the same breadth due to the reduced number of cases (Patton 2010:598). Fisher *et al.* (2011:326) provide an overview of the main differences between quantitative and qualitative research (see Table 5.2).

Table 5. 2: Quantitative v/s Qualitative research

Criteria	Quantitative research	Qualitative research
<i>Assumptions about the market</i>	Reality-based on objectivity (etic view)	Insider’s perspective (emic view)

Criteria	Quantitative research	Qualitative research
<i>Purpose of the research</i>	Concrete answers to market questions	Contextualised approach
<i>Approaches to conducting research</i>	Form hypotheses that can be applied in multiple situations (deductive approach)	Move from particular to more general statements (inductive approach)
<i>Role of the researcher</i>	Strive for objectivity and impartiality	Personal involvement and partiality; researchers become instrument

Source: Own work

In contrast to quantitative research, where hypotheses are formed and are then applied to various specific cases (deduction), qualitative research uses inductive reasoning, proceeding from particular to more general statements. To do this, qualitative research borrows methods from humanistic (for example, from the social sciences) researchers, who believe in multiple realities and focus on interpreting the interaction between researcher and phenomenon (Zarkesh 2008:35).

The discussion of quantitative versus qualitative research as two opposed paradigms has a long tradition and cannot be exhaustively explained here. Naderer and Balzer (2007:359) summarise the status of quantitative and qualitative research as equally academic and recognised, under the condition that research is conducted systematically and follows established rules. What differs is the degree of abstraction of data, which is increasing as one is moving towards quantitative data (see Table 5.3).

Table 5. 3: The Academic Status of Quantitative and Qualitative Research

Degree of abstraction	Form of data	Characteristics	Academic status
Abstraction increasing	Quantitative data	Abstract quantifies data, measures and quantifies the research problem, uses a large sample and identifies prevalence, averages and patterns in data.	Academic/Scientific
	Qualitative data	Abstract qualities that involves the use of unstructured exploratory techniques that are based on small samples in order to understand a problem further.	Academic/Scientific

Source: Dyckhoff, Zielke, Bültmann, Chatti and Schroeder (2012:58)

Table 5.2 and Table 5.3 indicates that quantitative and qualitative approaches are very different. These differences have a profound impact on the focus and conduct of research projects (Frels & Onwuegbuzie 2013:184), and this amounts to a strong suggestion within the research community to combine qualitative and quantitative research, called ‘mixed methodological approach’ (Östlund, Kidd, Wengström & Rowa-Dewar 2011:369). Mixed methods research is becoming increasingly articulated and recognised as the third significant research approach or research paradigm (Johnson, Onwuegbuzie & Turner 2007:112). Teddlie and Tashakkori (2010:2) outlined the following benefits for the adoption of mixed methods research:

- Combination enables confirmation or corroboration of each other through triangulation.
- Combination enables and develops analysis in order to provide richer data.
- Combination initiates new modes of thinking by attending to paradoxes that emerge from the two data sources.

For the purpose of this research study, a quantitative research approach was adopted. The researcher’s rationale behind using this approach is that it has pragmatic origins in terms of allowing large-scale data collection and analysis at a reasonably low cost and effort, including

the provision of statistical analysis (Sharp, Mobley, Hammond, Withington, Drew, Stringfield & Stipanovic 2012:34).

5.4 RESEARCH DESIGN

Research is characterised by three scientific purposes, which are exploratory, descriptive, and explanatory designs (Nolan, Damm & Prentki 2011:169). 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 which to refer. 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 in order 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, according to 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 individuals, 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 and how questions. However, they do not determine the cause-effect relationship. In this study, descriptive and explanatory research was used to build the manufacturing sector of South Africa.

Lastly, explanatory research is useful to explain relationships between the variables under study (Harrison & Reilly 2011:17). According to Berglund (2007:58), in explanatory research, the purpose is to explain the effect of given stimuli or factors on another variable. Owence, Pinagase and Mercy (2014:69) have observed that an explanatory design is to explain why things are the way they are and why one variable affects another. Neuman (cited in Zarkesh 2008:47) compared the conditions under which these discussed types of researches are appropriate, as depicted in Table 5.4.

Table 5. 4: Research Method Classification

Exploratory	Descriptive	Explanatory
Become familiar with the basic facts, setting, and concern.	Provide a detailed, highly accurate picture.	Test a theory's predictions or principle.
Create a general mental picture of condition.	Locate new data that contradict past data	Elaborate and enrich a theory's explanation.
Formulate and focus questions for future research	Create a set of categories or classify types.	Extend a theory to new issues or topics.
Generate new ideas, conjectures, or hypotheses.	Clarify a sequence of steps or stages.	Support or refute an explanation or prediction.
Determine the feasibility of conducting research.	Document a causal process or mechanism.	Link issues or topics with a general principle.
Develop techniques for measuring and locating future data.	Report on the background or context of a situation.	Determine which of several explanations is best.

Source: Neuman (2001) (cited in Zarkesh 2008:47)

5.1.1 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 provides a pictorial presentation of a sampling design.

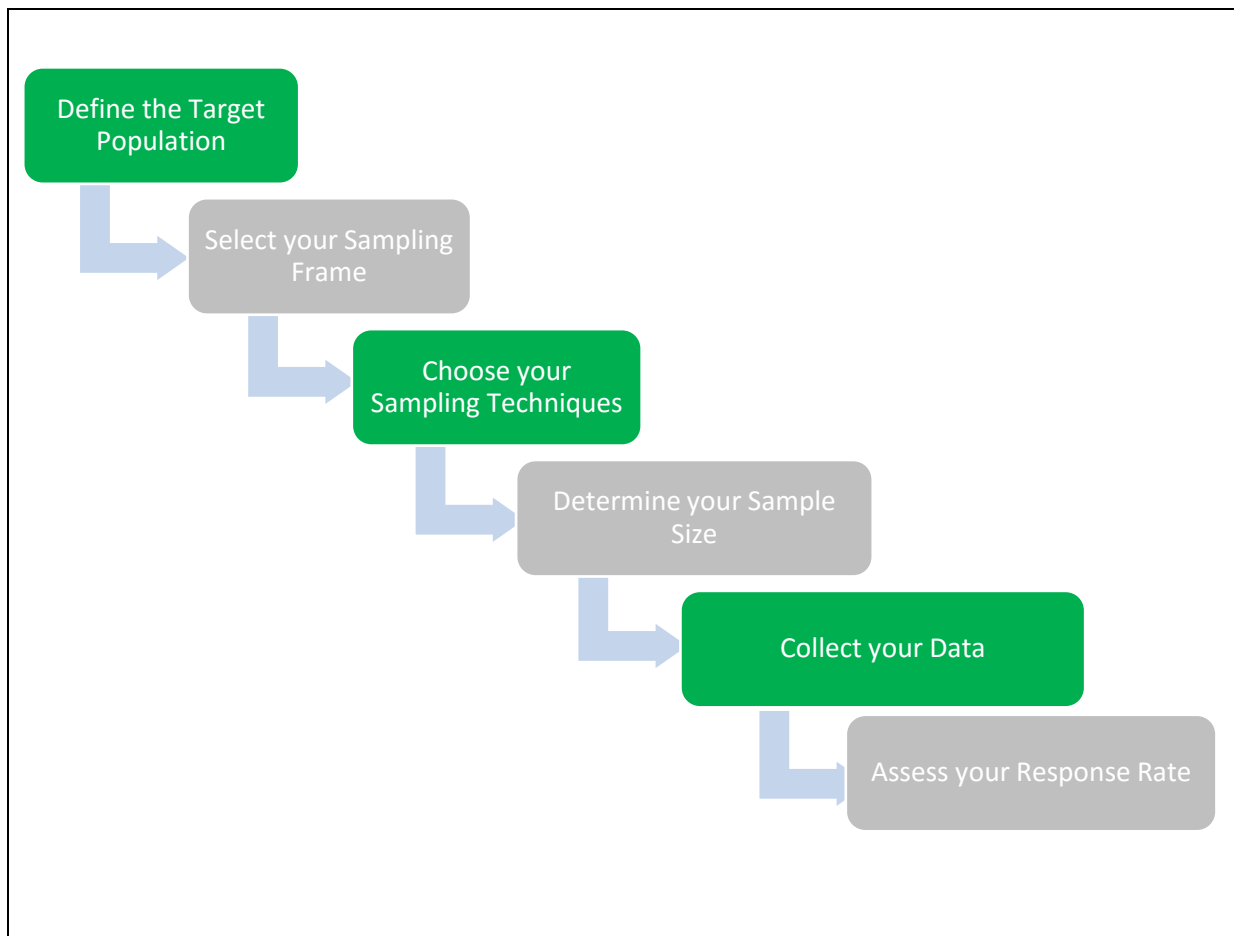


Figure 5. 1: Sampling Design

Source: Own work, adapted from Wilson (2010:160)

5.4.1 Target Population

People are the primary interest in social science studies, and even if research focuses on firms, the researcher is usually interested in the people who belong to that firm. Often, these people are referred to as a population in research terms. Consequently, a population is regarded as any group of people who share a set of common traits (Black 1999:111). According to Huysamen (1994:38), a population is defined as “the total collection of all members, cases or elements about which the researcher wishes to draw conclusions”. Berndt and Petzer (2013:33) defined it as “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”.

It is necessary for the researcher to clearly define the target population. This exercise should be done with great care by keeping with the formulated objectives of the study (Manoharan 2010:20). Regardless of how well the research instrument is designed, the data will lose value if the wrong population is targeted (Boyce 2002:232). The target population in this study was the manufacturing sector of Gauteng Province. The manufacturing firms' managers and owners were the target population of this study and those firms which are members of National Association of Automobile Manufacturers of South Africa, Chemical and Allied Industries' Association, Independent Communications Authority of South Africa, South African Iron and Steel Institute, and Textile Federation of South Africa. As the research currently stands, the number of the population is 2500 firms in the manufacturing sector. The target population is closely linked with the sampling frame.

5.4.2 Sampling Frame

Turner (2003:3) defines a sampling frame as the set of source materials from which the sample is selected. Moreover, Aaker, Kumar and Day (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. These definitions are important as they give an indication of the purpose of the sampling frame, which is to provide a means for choosing the particular members of the target population that are to be asked to participate in the research. Examples of sample frames include but are not limited to, lists of registered firms, employee list (Tustin, Ligthelm, Martins & Van-Wyk 2010:155). For the purpose of this study, only 600 manufacturing firm managers and owners who are members of the associations formed part of the sampling frame.

5.4.3 Sample Size

Sample size determination is a sophisticated matter because it is highly dependent on several factors such as *inter alia*, the type of sample, the homogeneity of the population, the stats method, the time, the money and the personnel available for the study (Surujlal 2003:144). Mbundu (2011:42) argues that once the target population has been specified, the researcher should decide if the information would be collected from all individuals (N) or on a sub-set only (n). 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 critical factors in determining a sample size; the reason is that they have a direct effect on the sample data used to draw inferences about the population and to 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 accurate and unreliable findings. The practical limitations, such as cost and time, are usually operative in the situation and stand in the way of studying the total population. As such, the sampling concept has been introduced with a view to making the research results economical and accurate (Singh & Bajpai 2007:137).

Researchers should, therefore, select samples of respondents before administering questionnaires to collect information about their attitudes, values, habits, ideas, demographics, feelings, opinions, perceptions, and beliefs (Maree 2010:155). It has been recommended that if the population size is about 2 000, at least 20 per cent should be sampled (Leedy & Ormrod 2010:214). For the purpose of this study, 600 (n) participants were randomly selected from the total population of manufacturing firms in the Gauteng Province (N = 2500), thus targeting approximately 20 per cent of the target population.

5.4.4 Sampling Method

There are two approaches to sampling methods, namely probability and non-probability sampling (Malhotra 2010:374). Probability sampling is based on the premise that each member of the population has a definite opportunity to be selected such that sample elements are selected by chance and the chance is known for each element that is selected (Zikmund, Babin, Carr & Griffin 2013:398). In non-probability sampling, sample element selection relies on the discretion of the researcher and, furthermore, the degree of sampling error cannot be determined (Tustin, Ligthelm, Martins & Van Wyk 2010:345).

There are three different types of non-probability sampling methods that can be distinguished, namely, judgemental, quota, and convenience sampling methods (Bradley 2010:161; Zikmund et al., 2013:398). In contrast, probability sampling methods are grouped into the following types: simple random sampling, systematic sampling, stratified sampling, namely cluster sampling and multistage sampling (Tustin *et al.* 2010:345).

For the purpose of this study, a simple random sampling method was used since the characteristics of this method have particular appeal to financial and time constraints. When using simple random sampling, the sample elements are chosen because it is expected that they can serve the research purpose (Churchill, Brown & Suter 2010:336).

5.4.5 Data Collection Method

This section focuses on the primary methods used by the researcher in order to physically collect the requisite data.

5.4.5.1 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 from 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 the anonymity of the respondents' assistance are highlighted in the cover letter. Can and Walker's (2011:508) 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 the current research study further to the managers and owners of firms in the manufacturing sector of Gauteng Province.

5.4.5.2 Questionnaire Design

In a research study, the theoretical constructs that are measured are the determining factors for the choice of measurement methodology (Plantard, Shum, Le Pierres & Multon 2017:562).

Questionnaires are designed basically to achieve three goals (Martins *et al.* 2002:216), to namely maximise the relevance and accuracy of the data collected; to maximise the participation and co-operation of the target respondents, and to facilitate the collection and analysis of the data.

Narteh, Agbemabiese, Kodua and Braimah (2013:407) defines a questionnaire as a reformulated written set of questions to which respondents record their answers, usually within closely defined alternatives. This instrument was utilised because of its effectiveness in gathering large volumes of empirical data from large samples, as well as the timely collection of predetermined data (Narteh *et al.* 2013:407).

A questionnaire is a type of data collection instrument and provides a structure to the data collection process. The methods are explained below:

- A self-completion questionnaire, is a questionnaire that is sent or given to the person who will take part in the study or respondent for completion and return. There are four main types of self-completion questionnaire which include:
- Postal questionnaires, the questionnaire is posted to the respondent, asking him/her to complete it and to post it back. The respondent may be encouraged to complete and return the questionnaire by enclosing pre-paid addressed envelopes.
- Drop-off and pick-up questionnaire, the questionnaire is delivered to and collected from the respondent by field staff.
- Computer-assisted self-interviewing (CASI), the questionnaire is filled in by the respondent on a PC or laptop in the presence of an interviewer; the interviewer is present only to explain the purpose of the questionnaire and to explain any questions or concepts when the respondent requires clarity.

- Electronic self-completion questionnaire, the questionnaire is sent to the respondent in an electronic format, such as floppy disc or via the internet, and the respondent completes the questionnaire electronically and sends back to the researcher.

The literature in this study was used as a guideline for formulating the statements in the questionnaires. The questionnaire was developed primarily on the basis of instruments used in other studies (as shown in Section 5.5). Multi-item scaled questions (particularly Likert scales) were used to test the research hypotheses.

Most of the questions contained in the questionnaire were 5-point Likert scale questions for the following reasons (Wegner 2012:86): they reduce the development of response bias amongst the respondents; they evaluate attitudes, beliefs, opinions, and perceptions; the use of a Likert scale makes the response items comparable amongst the respondents, and the answers from the Likert scale statements are easy to code and analyse directly from the questionnaires.

A questionnaire containing 25 items was designed based on previous work that was relevant to this study. The questionnaire items incorporated five constructs, namely, supply chain network design (five items) (Chen & Paulraj 2004:119), supply chain information competence (five items) (Kwon & Song 2011:87; Varcoe 2012:16; Kang & Moon 2016:237); supply chain integration (five items) (Prajogo & Olhager 2012:514; Kim 2009:328; Flynn, Hou & Zhao 2010:58); supply chain agility (five items) (Chan, Ngai & Moon 2017:486; Kim & Chai 2017:42); and firm performance (five items) (Prajogo & Olhager 2012:514; Kim 2009:328; Petersen, Handfield & Ragatz 2005:371; Flynn, Hou & Zhao 2010:58). All the measurement items were measured on a 5-point Likert-type scale that used 1=strongly disagree to 5=strongly agreed.

Table 5. 5: Questionnaire Items

VARIABLES	MEASUREMENT ITEMS	SOURCE
SUPPLY CHAIN NETWORK DESIGN	<ul style="list-style-type: none"> • Our firm has an absorptive boundary that facilitates better communication or relationship with key suppliers. • We have an interdependence supply chain relationship with key suppliers. • Our firm's supply chain can be categorised as a flexible value-adding network. • We have a supply chain network that does not involve power-based relationships. • Our supply chain network is designed in such a way that its members can make decisions independently. 	Chen and Paulraj (2004:119).
SUPPLY CHAIN INFORMATION COMPETENCY	<ul style="list-style-type: none"> • We have a high level of electronic document interchange through the supply chain. • Our firm has a department that evaluates information and its source critically. • We have a search engine that determines the nature and extent of the information we need. • Our firm is better able to acquire new customers. • Our firm has a good data standardisation between supply chain partners. 	Kwon and Song (2011:87); Varcoe (2012:16); Kang and Moon (2016:237).

VARIABLES	MEASUREMENT ITEMS	SOURCE
SUPPLY CHAIN INTEGRATION	<ul style="list-style-type: none"> • Our firm's supply chain is structured in such a way that it is integrated with suppliers. • We have a cross-functional integration within our firm. • We have a supply chain structure that is well integrated with our supplies logistics activities. • Our firm's supply chain is integrated in such a way that follow-up with our major customers for feedback is easy. • Our supply chain integration is structured to share production plans with major suppliers and customers. 	Prajogo and Olhager (2012:514); Kim (2009:328); Flynn, Hou and Zhao (2010:58).
SUPPLY CHAIN AGILITY	<ul style="list-style-type: none"> • We have a joined planning system with key suppliers that improving purchasing, productivity, and logistics. • Our firm has a high level of customer service which is a priority. • Our firm has a high level of delivery reliability which is a priority. • Our supply chain is designed in such a way that inventory and demand levels are visible throughout the chain. • We have a supply chain that is capable of forecasting market demand and responding to real market demand. 	Chan, Ngai and Moon (2017:486); Kim and Chai (2017:42).

VARIABLES	MEASUREMENT ITEMS	SOURCE
FIRM PERFORMANCE	<ul style="list-style-type: none"> • Our previous year return on sales is higher compared to that of three years ago. • The involvement of partners in the supply chain increases our profits beyond what could have been expected without integration. • The involvement of partners in the supply chain increases our return on investment beyond what could have been expected without integration. • Our return on asset has increased for the previous year compared to that of three years ago. • The involvement of partners in the supply chain increases the growth in market share beyond what could have been expected without integration. 	Prajogo and Olhager (2012:514); Kim (2009:328); Petersen, Handfield and Ragatz (2005:371); Flynn, Hou and Zhao (2010:58).

Source: Own work

Table 5.5 shows a list of the questionnaire items adopted in comparison to the original items, as well as the authors from which they have been adopted. The fully developed and pre-tested questionnaires were then distributed to the target population.

5.4.5.3 Data Collection Technique

When conducting a study, it is vital to obtain truthful and reliable information about the phenomena being studied. It is essential that all data collection methods, from the simplest to the most complex, be taken care of with diligence and respect. Questions, observation sessions, and other activities must be designed meticulously to ensure that the data to be collected is significant (Verner & Abdullah 2012:866).

A questionnaire is an instrument for gathering surveyed information. It collects structured, often numerical data that can be managed without the presence of a researcher and is typically relatively simple to analyse (Wu, Xu, Liu, Zhang, Hua, Zheng & Hu 2012:331). When

administering a questionnaire, it is vital that attention is paid to the wording of the questions, the design of the forms and the order of the questions in order to ensure valid results (Niazi, Mahmood, Alshayeb, Riaz, Faisal, Cerpa, Khan & Richardson 2016:3). According to Cohen et al. (2007:430), there are two types of a self-administered questionnaire, namely, those that are completed in the company of the researcher and those that are attended to when the researcher is not present.

5.5 DATA ANALYSIS

Malhotra (1996:469) refers to data analysis as a statistical process that includes modelling 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”.

Descriptive Statistics

Descriptive statistics are used to describe the basic features of this study through the use of graphical analysis. Table 5.6 illustrates the basic descriptive statistics used in data analysis.

Table 5. 6: Basic Descriptive Statistics

Frequency	This simply means the number of instances in a class by showing what percentage of respondents answered for each attitude category to the statement. In a survey study, it is associated with the use of a Likert scale.
Mean	A mean is calculated by summing the values of a variable for all observations and then dividing by the number of observations. This describes the central tendency of data.
Standard deviation	This is defined as the square root of the average of squares of deviations, when such deviations for the values of individual items in a series are obtained from the arithmetic average. This describes the dispersion of the data. Standard Deviation is a direct form of variance and was used in place of the latter for reporting.
Variance	This is calculated by finding the squared difference between the mean and an observation, adding all cases and then dividing by the number of observations

	minus one. It shows the relation that a set of scores has to the mean of the sample. This describes the dispersion of the data.
Skewness	This is the measure of asymmetry and shows the manner in which the items are clustered around the average. The importance of skewness lies in the fact that through it, one can study the formation of series and can have the idea about the shape of the curve, whether normal or otherwise, when the items of a given series are plotted on a graph.
Median	This is the value of the middle item of series when it is arranged in ascending or descending order of magnitude. It divides the series into halves; in one half all items are less than median, whereas in the other half all items have values higher than median.
Kurtosis	Kurtosis is the measure of flat-toppedness of a curve. It is the humpedness of the curve pointing to the nature of distribution of items in the middle of a series. If the curve is relatively more peaked than the normal curve, it is called leptokurtic whereas, if a curve is flatter than the normal curve, it is called platykurtic.

Source: Norusis (2012:499)

The current research study made use of descriptive statistics and the Statistical Package for Social Sciences (SPSS) version 25.0 (for Windows) for analysing data. Through SPSS, the researcher provided a statistical summary of data, which was collected by means of descriptive statistics. This enabled the researcher to convert data into frequency distribution tables by forming classes for ease of interpretation. The rationale behind using descriptive statistics is to reduce data to an interpretable form so that the relations of research problems could be studied, tested and conclusions drawn (De Vos 1998:203; Celebi, Kingravi & Vela 2013:200).

The primary hypothesis of this study broadly claims that supply chain capabilities (supply chain network design; supply chain information competency; and supply chain integration) have a positive influence on supply chain agility and firm performance and also supply chain agility has a positive influence on firm performance.

The quantitative research data that was gathered for the purpose of this research study was analysed using a two-step procedure which included Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM). The CFA was used to test the probability that the hypothesised factor structure was supported or confirmed by the sample data.

SEM, through the path analysis, was used to test the research model and hypotheses. Analysis of Moments of Structure (Amos version 25.0) was employed as the computational SEM software; while SPSS was used for descriptive statistics and reliability testing.

5.5.1 Structural Equation Model

Structural equation modelling (SEM) was employed in this research study to analyse data. It has become an admired statistical technique to test the theory in several fields of knowledge (Hair, Black, Babin, Anderson, Tatham & Black 2010:5; Schumacker & Lomax 2004:12). Qureshi and Kang (2015:170) describe SEM as “a multivariate, statistical technique largely employed for studying relationships between latent variables (or constructs) and observed variables that constitute a model”. Moreover, Byrne (2013:3) defines SEM as “a statistical methodology that takes a confirmatory (That is, hypothesis-testing) approach to the analysis of structural theory (causal processes that generate observations on multiple variables) bearing on some phenomenon”.

It is recognised as being similar to regression analysis but more predominant in that it assesses the causal relationships among constructs while concurrently accounting for measurement error (He, Gai, Wu & Wan 2012:853; Sarstedt, Ringle, Smith, Reams & Hair 2014:105). SEM’s ability to address numerous modelling difficulties, the endogeneity among constructs and composite underlying data structures found in various phenomena (Sadri, Ukkusuri, Murray-Tuite & Gladwin 2013:61) can be assumed to be part of the reason for its popularity.

The primary 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 (Swoboda, Meierer, Foscht & Morschett 2011:275).

According to Hair *et al.* (2010:17), SEM comprises two main components, namely, the measurement and the structural model. The measurement model enabled this research study to

use several indicators for multiple independent variables (supply chain network design, supply chain information competency; and supply chain integration). The structural model, which is path analysis, enabled this research study to connect and test the hypothesised relationships between the independent (supply chain network design, supply chain information competency and supply chain integration) and dependent variables (supply chain agility, and firm performance). In addition, this study identified supply chain network design, supply chain information and supply chain integration as having an influence on supply chain agility and firm performance and supply chain agility as having an influence on firm performance. The SEM technique initially requires the performance of a measurement model, which is discussed below.

5.5.1.1 Measurement model

Nunkoo, Ramkissoon and Gursoy (2013:579) 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 unidimensionality of the measurement items (Nunkoo *et al.* 2013:579). The measurement model can be performed either as exploratory factor analysis or confirmatory factor analysis. Generally, for exploratory factor analysis, we use principal component analysis or common 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 (Voors, Nillesen, Verwimp, Bulte, Lensink & Van Soest 2012:941). 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 (Reisinger *et al.* 2007:43; Lei & Wu 2014:407) and is discussed in the next section. This research study applied the confirmatory factor analysis as the measurement model since previous measures of the latent variables (supply chain network design; supply chain information competency, supply chain agility, and firm performance) exist.

5.5.2 Confirmatory Factor Analysis (CFA)

CFA was used to determine how well the obtained structure fits the data (Schreiber, Nora, Stage, Barlow & King 2010:321). In CFA, the researcher specifies the number of factors and the pattern of indicator-factor loadings in advance (Brown & Moore 2012:3). CFA, therefore, verifies the number of underlying dimensions of the instrument (factors) and the pattern of item-factor relationship (factor loadings).

A measurement model relates to the theory specifying observed variables of constructs, thereby permitting the assessment of both convergent and discriminant validity (Malhotra 2010:725). The measurement model specifies the number of factors, how various indicators are related to the factors and the relationships among indicator error (such as a CFA model). It identifies the relationship between latent variables and their indicators (Sharma 2012:13) and is constructed for confirmatory analysis purposes (Byrne 2010:6). The adequacy of the measurement model was assessed by conducting CFA using Amos Version 25.0.

Based on CFA, the adequacy of the measurement model was ascertained through assessing the significance of the item loadings of all constructs. Items reported loadings below the minimum acceptable threshold of 0.50 (Chinomona, Dhurup & Chinomona 2013:7).

Model fit is the level to which the hypothesised theoretical model fits the model deduced from the actual empirical data of the study sample (Kim 2009:387). In order to achieve this, it is necessary to assess different model fit indices, which differ regarding their purpose (Hooper, Coughlan & Mullen 2008:53) as summarised in Table 5.7.

Table 5. 7: Model Fit Indices

Fit indices	Acceptable Threshold.
Chi-square(CMIN/DF)	Tabled Chi-square smaller or equal to 3
Normed fit index (NFI)	Value Equal to or greater than 0.90
Increment fit index (IFI)	Values greater than 0.90
Tucker-Lewis index (TLI)	Values greater than 0.90
Comparative fit index (CFI)	Values greater than 0.90
Goodness-of-fit index (GFI)	Values greater than 0.90

Fit indices	Acceptable Threshold.
Adjusted Goodness-of-fit index (AGFI)	Values greater than 0.90
Root mean square error of approximation (RMSEA)	Less than 0.08 with confidence interval

Source: Bagozzi and Yi (2012:15)

- The absolute fit indices indicate how well an hypothesised model matches the empirical data of the study (Kenny, Kaniskan & McCoach 2015:486). The absolute fit indexes include indices such as goodness-of-fit index (GFI), the adjusted-goodness-of-fit index (AGFI) the badness of fit indices, such as the chi-square test, the standardised root mean square residuals (SRMSR) and the root square mean square error of approximation (RMSEA) (Malhotra 2010:731). For the RMSEA, a value of 0.08 is the recommended upper value (Byrne 2013:77).
- The incremental fit indexes respond to how well the proposed model is performing when assessed against baseline or null models (Schmitt 2011:304). These indexes include the comparative fit index (CFI) and the Tucker-Lewis index (TLI). The values of both absolute and incremental should be equal to 0.90 or higher to indicate a good fit (Hooper *et al.* 2008:55).
- According to Hair *et al.* (2010:638), the parsimonious fit measures whether model fit has been achieved. However, these measures are not a measure of significance; they are used mainly to choose between models and are perceived as a punishment by introducing more parameters into a model (Blunch & Pörtner 2011:17).

The confirmatory factor analysis leads to the performance of a path modelling/analysis which is discussed in the next section.

5.5.2.1 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 (Nunkoo *et al.* 2013:579). 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 5.8.

Table 5. 8: Theorised Variable Paths

Hypothesis	Theorised variable paths
H1	Supply chain network design → supply chain agility
H2	Supply chain network design → firm performance
H3	Supply chain information competency → supply chain agility
H4	Supply chain integration → supply chain agility
H5	Supply chain integration → firm performance
H6	Supply chain agility → firm performance

Source: Own work

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.

5.5.3 Path modelling/analysis

The next phase of data analysis through the use of SEM involved path analysis (Beran & Udell 2001:267; Stein, Morris & Nock 2012:497).

Path modelling describes the relationships between observed or measured variables and theoretical constructs (Roche, Duffield & White 2011:1480) and tests the structural paths of the conceptualised research model (Anderson *et al.* 1988:411). This SEM procedure was conducted in order to demonstrate and test the theoretical underpinnings of the research study and the significance of the relationships between model constructs (Jenatabadi & Ismail 2014:27). The research study's structural model was evaluated by examining the p-values as

well as standardised regression coefficients (Han & Jekel 2011:41). In conducting path modelling, a particular responsibility is to explain standardised regression coefficients as well as the predictive ability (Wu 2010:136).

5.6 ADMINISTRATION OF THE QUESTIONNAIRE

Owing to the nature of the sampling procedure that was utilised in this study and the geographic distance between firms from which the sample was drawn, the appointment of a fieldwork/research assistants was used. Two research assistants from the Vaal University of Technology were deployed in order to facilitate the data collection process. According to Gomes, Angwin, Peter and Mellahi (2012:2874), adequate training of interviewers, research assistants, and field workers is a precondition of any research study.

The research assistants were trained prior to the execution of the duty. The training was done to give the research assistants clear instructions about their duties, which included, inter alia, how to approach research participants and anonymity of the answers on the questionnaire. This, in turn, ensured the reliability of the information they received. The training took almost five hours. The researcher discussed all the questions in the questionnaire with the research assistants. The research assistants then distributed the questionnaire to the firms in the manufacturing sector of Gauteng and later collected these on the agreed date.

5.6.1 Pre-Testing the Questionnaire

Pre-testing a questionnaire is an imperative advance in survey research (Kambule 2012:65). At the point when a questionnaire is utilised as an information-gathering instrument, it is fundamental to decide whether the questions are rationally tended to and react to the research objectives. Moreover, the motivation behind pre-testing is to distinguish any problems in the research questionnaire and to enhance the nature of the outcomes. Figure 5.2 demonstrates a few phases engaged with the plan of a questionnaire.

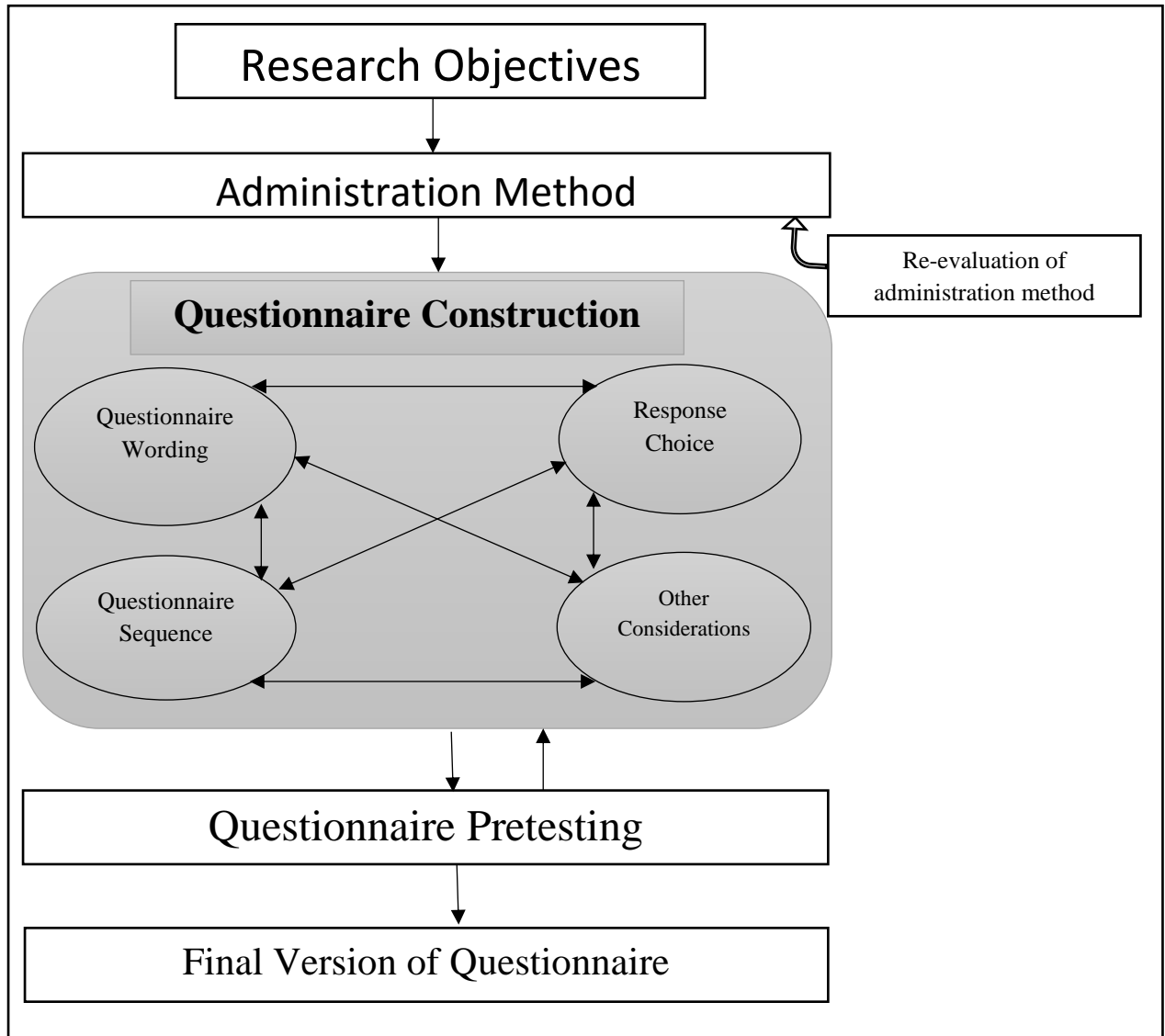


Figure 5.2: Questionnaire Construction Process

Source: Jabbour, De Sousa Jabbour, Govindan, Teixeira and De Souza Freitas (2013:129)

The researcher pre-tested the questionnaire on 15 manufacturing firms in the Vaal triangle region. All the firms reacted to the questions. Having received the responses, the researcher reconsidered the questionnaire. From this activity, nothing was changed in the questionnaire as it was clear that the questions reacted to the research objectives.

5.7 DATA PROCESSING

After data has been collected, it has to be processed. This consists of preparation and data analysis, which is discussed briefly in the subsequent sections.

5.7.1 Data preparation

Data preparation process is the first step when analysing data in completed questionnaires (Cooper & Schindler 2011:490). Editing, coding, capturing and cleaning the data are some of the data preparation methods that were used in this study. These four components are explained briefly hereafter.

5.7.1.1 Editing

Alhotra (2010:461) mentioned that the questionnaire is screened with the objective of increasing its accuracy and precision. Zikmund and Babin (2010:369) maintain that editing consists of checking completed questionnaires for omissions, incomplete or otherwise unusable responses, illegibility, and obvious inconsistencies. The purpose of editing, therefore, is ensuring completeness, consistency, and readability of data to be transferred to storage and involves the inspection and correction of the questionnaire, if necessary (Iacobucci & Churchill 2010:406).

The researcher checked for errors and omissions in the returned questionnaires. The researcher also conducted central editing by checking again when capturing the data to ensure that the information was correct and complete.

The options of substituting missing data with artificially created average data points was not exercised since this could have considerably changed the values of correlation (Aaker, Kumar, Leone & Day 2013:382). Furthermore, to avoid the decrease in variation of the scores as well as the validity of the information that was collected, the questionnaires were discarded (Emory & Cooper 1995:450).

5.7.2 Coding

Once all the questionnaires were completed and returned, they were edited, and the researcher coded the responses. Cooper and Schindler (2011:456) describe coding as an assignment of numerals or other symbols to categories or classes. Codes can be assigned before or after a research study is completed. In this research study, pre-coding was adopted as mainly closed-ended questions, and scaled questions were used (Zikmund & Babin 2013:363). Pre-coding

saves time, money, and decreases the chances of coding errors since data is accessible directly from the questionnaire and grouped into useable classifications. The codes are fixed-filled, meaning that the number of records for each respondent is the same, and the same data appears in the same column for all the respondents (Malhotra 2010:454).

5.7.3 Data capturing

Data entry or capturing refers to the task involved in the direct input of coded data into a software package that will ultimately allow the researcher analyst to transform the raw data into usable information (Aaker *et al.* 2013:236). Data was entered directly from the questionnaires with the use of a personal computer and fed into an MS Excel spreadsheet by an administrator. The researcher also checked the final captured data to ensure that no mistakes were made and necessary changes were done, by referring back to the original questionnaires.

5.7.4 Data cleaning

In this regard, frequency distribution test was processed to examine missing variables. Churchill, Brown and Suter (2010:412) refer to data cleaning as an error checking process performed after data capturing and most importantly, precedes data analysis in order to identify omissions, ambiguities and errors in the responses made during data entry (McDaniel & Gates 2010:140). Data cleaning was done by making use of wild code checks to detect codes that were not defined for a particular variable including extreme cases for responses to a variable that was far from ordinary (Malhotra 2010:461). For example, a six used instead of a five on the Likert-type scale may have been entered on MS Excel.

5.8 RELIABILITY AND VALIDITY

Reliability and validity are the two criteria that are used to determine the quality of a research study (Zarkesh 2008:53).

5.8.1 Reliability

Reliability is described by Iacobucci and Churchill (2010:258) as referring to the similarity of results provided by the independent but comparable measures of the same object or construct. The primary purpose of reliability is to provide consistent results and minimise errors and

biases (Hammond & Wellington 2013:150). There are various general forms or classes of reliability estimates, and these are provided in Table 5.9.

Table 5. 9: Forms of Reliability and Administration

Form of Reliability	Administration
Test-retest reliability	An approach for assessing reliability in which respondents are administered identical sets of scale items at two different times under as nearly equivalent conditions as possible.
Alternative forms reliability	An approach for assessing reliability that requires two equivalent forms of the scale to be constructed and then the same respondents are measured at two different times
Internal consistency reliability	<p>An approach for assessing the internal consistency of the set of items when several items are summated in order to form a total score of the scale:</p> <ul style="list-style-type: none"> • Split-half reliability; a form of internal consistency reliability in which the items constituting the scale are divided into two halves and the resulting half scores are correlated, • Cronbach's alpha, a measure of internal consistency reliability that is the average of all possible split-half coefficients resulting from different splitting of the scale items.

Source: Malhotra (2010:268).

Construct reliability of the research measures was employed in this research study, namely, Cronbach's alpha reliability test, the composite reliability test (CR), and the average value extracted test (AVE). Cronbach alpha testing was adopted as the measure of internal consistency for the measurement scale and was used with a coefficient value of 0.70 as a cut-off point, in line with the suggestion made by Nunnally (1978:245). An essential property of the coefficient alpha is that its value tends to increase with an increase in the number of scale items (Bryman & Bell 2011:158). A large alpha indicates high reliability, while scores close to zero indicate that the reliability of the instrument is low (Malhotra 2010:724).

CR coefficient is another measure of internal reliability, and it provides a robust measure of reliability by taking into account the contribution of each latent factor to each item and each item's error (Starkweather 2012:4). Interpreted the same as Cronbach alpha, the CR measurement threshold must be 0.70.

Malhotra (2010:725) defines AVE as the variance in the indicator or observed variables that are explained by the latent construct. A value of 0.40 or higher indicates a satisfactory measure (Hair, Ringle & Sarstedt 2011:139).

Reliability and validity are suitable measures for assessing the appropriateness of any measuring instrument (Malhotra 2010:318). Therefore, for the purpose of this research study, it is imperative to provide the validity of the measuring instrument.

5.8.2 Validity

Validity is a measurement concept that is concerned with the degree to which a measuring instrument actually measures what it is purported to measure, and it is justified by the evidence (Woodward, Rohmaniyah, Amin & Coleman 2010:28). Validity refers to the question of whether or not one's measurement of a phenomenon is true (Joslin & Müller 2016:1047). The primary importance in the use of assessment instrument is the extent to which their factorial structures are valid (Tims, Bakker & Derks 2012:173). For the purpose of this research study, the validity of the measuring instrument was assessed by means of the following types of validity: content validity, construct validity, convergent validity, and discriminatory validity. Table 5.10 provides the definition of these validities.

Table 5. 10: Types of Validity and Definitions

Form of validity	Definition
Content validity	Refers to the extent to which a measuring instrument covers the whole concept (Van Saane, Sluiter, Verbeek & Frings-Dresen 2003:193). Nunnally and Bernstein (1994:265) define content validity as “the degree to which a measure’s items represent a proper sample of the theoretical content domain of a construct”.
Construct validity	Relates to research on various concepts whose constructs have been detailed and how representative the questions in a measuring instrument are of the same characteristics making up the construct (Black 1999:298). According to Wilson and Eilertsen (2010:5), the construct validity of a questionnaire refers to the degree to which it measures the intended construct rather than irrelevant constructs.

Form of validity	Definition
Convergent validity	Convergent validity assesses the degree to which two measures of the same concept are correlated (Martin 2007:93). <i>In this research study, the criterion for the convergent validity was considered as reasonable correlations at 0.50 or higher values.</i>
Discriminatory validity	Refers to the degree to which two conceptually similar concepts are distinct (Martin 2007:93). The proliferation of different concepts bears a potential danger of a lack of specificity concerning the measurement of different variables (Mathieu & Farr 1991:127).

Source: Own Work

5.9 ETHICAL CONSIDERATIONS

For most professions, ethical codes in research are an integral part of their overall ethics, though some research bodies have evolved their own codes (El Mourad 2017:105). In research, ethical issues can be examined as they relate to participants, researchers, and sponsoring organisations. According to Sanjari, Bahramnezhad, Fomani, Shoghi and Cheraghi (2014:14), the participants, the researcher, and the sponsoring organisations all have ethical issues which should be considered when formulating a research document.

Therefore, the respondents who completed the questionnaire were informed about the ‘potential impact of the investigation’ and that the research study was 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 (Sorrentino 2010:2914). In addition, the respondents’ information was kept in strict confidence, and they remained anonymous (Churchill 1991:54).

5.10 SUMMARY OF THE CHAPTER

In this chapter, the research paradigm was outlined. The paradigm guided the researcher as to which approach would be adopted. The research approach was adopted and discussed against the background of the envisaged research objectives. First, three approaches, namely, qualitative, quantitative, and mixed methodologies, were explained and differentiated as a basis to provide motivation for the chosen approach in this study. The optimum research approach

selected could be described as quantitative and non-experimental with the usage of primary data as the design of analysis. This approach was selected on the basis of the formulated hypotheses. The research methodology referred to the target population and research procedure, which guided the research in a sampling process whereby a self-completion questionnaire through a cross-sectional survey was utilised.

Pre-testing of the measuring instrument was explained as the prerequisite requirements prior to primary fieldwork of any research project. The discussion of the research methodology continued with the questionnaires, where the theoretically sound reliability and validity were provided. The statistical procedures were presented, highlighting the route chosen in order to achieve the objectives of the study in the analysis of data. An explanation as to how the statistical techniques and the absolute fit indices have been used and their relevance in this study were provided. Finally, the ethical code of conduct that informed the researcher and field workers' behaviour were also stated.

The next chapter discusses the results and their interpretation of the data analysis.

CHAPTER 6

PRESENTATION OF FINDINGS AND ANALYSIS

6.1 INTRODUCTION

In the previous chapter, a theoretical exposition of the research methodology was outlined. The study is located within a quantitative research paradigm. In the research methodology chapter, reference is made to the target population, research procedure, measuring instruments, data analysis, and statistical techniques.

This chapter deals with the pilot study, interpretation, and discussion of the results. Descriptive statistics, factor analysis, reliability, correlations, confirmatory factor analysis (CFA), model fit and hypotheses testing using structural equation modelling (SEM) are also reported on and interpreted.

6.2 RESULTS OF THE PILOT STUDY

Before the essential research concept was directed, the exploration instrument was subjected to a board audit, a pre-test, and a pilot study. As indicated by Mohorko and Hlebec (2014:79), a pre-test of the questionnaire includes improvement of selected item-scales. It is directed to enhance the nature of the whole questionnaire to guarantee that the information asked for from the research study is clearly exhibited and comprehended with no ambiguity to the respondents (Burn & Kho 2015:198). This is vital in light of the fact that it encourages the enhanced perception of the setting of a study. The modification of items depends on the maintenance of their central importance on the grounds that the comprehension of significance is impacted by different outside variables, such as social or cultural background (Adaire, Holland, Patterson, Mason, Goering & Hwang 2011:38).

A panel of two academics who specialise in supply chain management at a South African university of technology were requested to review the questionnaire. Perspectives that were incorporated into the sentence structure included the wording of the questions that were altered to guarantee that the research could obtain the required information precisely. The survey was further directed to ensure that the context of the study stays as straightforward as conceivable in guiding the respondents in their comprehension of the research study.

The sample questionnaire was then pre-tested, utilising a preselected sample of 10 (n=10) manufacturing firms that were randomly chosen as a result of their proximity to the researcher's location. Productive criticism was acquired from the returned questionnaires; it was clear that the respondents comprehended the questions that were asked from the questionnaire, and there was no requirement for further modification of the survey.

After a successful pre-test, a pilot study was undertaken to test for content validity and reliability of the questionnaire. The pilot study was carried out through the selection of 100 (n=100) manufacturing firms in the Vaal Triangle region, which were also randomly chosen. A decision was taken to ensure that these manufacturing firms in this region did not form part of the final research study. A total of 88 (n=88) usable questionnaire were utilised in the examination of a pilot study. Table 6.1 presents the results of the analysis of the pilot study.

Table 6. 1: Pilot Study Results

Scale	Means	Std. Dev.	Average item- total correlation	Cronbach Alpha
Section B	3.702	0.859	.678	.910
Section C	3.868	0.919	.618	.886
Section D	3.891	0.939	.721	.927
Section E	3.968	0.922	.812	.956
Section F	3.875	0.925	.740	.929

Table 6.1 shows that the respondents of the pilot study agreed with the questions posed in the research study. This is because of the average mean score for all the scales was $\bar{x}=3.861$, $SD=0.912$. Regarding the average item-total-correlation, the analysis found that scores for all the scales were above the required minimum threshold of 0.5, as suggested by Churchill (1979:64), with sections B, C, D, E and F registering values of 0.678, 0.618, 0.721, 0.812 and 0.740 respectively. The results further revealed that the Cronbach alpha scores for all the constructs were reliable as they met the required cut-off value of 0.7 (Bagozzi & Yi 1988:74),

with supply chain network design, supply chain information competency and supply chain integration scoring 0.910, 0.886, 0.927 and supply chain agility and firm performance registering values of 0.956, 0.929 respectively.

6.3 RESULTS AND DISCUSSIONS OF THE MAIN STUDY

Data obtained from the questionnaires were analysed and interpreted. The results are illustrated, using tables, figures, graphs and pie charts. This section reveals the responses on a question-by-question basis. The results from all the sections of the questionnaire are also compared to existing empirical evidence to assess consistency.

6.3.1 Preliminary Analysis

A preliminary analysis was done before testing the results. According to Pallant (2013:43), it is very important to check the data file for errors and mistakes in order to rectify any missing values and data that are not within the minimum and maximum ranges of the coded data. In other words, values that are far below or far above the data scores need to be corrected. For example, the researcher might enter 44 when he or she meant four (4). These mistakes can negatively interfere with the results of the correlation analysis. The correcting of the raw data for this research study involved two steps:

Step 1: Checking for errors. First, the researcher checks each data variable for scores that are out of range. This step is achieved through the SPSS – descriptive statistics frequencies to enable the researcher to easily identify any value that falls outside the range values of the research variables as well as identifying both the valid and missing cases.

Step 2: Finding and correcting the error in the data file. Secondly, the researcher finds wherein the data file the mistake occurred. Finding the actual mistake is achieved through SPSS – data sort cases so as to rectify or delete the value. When the error is identified, the record of the questionnaire is checked to find out what the missing value should be. However, frequencies are repeated to double-check if there are still any missing values.

6.3.2 Response rate

Table 6.2 shows the total and percentage of questionnaires that were sent out, the questionnaires that were not answered, firms that were closed or where neither the owner nor the manager was available to complete the questionnaire, and questionnaires that were discarded during the process of data editing and cleaning by the researcher.

Table 6. 2: Response Rate from the Questionnaires

Sample	Total	Percentage (%)
Final sample	388	64.60%
Non-responses	142	23.70%
Unavailable	21	3.50%
Discarded	49	8.20%
Original sample	600	100.00%

The above table indicates that a total of 600 questionnaires were sent out to respondents. From this, 437 questionnaires were returned, but only 388 were fully completed, meaning that 49 returned questionnaires were discarded because they were incomplete. This means that only 388 questionnaires were analysed (64.60 per cent response rate). This number was high enough to guarantee accurate results.

6.4 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 in the next sections. These include respondents' gender, marital status, age group, race, home language, educational level, years in operation and industry. 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 technologies and firm performance. These fundamentals have a strong bearing on the supply

chain technologies adopted and implemented in the firms, individually as well as the supply chain, collectively. They also affect the supply chain agility of the entire supply chain.

6.4.1 Gender Representation

The frequencies and percentages pertaining to the respondents' gender are illustrated in Table 6.2. Below.

Table 6. 3: Frequencies and Percentages of Respondents' Gender

Gender					
		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Male	223	57.5	57.5	57.5
	Female	165	42.5	42.5	100.0
	Total	388	100.0	100.0	

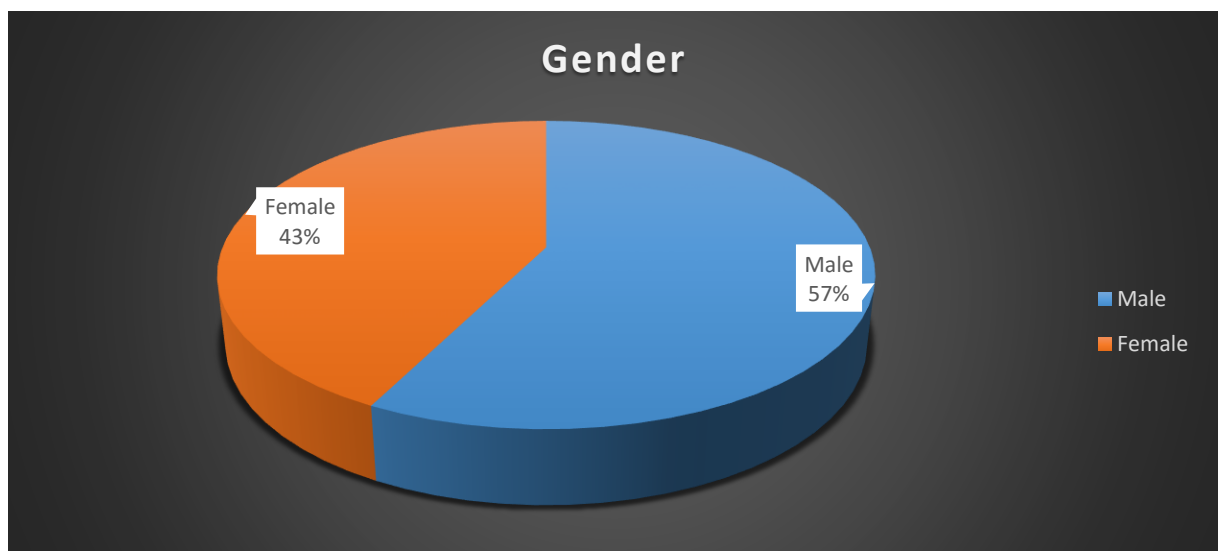


Figure 6.1: Pie Chart of the Gender Representation

An analysis of the gender of the respondents shown in table 6.3 indicates that 57.5 per cent (n=223) of respondents were male and 42.5 per cent (n=165) were female. The fact that there was only 15 per cent difference in the ratio of male to female in the sample suggests that there is gender balance in the manufacturing sector of Gauteng Province. This further indicates that the firms are operating within the recommendation of the Commission for Gender Equality (2008:3) which holds that firms in South Africa should take steps to eliminate all traces of

patriarchal domination and gender inequality within them. A study conducted by Barber & Mourshed (2007:2) also offers fact-based insights that support the notion that firms where women are most strongly represented are also the best performers. It appears then that the gender structure within the manufacturing sector of Gauteng Province is likely to play an instrumental role in fostering the firm's performance.

6.4.2 Marital Status Representation

The marital status representation presented in table 6.4 and Figure 6.2 indicated that from the majority of the respondents, 38.1 per cent (n=148) were engaged, with 25.5 per cent (n=99) indicating they were married and 15.5 per cent (n=60) showing they were single. A small component of the sample 14.2 per cent (n=55) were divorced, while 6.7 per cent (n=26) were widows, respectively. Both single and engaged males and females find it easy to leave for greener pastures, the reason being that they are still young and have high ambitions, unlike the married, divorced and widowed ones who are usually satisfied with the status quo (Chinomona 2015:149).

Table 6. 4: Frequency and Percentages of Marital Status

Marital Status					
		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	SINGLE	60	15.5	15.5	15.5
	ENGAGED	148	38.1	38.1	53.6
	MARRIED	99	25.5	25.5	79.1
	DIVORCE D	55	14.2	14.2	93.3
	WIDOWE D	26	6.7	6.7	100.0
	TOTAL	388	100.0	100.0	

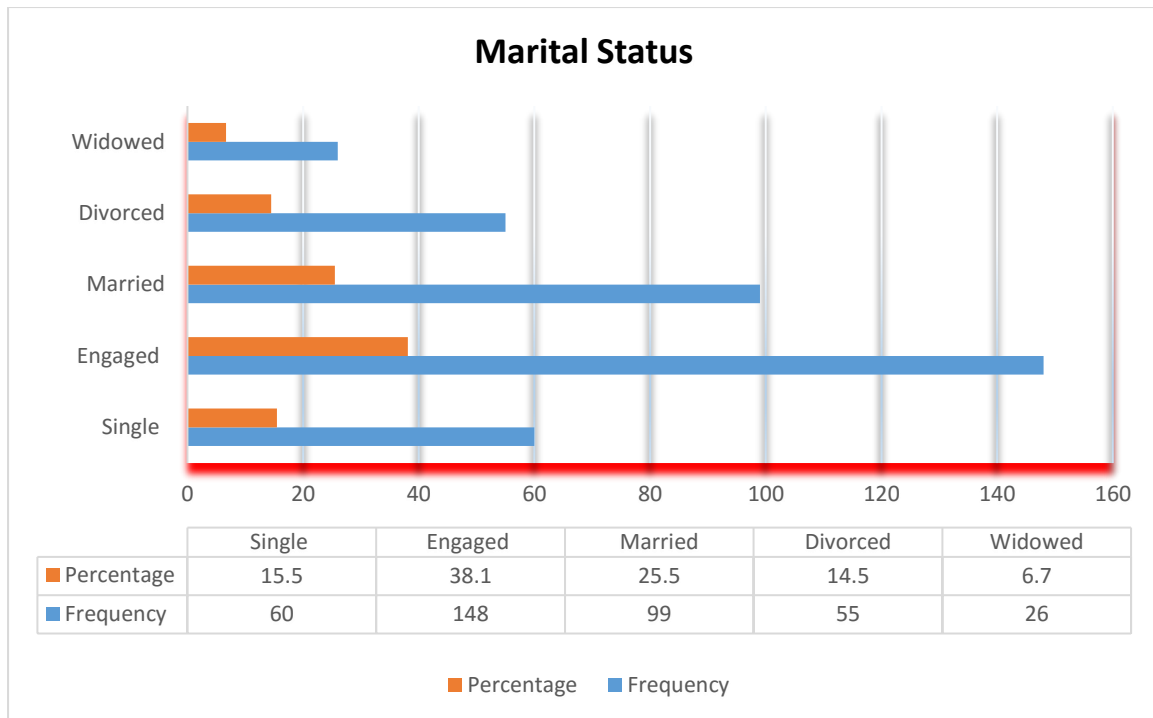


Figure 6. 2: Clustered Column of Marital Status

6.4.3 Age Group Representation

The respondents were classified into six groups as illustrated in both Table 6.5 and Figure 6.2. The majority of the respondents 23.7 per cent (n=92) were in the age group between 37-47 years, followed by the age group of 48-58 years 23.3 per cent (n=91), then the age group of 26-36 years 18.0 per cent (n=70), the fourth and fifth age groups to follow were between 59-69 years with a 17.3 per cent (n=67) and between 70+ years with a 11.3 per cent (n=44) respectively. The remainder of the sample (n=24), which is 6.2 per cent were in the age group of 25 years or less. These results suggest that the manufacturing sector of Gauteng is dominated by the under 47 year age group. Eckford (2005:4) opines that young and middle-aged people tend to offer intelligence, creative thinking and a valuable outlook on the world that is seldom introduced into the firms. The researcher further added that these groups can enliven the atmosphere of a firm in addition to working energetically and enthusiastically, thereby enhancing firm performance.

Table 6. 5: Frequency and Percentages of the Age Groups

Age Group					
		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	25-less	24	6.2	6.2	6.2
	26-36	70	18.0	18.0	24.2
	37-47	92	23.7	23.7	47.9
	48-58	91	23.5	23.5	71.4
	59-69	67	17.3	17.3	88.7
	70+	44	11.3	11.3	100.0
	Total	388	100.0	100.0	

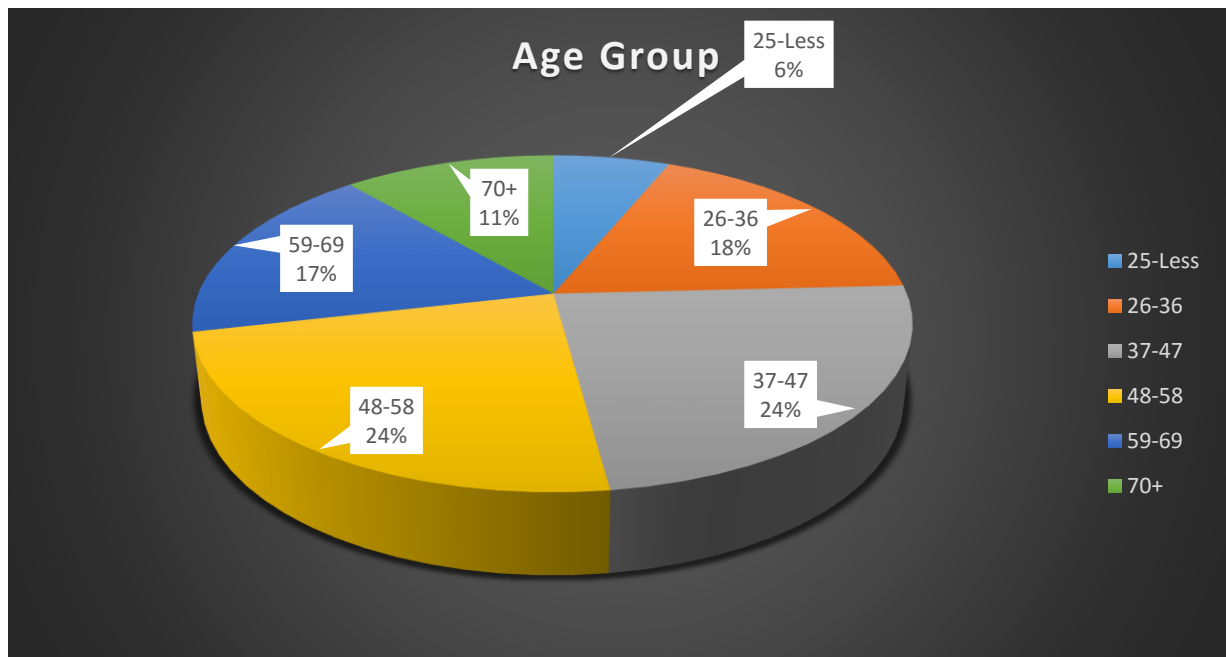


Figure 6. 1: Pie chart of the Age Group Representation

6.4.4 Race Representation

The race representation of the sample presented in Table 6.6 and Figure 6.3 demonstrated that the majority of managers and owners working in the manufacturing sector of Gauteng were White with 33.5 per cent (n=130). The second-largest race were Indians with 27.3 per cent (n=106). This was followed by other minority racial groups, namely Coloured with 21.1 per cent (n=82), then the majority racial group in South Africa who are Blacks had 18.1 per cent (n=70). These results suggest that the manufacturing sector of Gauteng is dominated by White

people, the reason being that South Africa is a racially and culturally diverse country, which has recently emerged from a history of entrenched racial segregation. Although apartheid can be regarded as the worst practice of racial discrimination, it only served to entrench and perpetuate practices that were already in place (Wolpe 1972:121).

Job reservation for Whites was already in practice in the early 1900s and also the early 2000 (Johnstone 2010:124). For example, the Mines & Works Act No.12 of 1911 (as repealed) instituted a colour bar, which was later extended to other industries under the Industrial Conciliation Act, was used to reserve certain categories of skilled jobs for Whites. After decades of opposition from racial oppression from all sectors of the society, a democratic state emerged in 1994. Although apartheid, together with all legislation pertaining to it, has been abolished since the advent of democracy, the effects are still visible in the society at large and within the workplace in particular. The injustices that blacks were subjected to resulted in them lagging behind their white counterparts in every aspect of life. The sudden opening of opportunities to the previously disadvantaged, however, did little to address the existing inequalities in this sector (Mputa 2016:121).

Table 6. 6: Frequency and Percentage of Race

Race					
		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Black	70	18.1	18.1	20.9
	Indian	106	27.3	27.3	48.2
	White	130	33.5	33.5	78.9
	Coloured	82	21.1	21.1	100.0
	Total	388	100.0	100.0	

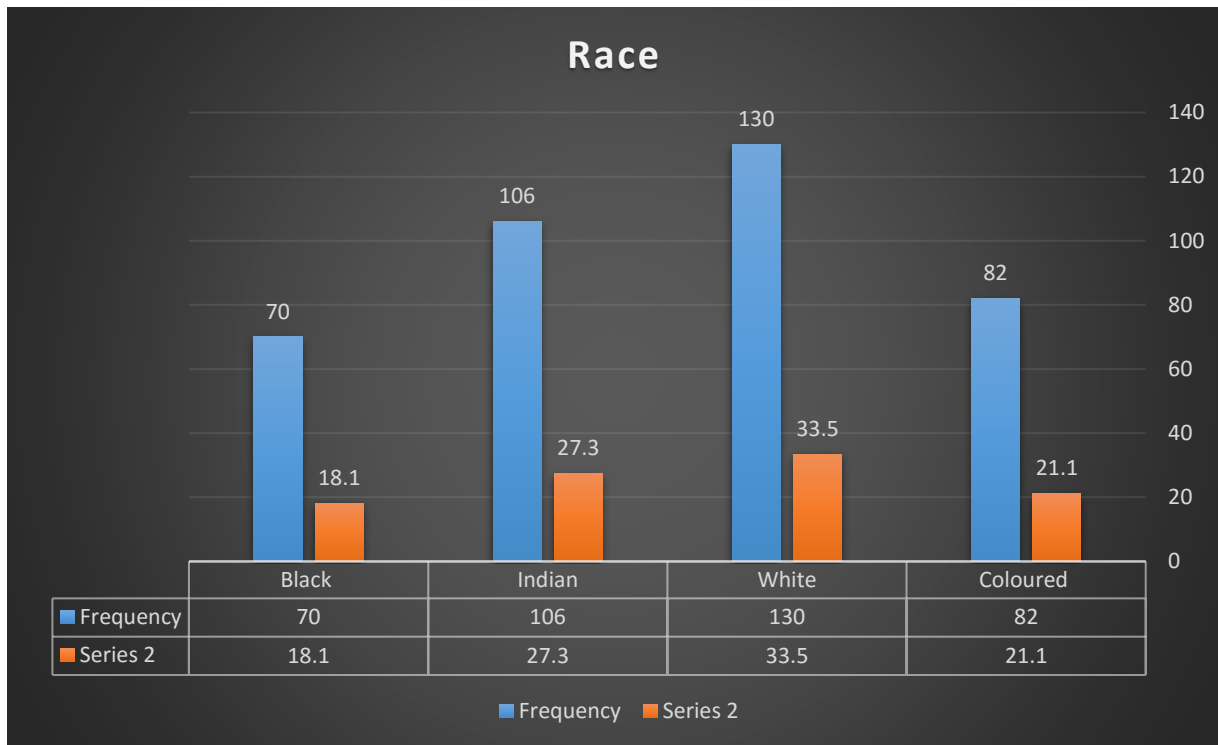


Figure 6. 2: Clustered Column of Race

6.4.5 Home Language Representation

Table 6. 7: Frequency and Percentage of Home Language

Home Language					
		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	English	42	10.8	10.8	23.2
	Sotho	27	7.6	7.6	31.7
	Xhosa	52	14.5	14.5	47.9
	Afrikaans	170	42.1	42.1	84.5
	Zulu	63	16.2	16.2	91.2
	Other	34	8.8	8.8	100.0
	Total	388	100.0	100.0	

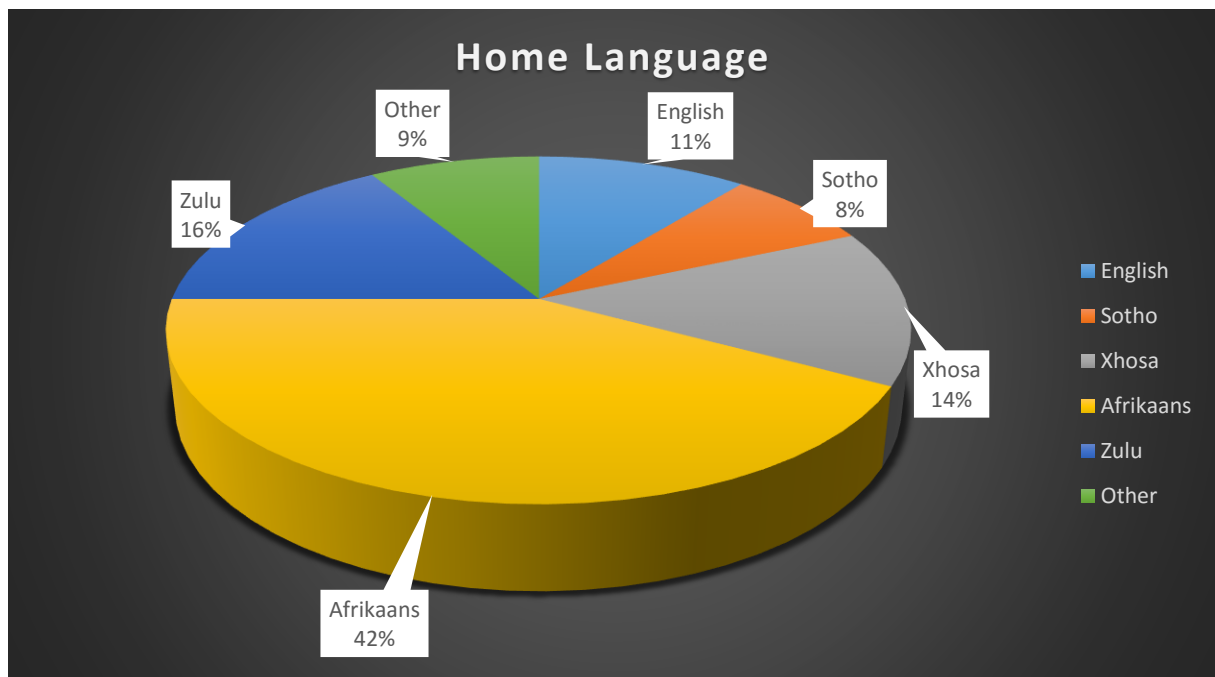


Figure 6. 3: Pie Chart of Home Language

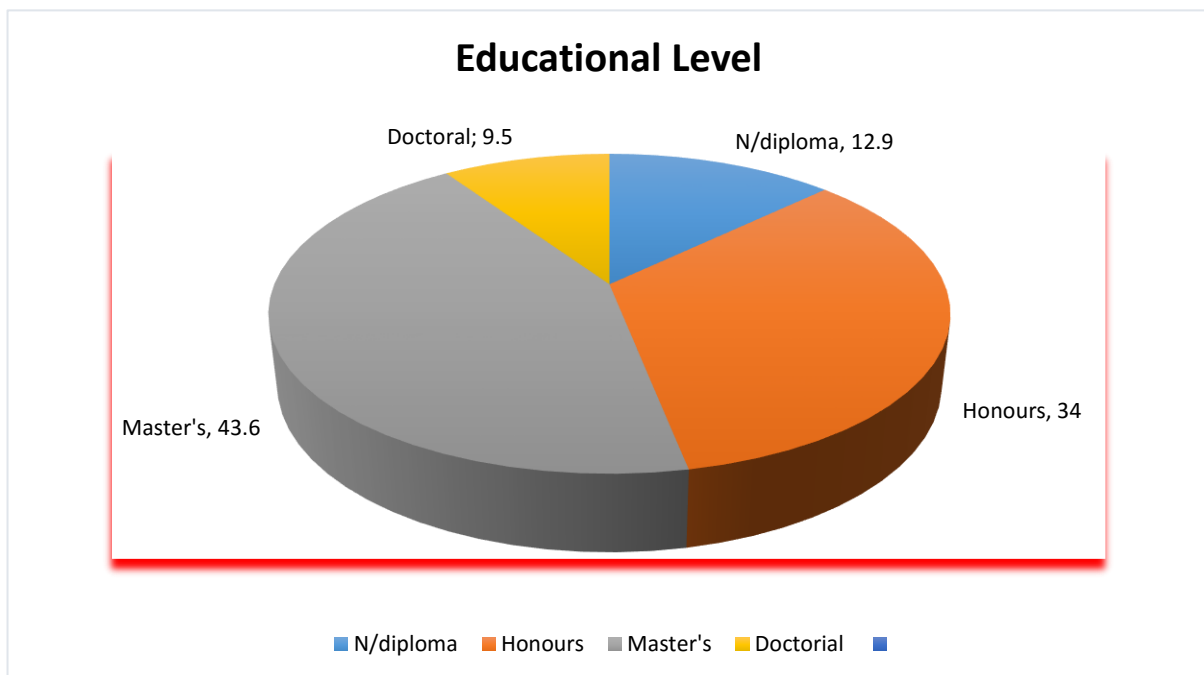
Home language of the respondents (Table 6.7 and Figure 6.4) report that 42 per cent ($n=170$) of the sample were Afrikaans speaking, Zulu speakers were represented in the sample by 16.2 per cent ($n=63$). Xhosa speakers were also represented in the sample by 14.5 per cent ($n=52$) and English speakers by 10.8 per cent ($n=42$). The lowest home language speaking groups were Sotho and other with 7.6 per cent ($n=27$) and 8.8 per cent ($n=32$) respectively. Calitz (1992:146) states that previous political systems and processes are to be blamed for the imbalances in ownership and managerial positions in firms where one finds more White (Afrikaans speaking) people than other races in South Africa. It seems that the manufacturing sector of Gauteng is dominated by an Afrikaans speaking group within these firms, followed by the Zulu speaking group.

6.4.6 Educational Level Representation

Table 6.7 and Figure 6.5 depict respondents' educational level. Approximately 43.6 per cent ($n=169$) of respondents hold a Master's degree.

Table 6. 8: Frequency and Percentage of the Educational Level

EDUCATIONAL LEVEL				
		Frequency	Per cent	Valid Per cent
Valid	N/Diploma	50	12.9	12.9
	Honours	132	34	34
	Masters	169	43.6	43.6
	Doctoral	36	9.5	9.5
	Total	388	100.0	100.0

**Figure 6. 4: Pie Chart of the Educational Level**

The results further indicate that 34 per cent (n=132) of the respondents hold honours degrees. Only 12.9 per cent (n=50) of the respondents hold a national diploma certificate and the remaining 9.5 per cent (n=36) hold a Doctoral degree. These findings are consistent with the previous study by Walker, Di Sisto and McBain (2008:82), which advocate that the level of education and training affects the mind-sets of the owners and managers of these firms, particularly when it comes to the quality of supply chain-related decisions. Therefore, the manufacturing sector is composed of significantly qualified employees. As revealed in a study conducted by Rice, Martin and Rathnappulige (2009:77), performance is higher in firms that

have appropriately qualified employees than in those in which employees do not possess the necessary skills and qualifications.

6.4.7 Years in Operation Representation

Figure 6.6 and Table 6.9 describes the numbers of years the firms in the manufacturing sector of Gauteng who participated in the research study have been operating in business. The majority of the firms have been in operation between 6-10 years with a 39.7 per cent (n=154) and some have been in operation for 2-5 years with a 32.5 per cent (n=126) followed by those firms which have been in operation between 11 years and above with a 26 per cent (n=101). Those who have been operating their firms for less than one year round up to 1.8 per cent (n=7). This indicates that the firms in the manufacturing sector within the region of Gauteng strive to stay operational and achieve success, despite sector challenges within the present competitive environment.

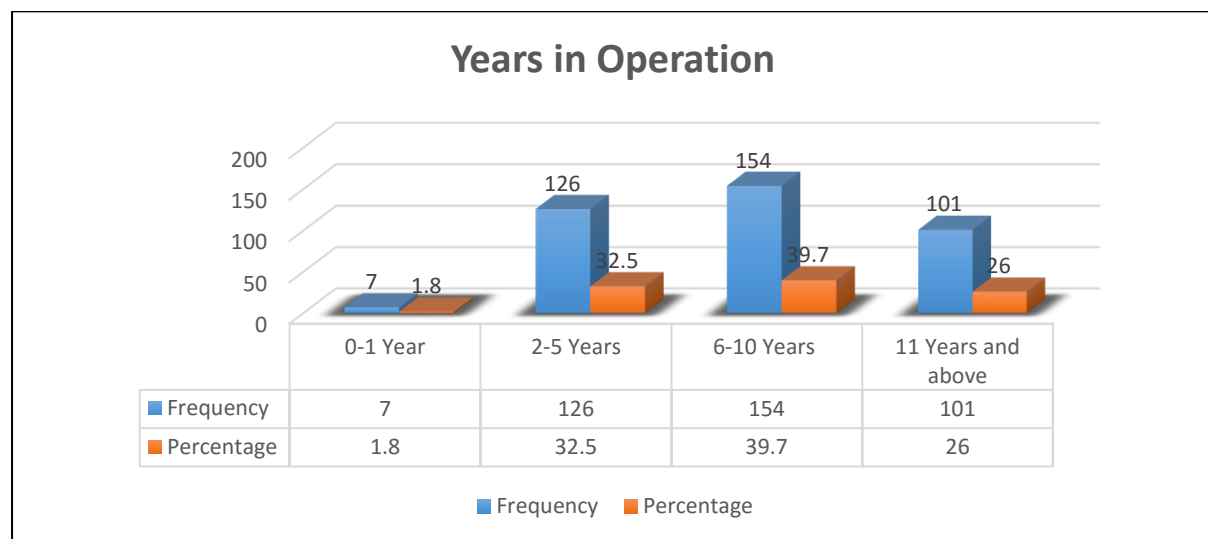


Figure 6. 5: 3D Clustered Column for the Numbers of Years in Operation

Table 6. 9: Frequency and Percentages of Numbers of Years in Operation

Years in Operation					
		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	0-1 Year	7	1.8	1.8	1.8
	2-5 Years	126	32.5	32.5	30.9
	6-10 Years	154	39.7	39.7	68.0

Years in Operation					
		Frequency	Per cent	Valid Per cent	Cumulative Per cent
	11 Years and above	101	26	26	100.0
	Total	388	100.0	100.0	

6.4.8 Type of Industry Representation

The type of industry of the respondents (Table 6.10 and Figure 6.7) depicts that the majority of the firms that participated in the study area are in the textile, clothing and footwear industry with a 28.6 per cent (n=111) representation and the next highest rated industry are those offering metal with a 24.5 per cent (n=95). This is followed by those firms classified under the other industry with a 21.9 per cent (n=85) and chemical industry with a 12.6 per cent (n=95). The lowest industry type represented is that of the agri-processing with 8.2 per cent (n=32). Perhaps the reason for this high representation from the textile, clothing and footwear might be that entrepreneurs are lured to this industry because of high profitability and return on investment. These results suggest that the manufacturing sector of Gauteng is dominated by Textile, Clothing and Footwear. Essop and Yu (2012:23) found that this industry accounted for 42 per cent of the total informal sector employment in the 2003-2011 period.

Table 6. 10: Frequency and Percentages for the Type of Industry

Type of Industry					
		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Agri-Processing	32	8.2	8.2	7.0
	Chemical	49	12.6	12.6	19.6
	Textile, Clothing and Footwear	111	28.6	28.6	48.2
	Automotive	16	4.2	4.2	57.5
	Metals	95	24.5	24.5	80.7
	Other	85	21.9	21.9	100.0
	Total	388	100.0	100.0	

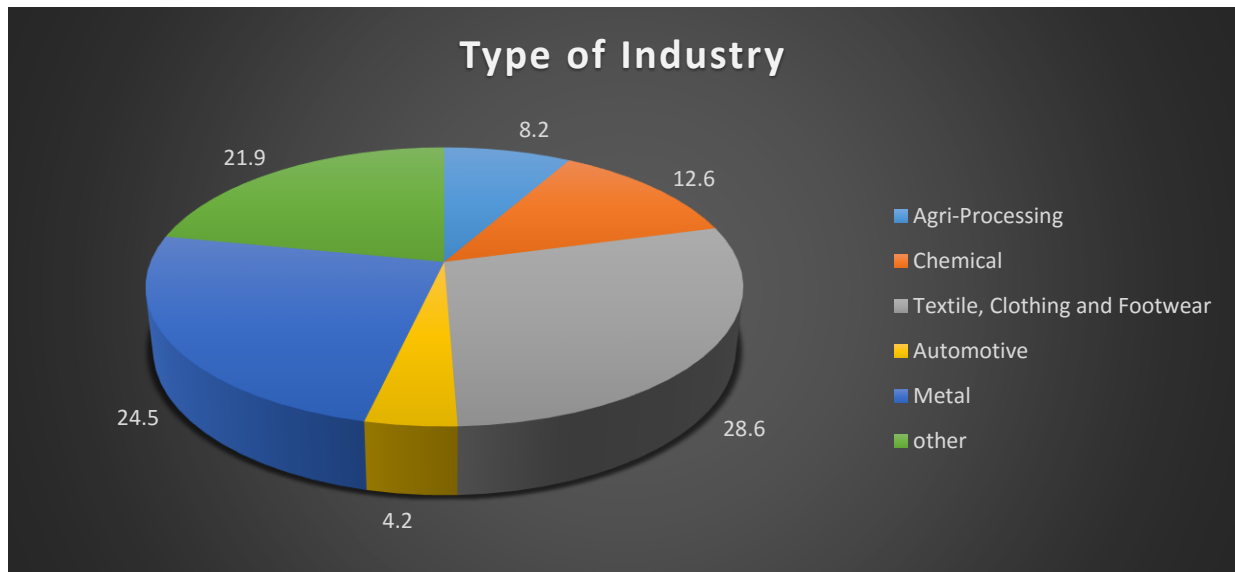


Figure 6. 6: Pie Chart of the Type of Industry

Table 6. 11: Frequencies and Percentages of all the Variables

<i>Scale Frequency & Percentages (%)</i>						
Variable	Measurement Item	Strongly Disagree	Disagree	Moderately Agree	Agree	Strongly Agree
Supply Chain Network Design	1	11 (2.8)	39 (10.1)	57 (14.7)	144 (37.1)	137 (35.3)
	2	12 (3.1)	41 (10.6)	67 (17.3)	172 (44.3)	96 (24.7)
	3	11 (2.8)	31 (8.0)	75 (19.3)	162 (41.8)	109 (28.1)
	4	6 (1.5)	33 (8.5)	85 (21.9)	158 (40.7)	106 (27.3)
	5	22 (5.7)	48 (12.4)	90 (23.2)	121 (31.2)	107 (27.6)
Supply Chain Information Competency	1	6 (1.5)	35 (9.0)	61 (15.7)	138 (35.6)	148 (38.1)
	2	7 (1.8)	22 (5.7)	56 (14.4)	111 (28.6)	192 (49.5)
	3	10 (2.6)	18 (4.6)	47 (12.1)	128 (33.0)	185 (47.7)
	4	6 (1.5)	15 (3.9)	35 (9.0)	107 (27.6)	225 (58.0)
	5	21 (5.4)	39 (10.1)	90 (23.2)	150 (38.7)	88 (22.7)

<i>Scale Frequency & Percentages (%)</i>						
Variable	Measurement Item	Strongly Disagree	Disagree	Moderately Agree	Agree	Strongly Agree
<i>Supply Chain Integration</i>	1	18 (4.6)	35 (9.0)	35 (9.0)	125 (32.2)	175 (45.1)
	2	11 (2.8)	26 (6.7)	66 (17.0)	165 (42.5)	120 (30.9)
	3	8 (2.1)	29 (7.5)	68 (17.5)	168 (43.3)	115 (29.6)
	4	14 (3.6)	32 (8.2)	68 (17.5)	138 (35.6)	136 (35.1)
	5	11 (2.8)	24 (6.2)	54 (13.9)	155 (39.9)	144 (37.1)
<i>Supply Chain Agility</i>	1	6 (1.5)	20 (5.2)	61 (15.7)	170 (43.8)	131 (33.8)
	2	7 (1.8)	16 (4.1)	68 (17.5)	147 (37.9)	150 (38.7)
	3	7 (1.8)	20 (5.2)	63 (16.2)	147 (37.9)	151 (38.9)
	4	7 (1.8)	23 (5.9)	58 (14.9)	157 (40.5)	143 (36.9)
	5	7 (1.8)	21 (5.4)	62 (16.0)	145 (37.4)	153 (39.4)
<i>Firm Performance</i>	1	10 (2.6)	18 (4.6)	47 (12.1)	128 (33.0)	185 (47.7)
	2	6 (1.5)	35 (9.0)	61 (15.7)	138 (35.6)	148 (38.1)
	3	7 (1.8)	20 (5.2)	63 (16.2)	147 (37.9)	151 (38.9)
	4	6 (1.5)	35 (9.0)	61 (15.7)	138 (35.6)	148 (38.1)
	5	6 (1.5)	20 (5.2)	61 (15.7)	170 (13.8)	131 (33.8)

Table 6.11 indicates the frequency and percentages of all the variables that were measured by the researcher. The following variables were measured (supply chain network design, supply chain information competency, supply chain integration, supply chain agility and firm performance) respectively.

Table 6.11 also discusses the frequencies and percentages of the various variables used by the researcher in this research study. One of the most basic ways to describe the data value of variables is to construct a frequency distribution. A frequency distribution is a systematic arrangement of data values in which the frequencies of each unique data value are shown (Christensen, Johnson, Turner & Christensen 2011:142). The meaning of the data is conveyed by arranging the data into a more interpretable form (for example, by calculating percentages and generating graphical displays).

A frequency is simply the number of participants who responded to a particular category. However, it is often difficult to interpret frequency distributions because the frequency by itself is meaningless unless there is a reference point to interpret the number, so a percentage must also be incorporated (Straub, Boudreau & Gefen 2004:380). Percentage is calculated by taking the frequency in the category divided by the total number of participants and multiplying by 100 per cent. Percentages are easier to understand than frequencies since a percentage can be interpreted. Frequency and percentage statistics should be used to represent participants' point of view. The participants were required to tick to what extent they agreed or disagreed with the statements provided, using a five-point Likert-type scale, where 1 being strongly disagree, 2 disagree, 3 moderately agree, 4 agree, and 5 strongly agree. The research variables were as follows: Supply Chain Network Design, Supply Chain Information Competency, Supply Chain Integration, Supply Chain Agility, and Firm performance, respectively.

6.4.8.1 Supply Chain Network Design

Table 6.11 indicates that after having measured the construct 'supply chain network design' with a five-point measurement item scale. Results indicate that respondents mostly agreed with all five of the measurement items. This is evident in the range of respondents that is between 31 per cent (n=121) to 44 per cent (n=172) of the measurement items which measure supply chain network design. The measurement scale of 'supply chain network design' included enquiries relating to absorptive boundary that facilitates better communication with key suppliers, interdependence of supply chain relationship with key suppliers, supply chain categorised as being a flexible value-adding network, supply chain network that does not involve power-based relationships, and supply chain members being able to make decisions independently.

Judging from the results, it is clear that the manufacturing sector of Gauteng Province do develop a supply chain network that maintains a relationship with all its partners. The reason that firms in this sector design networks with key suppliers could be that they have seen or realised the benefits associated with supply chain networking (Kidwell, Linde & Johnson 2000:28). It may also be due to the reason that supply chain network design is important for a firm to have a competitive advantage (Choi & Ko 2012:550).

6.4.8.2 Supply Chain Information Competency

The research construct ‘supply chain information competency’ appears to have a response pattern similar to ‘supply chain network design’. A five-point measurement items scale was employed to measure ‘supply chain information competency’. The results indicate that most of the respondents strongly agreed with all five of the measurement items, evident by the range of respondents being between 22.7 per cent (n=88) to 58 per cent (n=225) for measurement items which measure supply chain information competency. The measurement scale of ‘supply chain information competency’ comprised inquiries relating to information aptitude. Firms were asked about the level of electronic document interchange through the supply chain and whether the firms have a department that evaluates information and its sources critically. Also do they have a search engine that determines the nature and extent of the information they need, is the firm better able to acquire new customers and lastly, does the firm have a good data standardisation between supply chain partners.

From the results, it is evident that information competency does exist between firms in the manufacturing sector of Gauteng Province. Firms therefore recognise that obtaining information about partners is important if they are to be competitive and flexible (Chopra & Meindl 2010:384). They are familiar with the notion that the key to building a seamless supply chain is by establishing data and information connection at the supply chain interface. By integrating the supply chain information competency, supply chain partners can virtually work as a single entity which will enable them all to respond to markets demands and to create best value for customers (Prajogo & Olhager 2012:514).

6.4.8.3 Supply Chain Integration

Supply chain integration was also measured with a five-point measurement scale. Respondents in this instance appear to have been in line with 'strongly agree' as well. Results indicate a range of responses that is between 29 per cent (n=115) to 45 per cent (n=175) for measurement items which measure supply chain integration. The measurement scale of 'supply chain integration' encompassed enquiries regarding the structure in which their supply chain is integrated with suppliers, the cross-functional integration within their firm, the structure in which their logistics activities is integrated with suppliers, the way their follow-ups are made regarding feedback from customers, and the structure in which sharing of production plans are made with major suppliers and customers of the firm. Based on the results, it is clear that firms in the manufacturing sector of Gauteng implement supply chain integration with key partners.

This development could be prompted by the will of firms to enhance internal and external efficiency of a firm (Cox, Dick & Rutner 2012:49). Another reason may be that they seek to acquire control over probable risk involved in supply chain (Rosenzweig 2009:462), as well as, to create a distinctive value chain which neither partner can create autonomously (Alfalla-Luque, Marin-Garcia & Medina-Lopez 2015:242).

6.4.8.4 Supply Chain Agility

The research construct 'supply chain agility' was measured using a five-point measurement scale as well, in this case respondents were mostly in line with 'agree' and 'strongly agree'. The results indicated a range that is between 37 per cent (n=145) to 43 per cent (n=170) and 33 per cent (n=131) to 39 per cent (n=153) respectively, for measurement items which measure supply chain agility. The measurement scale of supply chain agility included enquiries relating to joined planning systems with key suppliers, the high level of customer service which is a priority, level of delivery reliability of suppliers, the design of supply chains in such a way that demand and inventory is visible throughout the chain, and the capability of the supply chain to forecast market demand and respond to real market demand.

Judging from the result, firms can form close relationships with their trading partners which, when required by market changes, can be discontinued and other, equally close relationships formed. Such close but flexible relationships are inherent in the manufacturing sector of the Gauteng Province. Firms therefore, recognise that agile supply chain has to be engineered to

cope with uncertainty, yet still profitably satisfy customer demand. This indicates the importance of achieving an integrated supply chain to reduce the total cycle time and, hence, of being flexible and responsive (Stevens 1989:3).

6.4.8.5 Firm Performance

The research construct 'firm performance' was measured using a five-point measurement scale. In this case, respondents were mostly in line with 'strongly agree'. The results indicated a range that is between 33 per cent (n=131) to 47 per cent (n=185) for measurement items which measure firm performance. The measurement scale of firm performance included inquiries relating to firm performance in the manufacturing sector. Firms were asked if their return on sales compared to that of three years ago, the involvement of partners in the supply chain has increased their profits beyond what could have been expected without them, the involvement of partners in the supply chain has increased their return on investment beyond what could have been expected without them, return on assets for the previous year compared to that of three years ago. There was also an inquiry about whether the involvement of partners in the supply chain has increased their growth in market share beyond what could have been expected without them.

Judging from the results, it is evident that South African firms in the manufacturing sector of Gauteng display superiority in terms of performance. It can be conceived that firms in the manufacturing sector in Gauteng understand that a display of good performance is vital for gaining and maintaining competitiveness (Cu, Charrette, Dieu, Hai & Toan 2009:65). They seem to have the knowledge that superior firm performance is important since competition in these modern times is between supply chain rather than firms (Tilman, Matson, Naylor & Polasky 2010:318).

6.5 RELIABILITY AND MEAN SCORE RANKINGS OF CONSTRUCTS

To determine the reliability of each construct, the Cronbach alpha value was assessed using the SPSS Version 25.0 application.

Table 6. 12: Reliability and Mean Score Ranking

Construct	No of items	Reliability	Mean score	Position in the mean score rank
Supply chain network design	5	.901	3.800	5th
supply chain information competency	5	.874	4.074	1st
Supply chain Integration	5	.890	3.958	4th
Supply chain Agility	5	.936	4.049	3rd
Firm performance	5	.903	4.058	2nd
Overall Scale	25	0.901	3.989	N/A

An analysis of Table 6.12 indicates that the Cronbach alpha values for the five measurement scales ranged from 1, which stands for strongly disagree to 5, which stands for strongly agree. The Cronbach alpha value for the overall scale was 0.901, all the measurement scales were above the 0.7 minimum threshold suggested by (Katsoni & Stratigea 2016:611). Therefore, all the measurement scales used in this research study were reliable or internally consistent.

An analysis of the means indicates that mean scores for the five constructs ranged between 3.800 and 4.074. The mean scores value for the overall scale was 3.989. This demonstrates that respondents were in agreement that these constructs are important in their organisation. Supply chain information competency scored the highest mean score of 4.074, which makes it the most important construct, followed closely by firm performance and supply chain agility with mean scores of 4.058 and 4.049 respectively, the last two ranks are shared by supply chain integration and supply chain network design with mean scores of 3.958 and 3.800 respectively.

6.6 MEASUREMENT ACCURACY ASSESSMENT

The measurement accuracy assessment includes the reliability and validity tests of the measurement items used in the research study. These tests are particularly necessary for the current research study since most of the measurement items for the five research variables are adopted and modified to fit the current research context. The reliability and validity tests performance in this research study are discussed in the following sections.

6.6.1 Reliability Tests

Reliability refers to the degree to which an independent, but comparable measure of the same object or latent variable yields the same score across different times, groups of people, or versions of the instrument (Vanderstoep & Johnston 2009:62). For more clarity refer to chapter five, section 5.8.1.

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 items. Some of the examples include split-half reliability coefficient, the Kuder-Richardson #20 (K-R 20), the Cronbach's alpha and the Item-to-Total correlations (Huck 2004:80). The current research study employed the Item-to-Total correlation values, Cronbach's coefficient alpha (α), Composite Reliability (CR) and Average Variance Extraction (AVE) to test reliability.

6.6.1.1 Cronbach's coefficient alpha

The Cronbach's coefficient alpha, also known as the coefficient alpha, is an internal consistency measurement index used to evaluate the extent to which a number of measurement items measure the same latent variable (Baarda, De Goede & Van Dilkum 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 value can range from 0.00 to 1.00 and signifies 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 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 coefficient and that it depends mostly on the purpose of the research study in question (Iacobucci & Churchill 2010:259). This research study computed the coefficient α value for the five latent variables using the reliability procedure in the SPSS (version 25) software.

The standardised Cronbach's coefficient alpha was used to assess the internal reliability of each latent variable in this research study. A higher level of Cronbach's coefficient alpha (particularly closer to 1) indicates a higher level of measurement item reliability. The current research study also used the Item-to-Total correlations to complement the Cronbach's coefficient alpha in showing statistical agreement among the measured items. Table 6.12 presents the results of the reliability tests.

Table 6. 13: Accuracy Analysis Statistics: Reliability Test.

Research Constructs		Descriptive Statistics		Cronbach's Test		C.R	AVE	Factor Loading
		Mean	SD	Item-to-total	α Value			
Supply Chain Network Design	SD1			0.708				0.763 ^c
	SD2			0.795				0.909 ^c
	SD3	3.800	0.894	0.790	0.901	0.92	0.70	0.905 ^c
	SD4			0.797				0.857 ^c

Research Constructs		Descriptive Statistics		Cronbach's Test		C.R	AVE	Factor Loading
		Mean	SD	Item-to-total	α Value			
	SD5			0.630				0.709 ^c
Supply Chain Information Competency	SC1			0.724				0.841 ^c
	SC2			0.783				0.875 ^c
	SC3	4.074	0.821	0.797	0.874	0.88	0.59	0.830 ^c
	SC4			0.661				0.689 ^c
	SC5			0.543				0.571 ^c
Supply Chain Integration	SI1			0.632				0.696 ^c
	SI2			0.793				0.865 ^c
	SI3	3.958	0.871	0.748	0.890	0.89	0.63	0.842 ^c
	SI4			0.682				0.765 ^c
	SI5			0.677				0.787 ^c
Supply Chain Agility	SA1			0.764				0.826 ^c
	SA2			0.815				0.848 ^c
	SA3	4.049	0.845	0.789	0.936	0.92	0.72	0.882 ^c
	SA4			0.760				0.859 ^c
	SA5			0.723				0.836 ^c
	FP1			0.719				0.728 ^c
	FP2			0.829				0.945 ^c

Research Constructs		Descriptive Statistics		Cronbach's Test		C.R	AVE	Factor Loading
		Mean	SD	Item-to-total	α Value			
Firm Performance	FP3	4.058	0.833	0.655	0.903	0.91	0.67	0.813 ^c
	FP4			0.819				0.823 ^c
	FP5			0.711				0.778 ^c

Note: SD = Supply chain network design, SC = Supply chain information competency, SI = Supply chain integration, SA = Supply chain agility, FP = Firm performance. SD = Standard Deviation, CR = Composite Reliability, AVE = Average Variance Extracted
*Score: 1 – Strongly Disagree, 2 – Disagree, 3 – Moderately Agree, 4 – Agree, 5 – Strongly Agree

As shown in Table 6.13, the Item-to-Total values ranged from 0.630 to 0.797 for supply chain network design; 0.543 to 0.789 for supply chain information competency; 0.632 to 0.793 for supply chain integration; 0.723 to 0.815 for supply chain agility; and 0.655 to 0.829 for firm performance. All the measurement items for the five latent variables had Item-to-Total values greater than the acceptable threshold value of 0.05 or above (often ≤ 0.3) (Dunn, Seaker & Waller 1994:145). Moreover, Table 6.13 reveals that the Cronbach's alpha coefficients were between 0.874 and 0.936 for all five research latent variables. Therefore, all the Cronbach's alpha values for all the research variables used in this research study were above the acceptable threshold value of 0.7 used in the study by Nunnally and Bernstein (1994:24). All in all, the measurement items used in this research study were highly reliable since all the Item-to-Total values were above the recommended value of 3 and all the Cronbach's alpha coefficient were closer to 1. The research study used composite reliability checks as shown in Table 6.13 to complement the Item-to-Total correlations and the Cronbach's coefficient alpha value.

6.6.1.2 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, Anderson, Tatham and Black (2006:22) as follows: (CR): $CR_{\eta} = (\sum \lambda_{yi})^2 / [(\sum \lambda_{yi})^2 + (\sum \epsilon_i)]$, where CR_{η} = Composite Reliability, $(\sum \lambda_{yi})^2$ = square of the summation of the factor loadings; $(\sum \epsilon_i)$ = summation of error variances. The calculated composite reliability coefficient is then compared with the Cronbach's α . The recommended threshold value for Composite Reliability should be 0.7 or above (Hair *et al.* 2006:22).

As earlier noted, the current research study performed Composite Reliability tests to assess the internal reliability of each research latent variable. Previous evidence (Nunnally & Bernstein 1994:23; Hair, Anderson, Tatham & Black 2006:55) contends that a Composite Reliability coefficient exceeding 0.7 indicates a satisfactory level of internal reliability of a variable. Table 6.13 also presents the results of the calculated Composite Reliability values for all the five research latent variables.

Table 6.13 similarly shows that the Composite Reliability coefficient was between 0.88 and 0.92. All the Composite Reliability values for all the variables exceeded the recommended estimate criteria used in previous studies (Kline 2005:45; Chinomona 2011:108). More so, the Composite Reliability coefficients are similar to the Cronbach's alpha coefficients. Therefore, all the coefficients confirm that all the measurement for the five latent variables used in this research study were highly reliable. The next section discusses the Average Variance Extracted (AVE)

6.6.1.3 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. Therefore, higher AVE value of greater than 0.4 are said to show an adequate representation of a latent variable by its measurement items. The AVE value in this research study were manually calculated using a formula suggested by Hair *et al.*, (2010:17) as follows: $V_{\eta} = (\sum \lambda_{yi}^2) / [(\sum \lambda_{yi}^2) + (\sum \epsilon_i)]$; where V_{η} = Average Variance Extracted (AVE); $\sum \lambda_{yi}^2$ = Summation of the squared

factor loadings; $\Sigma \epsilon_i$ = Summation of error variances. Table 6.13 depicts the calculated AVE values for all the five research latent variables.

As shown in Table 6.13, the AVE values for all the research variables in this research study range from 0.59 to 0.72. As such, all the AVE values for all the variables were above the recommended threshold value of 0.5. Therefore, as previously noted, these AVE values exceeding 0.5 showed that the measurement items used in this research 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 research study suggest that the measurement items were internally reliable. The next section focuses on the validity of the research variables.

6.6.2 Validity Tests

Vanderstoep and Johnston (2009:59) described 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. For more clarity refer to chapter five, section 5.8.2. This research study construct validity was the only form of validity tested and discussed, the reason being that it befits the purpose of the study.

6.6.2.1 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 is highly correlated with the other measurement items that measure the same latent variable. For instance, convergent validity in this research study expects that measurement item SD1 has a high correlation with the other measurement items that measure

supply chain network design. In contrast, it is expected that these measurement items measuring supply chain network design, for instance, do not correlate highly with the measurement items which measure supply chain agility and firm performance (discriminant validity) (Iacobucci & Churchill 2010:258). Convergent validity in this research 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 results are shown in Table 6.13.

As depicted in Table 6.13, all the measurement items for supply chain network design (SD1-5) had factor loadings greater than the recommended threshold value of 0.5 and they ranged from 0.709 to 0.909. Table 6.13 further indicates that five measurement items of supply chain information competency (SC1-5) had factor loadings exceeding the acceptable threshold of 0.5 and were between 0.571 and 0.875. Table 6.13 also reports five measurement items (SI1-5) of supply chain integration with factor loadings greater than 0.5. Their factor loading ranged from 0.696 to 0.864.

Also, Table 6.13 reveals five items of supply chain agility (SA1-5) with factor loadings above 0.5 and ranged from 0.826 to 0.882. Lastly, table 6.13 depicts items of firm performance (FP1-5) with higher factor loadings ranging from 0.728 to 0.945 respectively. All in all, all the factor loadings of above 0.5 for all the five latent variables provide evidence of convergence validity in this research study. The next section focuses on discriminant validity.

b) Discriminant validity

Guo, Aveyard, Fielding and Sutton (2008:288) describe discriminant 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 research 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. Shared variance is often illustrated by Venn diagrams, which are three overlapping circles. These circles show the relationship between two variables that can be partitioned into two parts, one that is shared with a third variable and one that is not shared. Sometimes partial correlations are used to separate out the shared part of a relationship so that only the unique part remains (<http://flash.lakeheadu.co.za>). For example, out of the 1.0 amount of variance for each variable, how much of that variability between the two variables actually

overlaps the two variables, in other words squaring the correlation give you the proportion of the variance in each variable that is shared between the two and that sharing is where the relationship is. Its importance is that it indicates the proportion the shared variance has on the total variance that is predictable from a regression equation.

Discriminant validity requires that where the research variables are unrelated, their pair-wise correlation values is less than one (1.0) (Nunnally 1978:246). 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 research study was checked using all the abovementioned ways. Table 6.14 provides examples of assessing discriminant validity using the pair-wise correlation coefficients of less than one (1).

Table 6. 14: Correlation Matrix

Research Variable		SD	SC	SI	SA	FP
	SD	1.000				
	SC	.730**	1.000			
	SI	.702**	.816**	1.000		
	SA	.681**	.755**	.805**	1.000	
	FP	.729**	.922**	.804**	.875**	1.000

Note: SD = Supply chain network design, SC = Supply chain information competency, SI = Supply chain integration, SA = Supply chain agility, FP = Firm performance

As indicated in Table 6.14, a significant positive correlation exists between the different constructs. The correlation between SC and SD has a value of ($r=0.730$; $p<0.01$). Furthermore, the correlation matrix describes a positive relationship between SI and SD with a value of ($r=0.702$; $p<0.01$), as well as SI and SC with a value of ($r=0.816$; $p<0.01$). Moreover, a

constructive significant correlation exists between SA and SD ($r=0.681$; $p<0.01$), SA and SC ($r=0.755$; $p<0.01$), SA and SI ($r=0.805$; $p<0.01$). Lastly, Table 6.13 depicts a positive correlation between FP and SD ($r=0.729$; $p<0.01$), FP and SC ($r=0.922$; $p<0.01$), FP and SI ($r=0.804$; $p<0.01$), as well as, FP and SA ($r=0.875$; $p<0.01$) respectively. The correlation between all the constructs is less than the standard threshold of 1.0 as recommended by Chinomona (2011:110). Therefore, these results confirm the existence of discriminant validity.

6.6.3 Confirmatory Factor Analysis Model fit/Acceptability

The purpose of this section is to depict the confirmatory factor analysis model and bring to light the findings from model fit assessment. Below is an explanation of the model and the assessment, together with the finding.

6.6.3.1 CFA Model

Figure 6.8 is an illustration of the confirmatory factor analysis model. On the model, the circles or ovals represent the latent variables while the rectangles or squares represent the observed variable with their adjacent measurement errors in circular or oval shape. The bidirectional arrows signify the correlation between the variables. “The CFA model is a pure measurement model with un-gauged covariance between each of the possible latent variable pairs” (Jenatabadi & Ismail 2014:27).

The outcome of this procedure is goodness-of-fit values that additionally improve the measurement scale levels that are the observed variables, through measuring the related research constructs (Hair, Anderson, Tatham & Black 1998:88). These goodness-of-fit values are used to assess the measurement model as recommended by Bone, Sharma and Shimp (1989:105), Hair *et al.* (1998:88), Joreskog and Joreskog and Sorbom (1993:31), and Schumacker and Lomax (2004:29). This assessment is discussed in the following section.

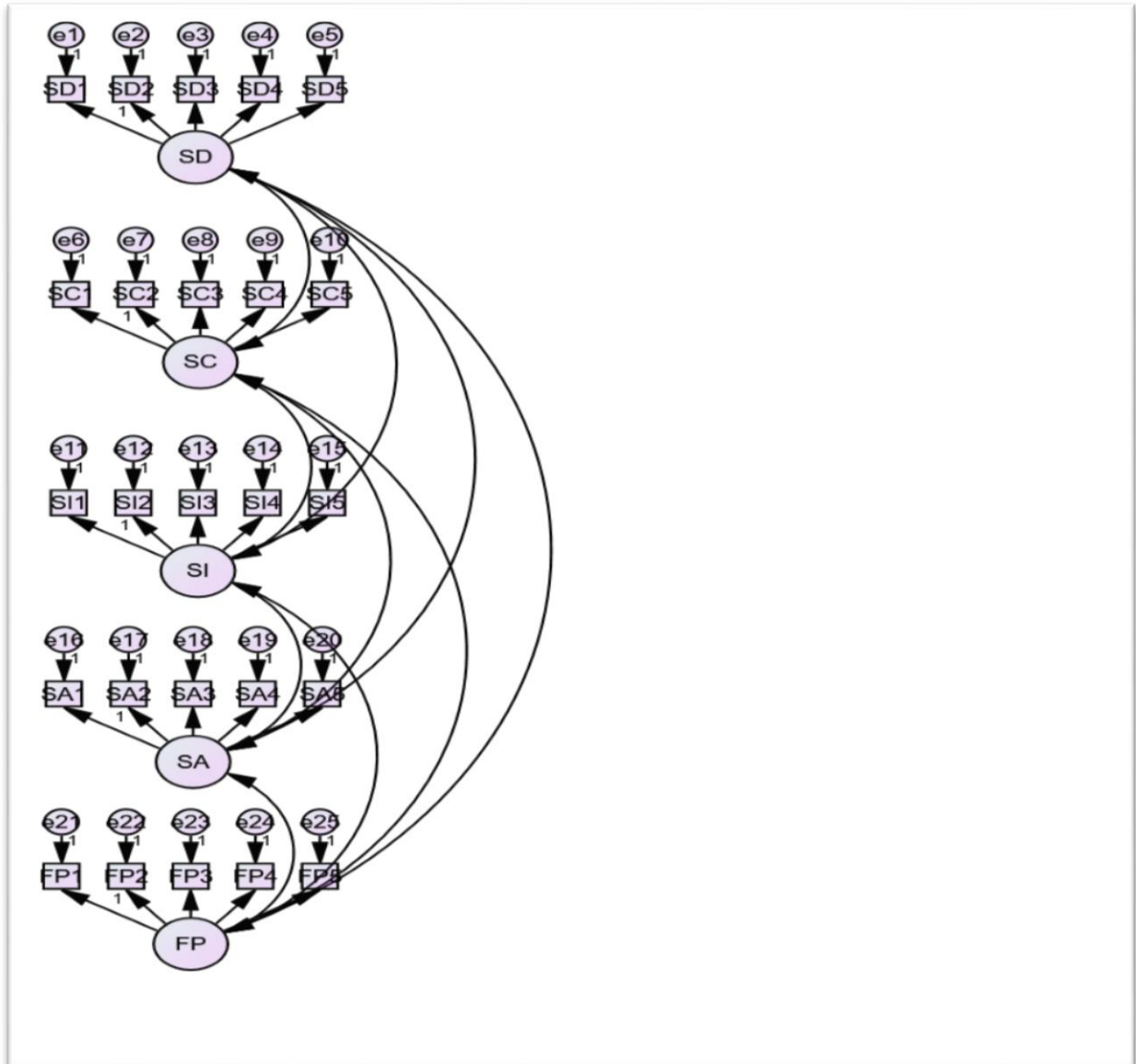


Figure 6. 7: Confirmatory Factor Analysis Model

6.6.3.2 Model fit assessment

According to Schumacher (2006:78), confirmatory factor analysis (CFA) and structural equation model (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 the existence of alternative models, which can provide the exact same data to model fit. As a result, this research study used different model fit criteria that combined the assessment of model fit indices (Hair *et al.*, 2006:43). It thus employed six model fit criteria to check the overall fit of the research model, starting with the chi-square index, following the work of Kline

(2005:209) as well as Cheung and Rensvold (2002:255). The other five model fit indices used are discussed in the next section.

Some of the CFA model fit acceptability guidelines are provided in Table 6.15. Table 6.15 shows that the values of chi-square over degree of freedom (χ^2/df) ranging between 1 and 3 provides an adequate model fit. In addition, the table shows that the values of Normed Fit Index (NFI), Tucker-Lewis Index (TLI), Incremental Fit Index (IFI), Comparative Fit Index (CFI) equals or greater than 0.90, and Root Mean Square Error of Approximation (RMSEA) value equal to or less than 0.080 provides a good model fit (see Table 6.15) (Curran & Hussong 2002:59)

Table 6. 15: Model Fit Criteria, Description and Acceptable Level

Model Fit Criteria	Description	Acceptable Level	Source
Chi-square (χ^2/DF)	Method used to assess the general fit of the model	Value must be between 1 and 3	Chen and Lin (2010:2087), Chinomona (2011:118)
Normed Fit Index (NFI)	Index that evaluates the model by comparing the χ^2 value of the model to the χ^2 of the null model	Value must be greater than 0.9	Hooper, Coughlan and Mullen (2008:55), Bentler and Bonnet (1980:588)
Tucker-Lewis Index (TLI)	Index that prefers simpler models and is known to address the issue of sample size associated with NFI	Value must meet or exceed 0.9	Hooper <i>et al.</i> (2008:55)
Incremental Fit Index (IFI)	Index developed to rectify the issue of parsimony and sample size related to NFI	Value must meet or exceed 0.9	Bollen (1989:82), Chinomona (2011:118)
Comparative Fit Index (CFI)	Index that presupposes that all latent variables are uncorrelated and compares	Value must meet or exceed 0.9	Hu and Bentler (1999:1), Hooper <i>et al.</i> (2008:55)

Model Fit Criteria	Description	Acceptable Level	Source
	the sample covariance matrix with the null model		
Root Mean Square Error of Approximation (RMSEA)	Index that informs how well the model, with indefinite but optimally selected parameter estimates, would fit the population's covariance matrix	Value must fall below 0.05 and 0.08	Byrne (1998:26) Brown and Cudeck (1993:136), Curran and Hussong (2002:59)

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

The next section focuses on the CFA results for the selected six model fit indices (see Table 6.16)

Table 6. 16: CFA Model Fit Indices Results

Model Fit Criteria	Values
Chi-square (χ^2 /DF) The degree of freedom (DF)	3.42
Normed Fit Index (NFI)	0.942
The Tucker-Lewis index (TLI)	0.953
The incremental fit index (IFI)	0.965
The comparative-fit-index (CFI)	0.961
The root mean square error of approximation (RMSEA)	0.066

Table 6.16 indicates that the measurement model yielded a ratio of chi-square value to degree of freedom of 3.42. The recommended threshold range is between 1 and 3. Although the current research study has a value of above 3, the difference of 0.42 is still tolerable. According to Reisinger and Mavondo (2008:57), chi-square to degree-of-freedom value below 5 still

provides a good model fit. As such, the chi-square to degree-of-freedom value of 3.42 in this research study is marginally accepted and reflects a good model fit. Table 6.16 also shows NFI, TLI, IFI, and CFI values (0.942, 0.953, 0.965 and 0.961 respectively) that are all above the recommended threshold of 0.9 or above. This further reflects a good model fit.

Table 6.16 further reports a RMSEA value of 0.066 which is within the recommended threshold of between 0.05 and 0.08 as stated by Browne and Cudeck (1993:137); Curran and Hussong (2003:526). Therefore, the RMSEA value further validates a good model fit. Given that all six goodness of fit indices provided in Table 6.16 are meeting their respective recommended threshold, it can be concluded that the data is fitting the model. The next section provides a discussion of the structural model, starting with the SEM model fit to the hypotheses testing.

6.6.4 SEM Conceptual Model Fit Assessment

This section focuses on the SEM model fit assessments and commences by establishing an acceptable model fit using the six selected model fit indices (see section 6.5.3.2 CFA model fit). These are discussed in detail below and the results are shown in Table 6.17 later in this chapter. The Chi-square is discussed in the next section.

6.6.4.1 Chi-square (χ^2)

Chi-square is a conventional model fit index used in SEM 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 nonstatistical significance level.

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 2006:68). The recommended threshold value for a chi-square should be less than (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 normed fit index.

6.6.4.2 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 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 (1995:40) 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. The following section discusses the comparative fit index.

6.6.4.3 The comparative fit index (CFI)

FI also known as the Bentler Comparative Fit Index (BCFI) is a revised form of NFI which takes samples 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.* 2005:55). 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 range from 0 to 1, with values closer to 1 indicative of a very good model fit. Reisinger *et al.* (2008:57) suggest that a good model fit is achieved by a threshold value of 0.9 or above, since it shows that 90 per cent of the covariation in the data can be reproduced by the given model. The next section discusses the incremental fit index.

6.6.4.4 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 al.*, 2006:36). The acceptable guideline threshold value for IFI that provides a good model fit should be 0.9 or above (Reisinger *et al.*, 2008:57). Lastly, the next section discusses the root mean square error of approximation.

6.6.4.5 Root mean square of error approximation (RMSEA)

Reisinger and Mavondo (2007:41) 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 sensitive to the number of estimates parameters in the model. According to Hooper *et al.*, (2008:54), the major benefits 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 1990s, 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 values of below 1.0 to yield a good model fit. However, Reisinger and Mavondo (2008:54) suggested that a good model fit is yielded by a RMSEA value of below 0.05, with values between 0.05 and 0.08, while those above 0.08 show a poor model fit. Table 6.17 shows the SEM model fit results.

Table 6. 17: SEM Model Fit Indices Results

Model fit criteria	Values
The Chi-square (χ^2 /DF) The degree of freedom (DF)	2.789
The Normed Fit Index (NFI)	0.931
The Tucker-Lewis index (TLI)	0.942
The Incremental Fit Index (IFI)	0.956
The Comparative-Fit-Index (CFI)	0.955
The Root Mean Square Error of Approximation (RMSEA)	0.060

As depicted in Table 6.17, the structural model yielded a ratio of chi-square value to degree-of-freedom of 2.789 which is within the recommended threshold of 3, as suggested by Schumacher (2006:68). This result reflects a good model fit. Table 6.17 further shows NFI, TLI, IFI, and CFI value (0.931, 0.942, 0.956, and 0.955 respectively) that are above the recommended threshold of 0.9. These results further confirm that the estimated model fits well the sample data in this research study, which provides a good model fit. Table 6.17 also report a RMSEA value of 0.060, and is within the threshold of 0.050 and 0.080, which provides a very good model fit. Based on the model fit acceptability guidelines provided in Table 6.14 and the actual SEM model fit results in Table 6.17 above, all the six selected model fit indices provide a good overall fitness of the SEM model to the specified sample data. The next section provides a discussion of the structural model (hypotheses testing).

6.7 SEM RESULTS AND THE CONCEPTUAL MODEL

The current research study theorised that supply chain technologies (supply chain network design, supply chain information technology, and supply chain integration) have a significant positive influence on supply chain agility as a mediator and firm performance as an outcome latent variable, as shown in Figure 6.9.

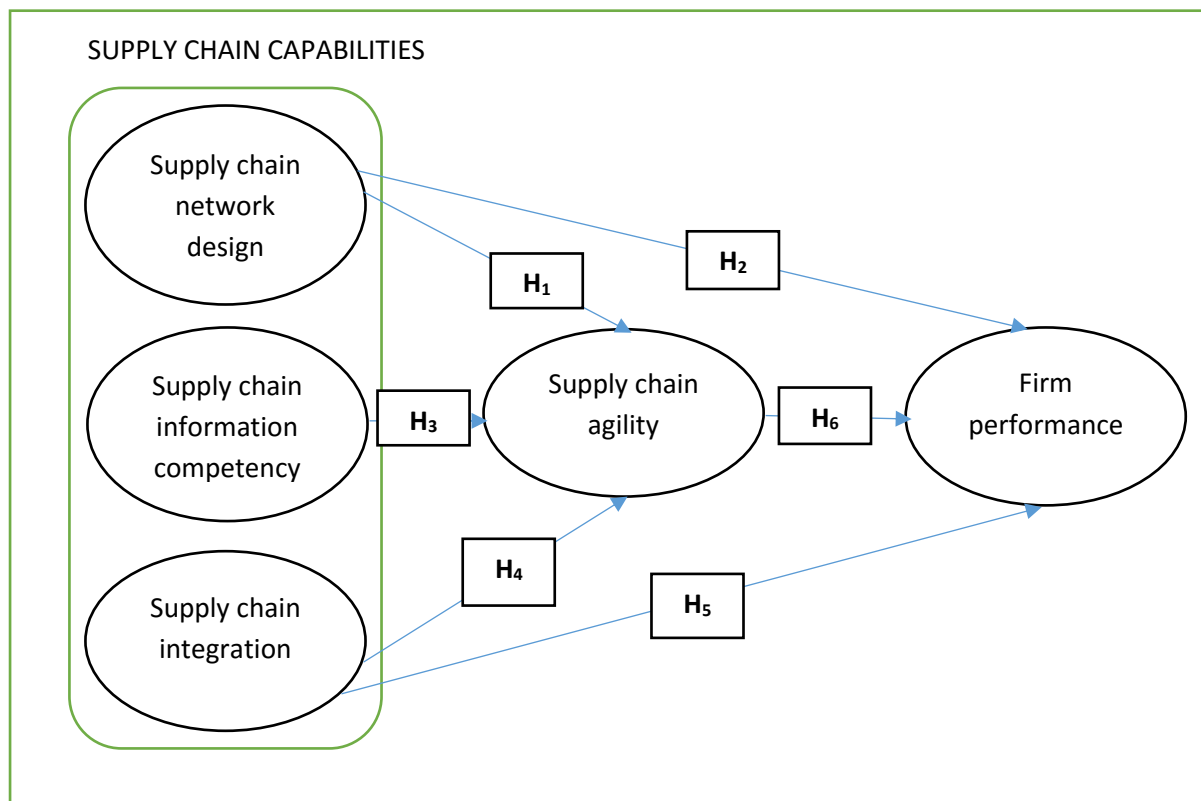


Figure 6.8: Research Conceptual Model

Source: Own work

Figure 6.9 depicts the six posited linear relationships between the five research latent variables, namely: supply chain network design, supply chain information competency, supply chain integration, supply chain agility, and firm performance. As noted (in Chapter four, section 4.7, the conceptual research framework), supply chain technologies (supply chain network design, supply chain information competency, and supply chain integration) are predictor variables, supply chain agility is the mediator, while firm performance is the outcome variable.

As shown in Figure 6.9, supply chain has a significant positive influence on supply chain agility and firm performance (H₁) and (H₂) respectively. Supply chain information competency has a positive and significant influence on supply chain agility (H₃) and supply chain integration also has a positive and significant influence on supply chain agility and firm performance (H₄) and (H₅) respectively. Lastly, supply chain agility has a positive and significant influence on firm performance (H₆). The hypotheses tests results and path modelling are displayed in Figure 6.11 and Table 6.17 and discussed in the next section.

6.7.1 The Hypotheses Testing Stage and Results (Path modelling)

Table 6. 18: Hypotheses Testing Results

Proposed hypotheses relationship	Hypotheses	Path coefficient estimates	P-value	Decision
Supply chain network design → Supply chain agility	H1	0.132	***	Accepted
Supply chain network design → firm performance	H2	0.162	***	Accepted
Supply information competency → supply chain agility	H3	0.296	***	Accepted
Supply chain integration → supply chain agility	H4	0.532	***	Accepted

Proposed hypotheses relationship	Hypotheses	Path coefficient estimates	P-value	Decision
Supply chain integration → firm performance	H5	0.397	***	Accepted
Supply chain agility → firm performance	H6	0.329	***	Accepted

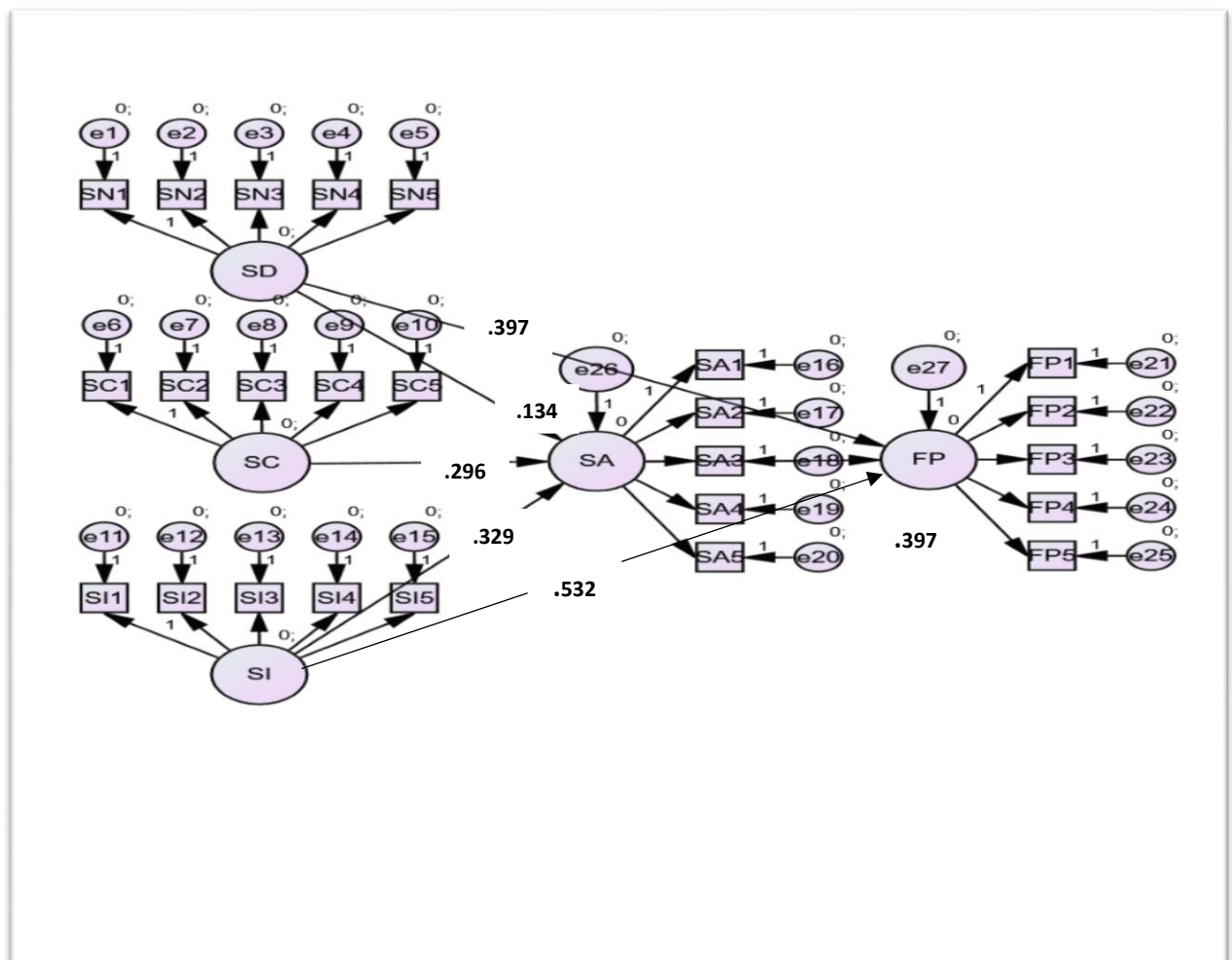


Figure 6. 9: Structural Model

6.7.1.1 Hypotheses testing and results

This section provides results of the preliminary formulated hypotheses developed out of the research hypotheses and objectives as specified in chapter 1. Specifically, the first hypothesis postulated was that of the relationship between supply chain network design and supply chain agility. Consistent with hypothesis one (**H₁**), results computed ($\beta = -0.132$; $t = -4.341$) indicate

that there is a strong positive relationship between supply chain network design and supply chain agility ($p < 0.000$). The path shows that there is a significant association between the two constructs. The model converged with a proper solution and provided an estimate of the relationship between the constructs. Charles (1998:43) stated that a firm's real core capability lies in its ability to design and manage the supply chain in order to gain maximum advantage in a market where competitive forces are changing.

According to Devor, Graves and Mills (1997:813), there is a positive relationship between supply chain network design and supply chain agility, claiming that supply chain network design, processing and electronic commerce are rapidly expanding the capability to achieve powerful interactive links among agile manufacturing firms. Jaradat, Adams, Abutabenjeh and Keating (2017:55) pointed out that the benefits of supply chain network design to supply chain agile include: increased accuracy, increased responsiveness and better understanding of the role each partner plays in the design of the supply chain network. In addition, Hollmann, Scavarda and Thome (2015:971) are also of the notion that there is a positive relationship between these two constructs, mentioning that supply chain network design has been proven to increase agility and reduce inventory across the entire supply chain, that is, overall lower inventories across linked suppliers (and their suppliers), manufactures and customers (and their further customers).

Nel and Badenhorst-Weiss (2011:307) suggested that the primary purpose of an effective supply chain network design and supply chain agility is to supply predictable and unpredictable market demand and, at the same time, achieve the lowest possible supply chain cost. In addition, inventory levels should be minimised throughout the whole supply chain network. Lead times should be shortened to the point which minimises costs. On the other hand, focus is required on responding to rapid and fast changes in the market. Furthermore, Provan, Fish and Sydom (2007:479), suggested that the firms' effort to increase their level of supply chain network and knowledge sharing in tandem should further enhance their ability to positively influence supply chain agility outcome. Therefore, empirically, previous researchers are of the notion that supply chain network design positively influences supply chain agility. The fit of the model is deemed adequate and thus the hypothesis is supported. Therefore, **H₁**, is valid and supported; thereby necessitating the rejection of the null hypotheses of **H₀₁**, which claims no influence of supply chain network design on supply chain agility.

The second hypothesis (**H₂**) postulated a positive relationship between supply chain network design and firm performance. The standard coefficients ($p < 0.000$) ($\beta = 0.397$; $t = 6.497$) provided an affirmative response to the Zebal and Goodwin (2012:352) assertion that improved firm performance is a consequence of higher level of supply chain network design. **H₂** is therefore supported. In addition, Seiler (2016:187) suggested that nowadays firms must rethink their performance measurement tools accompanied by strategic decisions in the light of supply chain network participation and mutual dependencies across many supply chains. Kotha and Swamidass (2000:257) found that supply chain network design in manufacturing generally led to higher growth rates and higher profitability. Moreover, Brandyberry, Rai and White (1999:993) discovered that higher network partnership led to more collaboration and an increase of the quality and timeliness of production.

All of these features have been linked to overall firm performance in past studies. Hence, Boudreau (2010:1849) added that network efficiency and a better utilisation of network resources enables a firm to dramatically reduce operational cost and improve its financial performance. According to Afuah (2000:387); Lavie (2006:638); Rosenbusch, Brinckmann and Bausch (2011:441); Krivanek, Lovejoy, Dellby, Aoki, Carpenter, Rez, Soignard, Zhu, Batson, Lagos and Egerton (2014:209) there is a significant positive relationship between supply chain network design and firm performance in their various studies conducted by these researchers, claiming that supply chain network design plays a significant role in shaping the resource-based competitive advantage of the firm, leading to a higher performance. Furthermore, Borgatti and Halgin (2011:1168) showed that both the number and structure of connections in collaboration networks can improve firm outcome in his study. Hence, DeBresson and Amesse (1991:363); Stam, Arzlanian and Elfring (2014:152) concluded that supply chain network design reduces co-operation risks and cost, thus positively impacting long-term firm performance.

However, Hsu, Liu and Huang (2012:477) found a negative relationship between these two constructs, mentioning that supply chain network design does not contribute to firm performance in transitional economies, especially in firm access to external resources. More so, evidence provided by Winata (2011:191) shows an indirect relationship between supply chain network design and firm performance. Thus, it is clear that previous empirical research found a mixture of results with regard to these two constructs. Therefore, this research study

concur with the previous researchers who found a positive relationship between supply chain network design and firm performance. In other words, this research study strongly validates and supports the claim that supply chain network design has a positive influence on firm performance (**H₂**); and rejects the null hypotheses **H₀₂**, which claim no influence of supply chain network design on firm performance.

The third hypothesis (**H₃**) revealed that supply chain information competency is found to have a positive influence on supply chain agility ($p < 0.000$) ($\beta = 0.397$; $t = 6.497$). Therefore, **H₃** is supported. Au and Ho (2002:247) acknowledge that supply chain information competency enables the smooth flow of products down the supply chain and can be best measured in terms of its level and quality that affects the agility of the supply chain. A simulation study by Zhao, Xie and Zhang (2002:24) concludes that supply chain information competency with supplier can significantly affect supply chain agility and reduce costs. In addition, Christopher (2000:37) suggested that information competency between supply chain partners can only be fully leveraged through process agility.

However, it should be noted that while information competency is crucial, its impact on the agility of a supply chain depends on what information is given, how it is given, and with whom. Similarly, a study by Hsu, Chiu, Chen and Li (2009:101) shows that the quality of supply chain information competencies has a positive impact on supply chain agility, and that information quality should be multi-dimensional in terms of accuracy, timeliness, adequacy and credibility of information exchanged. Moreover, Tafti, Mithas and Krishnan (2013:220) argue that the supply chain structure and the nature of interrelationships among firms in the supply chain may also influence the impact of information competency on the agility of the supply chain. DeGroote and Marx (2013:909) studied the impact of supply chain information competency on abilities of sense and response in an agile supply chain and found a significant and positive relationship between the two constructs.

Furthermore, Swafford *et al.* (2008:75) studied the improvement of supply chain agility through information competency and its effect on enhancement of overall competitive firm performance. Also, Kristianto, Gunasekaran, Helo and Sandhu (2012:791) mentioned that recent advances in information competencies, processing and electronic commerce are rapidly expanding the capability to achieve powerful interactive links among firms and functional units of the agile firm. For example, supply chain information competency has

been found to significantly improve the firm's agility while enhancing the relational stability and performance in buyer and supplier relationships (Li, Lin & Yan 2006:425). Thus, empirically, previous researchers are of the notion that supply chain information competency positively influences supply chain agility. The fit of the model is deemed adequate and thus the hypothesis is supported. Therefore, this research study validates and supports the hypothesis that supply chain information competency has a positive influence on supply chain agility (**H₃**); and rejects the null hypotheses **H₀₃** which claims no influence of supply chain information technologies on supply chain agility.

The Fourth hypothesis (**H₄**) shows that supply chain integration has a significant positive influence on supply chain agility ($p < 0.000$) ($\beta = 0.532$; $t = 11.586$). Therefore, **H₄** is supported. Supply chain integration has long been considered as important in management research because of its relationship to various outcomes that potentially impact on the supply chain (Francesco & Chen 2004:425). Firms with high degrees of supply chain integration are able to sense and respond to market changes with speed and dexterity. High supply chain integration affords unfettered access to information across firms' boundaries and allows firms to capture insights from partners that are seamlessly connected (Wang, Kang, Childerhouse & Huo 2018:828). In order to gain agility, it is important for supply chain partners to integrate their units in a way that they become responsive to each other's needs and start behaving as a unified whole (Barki & Pinsonneault 2005:165).

Firms with greater supply chain integration are able to sense and respond to market changes with speed and dexterity. High supply chain integration affords unfettered access to information across firms' boundaries and allows firms to capture insights from partners that are seamlessly connected (Wang & Wei 2007:649). In order to gain agility, it is important for supply chain partners to integrate their units in a way that they become responsive to each other's needs and start behaving as a unified whole (Barki & Pinsonneault 2005:166). Previous studies by Barratt (2004:30); Sabath and Fontanella (2002:24) suggested that supply chain integration provides greater benefits to the supply chain when environmental uncertainties exist and an agile supply chain is present. Hence, Braunscheidel and Suresh (2009:211) concluded that supply chain agility cannot be developed without integrating key supply chain partners. Braunscheidel and Suresh (2009:199) are of the view that supply chain integration is positively associated to supply chain agility.

It can be argued that supply chain integration has the potential to enhance supply chain responsiveness in terms of agility. Other researchers have reached similar conclusions, with supply chain integration improving agility maintenance and development across the supply chain (Kisperska-Moron & Swierczek 2009:217; Squire, Cousins, Lawson & Brown 2009:766). Furthermore, Blackburn (1991:201); Wang and Wei (2007:154) posit that supply chain integration affects supply chain agility positively. Krause, Handfield and Tyler (2007:528) found a positive relationship between these two constructs, mentioning in their study that supply chain integration enables firms to create, reconfigure and share information and resources so that they can be more agile to the volatile market.

Therefore, an agile supply chain requires integrative working between buyers and suppliers, joint product development, common systems and shared information (Rigby, Day, Forrester & Burnett 2000:178). According to Christopher and Peck (2004:6), supply chain integration among partners in the supply chain not only increases visibility but also reduces uncertainty in the market; both effects are important in supply chain agility. Thus, empirically, previous researchers are of the notion that supply chain integration positively influences supply chain agility. The fit of the model is deemed adequate and thus the hypothesis is supported. Therefore, this research study validates and supports the claim that supply chain integration has a positive influence on supply chain agility (H_4); and rejects the null hypotheses **H04** which claims no influence of supply chain integration on supply chain agility.

The fifth hypothesis (H_5) showed that supply chain integration is positively associated with firm performance ($p < 0.000$) ($\beta = 0,532$; $t = 11,586$). Therefore, H_5 is supported. Whether it is integration with customers or with suppliers, the majority of the existing studies have found a positive relationship between supply chain integration and performance. Frohlich and Westbrook (2011:190), Salvador, Forza, Rungtusanatham and Choi (2001:461) and Vickery, Jayaram, Droge (2003:523) found support for the positive impact of integrating with suppliers and customers (upstream and downstream integration). Also, the studies focusing specifically on downstream integration (Giménez & Ventura 2005:24; Gimenez, Van der Vaart & Pieter van Donk 2012:591) or on upstream integration (Scannell, Vickery & Droge 2000:23) found evidence that supports this relationship.

The literature also provides evidence for the relationship between the three dimensions of integration, for example, practices, patterns and attitudes, and performance. Firstly, the

positive impact of supply chain practices is confirmed by De Toni and Nassimbeni (1999:597). Secondly, with respect to patterns, there is a general belief that frequent communications in supply chains enable improvements in performance (Chen, Paulraj & Lado 2004:505; Prahinski & Benton 2004:39; Paulraj, Lado & Chen 2008:45). Finally, the literature also provides evidence for the positive impact of supply chain attitudes on performance (Chen *et al.* 2004:508; Johnston, McCutcheon, Stuart & Kerwood 2004:23). More so, that the majority of empirical surveys on supply chain integration report a positive relationship between integration and firm performance (Van der Vaart & Van Donk 2010:49). Lambert, Knemeyer and Gardener (2004:921) found a positive relationship between supply chain integration and firm performance in their study, stating that supply chain integration can lead to achieved cost saving and reduced duplication of effort by firms involved in the partnership.

However, Frohlich and Westbrook (2001:185) found a negative relationship between these two constructs in their study, arguing that integration has to be seen in terms of the direction (either toward suppliers or customers) and the degree of supply chain activities. Rosenzweig, Roth and Dean (2003:440) stretched this thought further, suggesting that effective integration is required within the supply chain to enable organisations to cope with increasing complexity and uncertainty in the business environment). Other researchers like Vickery, Jayaram, Droge and Calantone (2012:523); Cousins and Menguc (2006:602) yielded mixed findings in their studies and that could have resulted from the different definitions and measures of firm performance. Thus, it is clear that previous empirical research found a mixture of results with regard to these two constructs. Therefore, this research study concurs with the previous researchers who found a positive relationship between supply chain integration and firm performance. In other words, this study validates and supports the hypotheses that supply chain integration has a positive influence on firm performance (**H₅**); and rejects the null hypotheses (**H₀₅**), claiming no influence of supply chain integration on firm performance.

Finally, the sixth hypothesis (**H₆**) shows that supply chain agility has a significant positive influence on firm performance ($p < 0.000$) ($\beta = 0,397$; $t = 6,497$) and therefore **H₆** is supported. A number of studies have empirically demonstrated a direct relationship between supply chain agility and firm performance (Swafford, Ghosh & Murthy 2008:288; Yusuf & Adeleye, 2002:40). Specifically, supply chain agility, measured by the speed with which a firm's supply chain functions adapt to changes in the market, improves competitive business performance.

Yusuf *et al.* (2014:41) concluded that supply chain agility improves return on assets, market share, profit margins, and sales per employee. Similarly, supply chain agility is conceptualised as higher-order dynamic capabilities that is able to affect firm performance. Since dynamic capabilities reflect difficult to replicate sources of competitive advantage, supply chain agility can result in superior firm performance (Blome, Schoenherr & Rexhausen 2013:1295).

Supply chain agility enables firms to better synchronise supply and demand (Christopher 2000:37). Hence, supply chain agility cannot easily be imitated. In relation to the resource-based view, the capability of supply chain agility is appropriate not only for large-scale companies but also for any-scale companies without high investment requirement (Ngai, Zhou, Lyu & Liu 2010:694). More so, the premise of RBV is that firms that are able to accumulate resources and capabilities that are rare, valuable, non-substitutable, and difficult to imitate, will achieve a competitive advantage over competing firms (Wernerfelt 1984:171). Furthermore, Ngai *et al.* (2011:235) found a positive relationship between these two constructs in one of their studies, mentioning that in the oil and gas industry, supply chain agility has a significantly positive influence on business performance, including net profit, market share, customer loyalty, and performance relative to competitors (Yusuf, Gunasekaran, Musa, Dauda, El-Berishy & Cang 2014:531).

Similarly, Swafford, Ghosh and Murthy (2008:288) also found a positive relationship in their study and indicated that the higher the supply chain agility, the higher the competitive business performance. However, Gligor, Esmark and Holcomb (2015:71) empirically find that there is no direct relationship between supply chain agility and firm performance. Similarly, Vickery, Dröge, Setia and Sambamurthy (2010:7025) tested the mediating role of agility in the relationship between antecedents (supply chain information technology and supply chain organisational initiatives) and firm performance and also found the same results. Thus, it is clear that previous empirical research found a mixture of results with regard to these two constructs. Thus, this research study concurs with the previous researchers who found a positive relationship between supply chain agility and firm performance. In other words, it validates and supports the hypotheses that supply chain agility has a positive influence on firm performance (**H6**); and rejects the null hypotheses **H06**, claiming a negative influence of supply chain agility on firm performance.

6.8 SUMMARY OF THE CHAPTER

Chapter 6 presented the results for descriptive analysis, principal component analysis, testing for measurement accuracy and checking for model fit in CFA. It also tested the proposed hypotheses with the help of Structural Equation Modelling (SEM) and multiple regression analysis. As a result, the SEM results were evaluated and interpreted. Generally, the measurement items were found to be adequately acceptable and therefore reliable and valid. In addition, the findings to the research model in this research study show that the conceptualised model provides a good fit to the specified sample data.

The research study investigated the influence of supply chain technologies (supply chain network design, supply chain information competency, and supply chain integration) on supply chain agility and firm performance. All the posited six linear hypotheses (H_1 , H_2 , H_3 , H_4 , H_5 and H_6) were supported and validated. Both the SEM and regression analysis results showed that all hypotheses had a significant positive relationship. The implications of these research findings and an overall conclusion, as well as recommendations are provided in the following chapter (Chapter 7).

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

The previous chapter addressed the objectives of the study by interpreting and analysing the key statistical findings of the empirical study. The focus of this chapter is to provide a summary of the broad research process, with the emphasis on conclusions and recommendations. The limitations of the study, recommendations for further research, the value of the study and the conclusion is provided.

7.2 RESEARCH OBJECTIVES

This section addresses the evaluation of both theoretical and empirical objectives of the study.

7.2.1 The Evaluation of Theoretical Objectives

The evaluation of theoretical objectives was to:

- Conduct a literature review of the manufacturing sector in the context of a developing economy;
- Conduct a literature review of supply chain network design;
- Review the literature of supply chain information competency;
- Conduct a literature review on supply chain integration;
- Review the literature on supply chain agility; and
- Conduct a literature review on firm performance.

The first theoretical objective aimed at analysing the manufacturing sector of a developing country was addressed in Sections 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8 and 2.9 respectively. A literature review was conducted to achieve this objective. First, the definition of this concept was given. Second, the background and role of the manufacturing sector was provided. Based on the literature review, the contribution of the manufacturing sector in the South African economy is important, especially in the aspect of employment and poverty alleviation. However, the manufacturing sector of South Africa still faces some major issues, which have resulted in constraints to firms' performance. In order to strategically mitigate manufacturing firm constraints, a number of favourable strategic actions have been implemented by the South

African government to further aid the firm performance and growth in this sector. For example, the Transaction and Procurement Act and the Small Business Finance Act were established as enabling legal frameworks for firms to access to procurement, finance, training and technology.

Nevertheless, the performance success of the firms, especially the newly established ones, is still expected to rise in order to mitigate the unemployment rate and also to contribute significantly to economic development. Most of the firms still struggle to survive, considering the failure rate of about 70% of the new firms that are started eventually fail to become established businesses. This questions the capability of the firms' owner/managers skills to perform well. Irrespective of the failure rate, there is still a need in the literature to promote the establishment, survival and performance efficiency of firms' because the lack of it or the decline of firms in the manufacturing sector may result in a decrease in economic growth and hence, the importance of this research study.

The second theoretical objective was addressed in Sections 3.3.1, 3.3.2, 3.3.3, 3.3.4, and 3.3.5 respectively. The aim of this objective was directed at understanding the nature of supply chain network design. This concept was found to be well conceptualised theoretically, and defined, based on sound and dominating theories of motivation. In accordance with the literature, several factors were identified as benefits of supply chain network design, namely information exchange, complementary ideas and knowledge sharing, superior customer service, improved supplier relationships, reduced uncertainty, and reduced operating costs.

The third theoretical objective was aimed at analysing supply chain information competence was addressed in Sections 4.2, 4.2.1, and 4.2.2 respectively. The literature search on supply chain information competence revealed that the definition of this concept is not straightforward because the concept has been studied by several disciplines and from different approaches. However, competency opportunities come in two main forms, competence-enhancing-improvements in the specification or performance of the supply chain that rely on existing know-how, and competence-destroying new knowledge fundamentally different from previous information. Internal and external communications between the teams working on information sharing, components, and systems are critical for a firm's information competence. An effective supply chain information competency package is one that enables partners to recognise the value of information and use it to make informed choices in their business

environment. However, managers will always be sceptical about sharing information with trading partners due to the perceived complexities, risks, and costs.

The fourth theoretical objective, which was aimed at understanding the concept of supply chain integration was addressed in Sections 4.3, 4.3.1, 4.3.2, 4.3.3, and 4.3.4 respectively. A literature review was conducted to achieve this objective. First, the definition of this concept was given. Based on the literature review, supply chain integration is an important strategy within the supply chain to ensure smooth running of firms' operations in time and to ensure high levels of performance. It is the alignment of all operational processes within the value chain (both upstream and downstream). With this, innovation and commitment are assured by all stakeholders, top management and employees to deliver customer-specific requirements. Supply chain integration allows the establishment of quick ordering systems and a highly stable procurement throughout the value chain.

The fifth theoretical objective, which was aimed at analysing supply chain agility was addressed in Sections 4.4, 4.4.1, and 4.4.2 respectively. The aim of this objective was directed at understanding the nature of supply chain agility. While there is no single accepted definition of supply chain agility, the current definitions share common terms and themes, suggesting that a certain degree of consensus exists. A few researchers addressed this concept of supply chain agility from a rather narrow functional approach of logistics. Supply chain agility boosts firms' supply chain flexibility to respond quickly to any uncertain changes within the firms' environment with little cost, time and less effort. In accordance with the literature, several factors were identified as enablers of supply chain agility, namely the quality of supplier relationship, process integration, market sensitivity, level of shared information, and the level of connectivity between firms in the value chain.

The sixth and final theoretical objective, which was aimed at understanding the concept of firm performance was addressed in Sections 4.5 and 4.5.1 respectively. This concept was found to be well conceptualised theoretically. In accordance to the literature, there are two major streams on the determinants of firm performance, namely, primarily, upon an economic tradition emphasising the importance of external market factors; secondarily, upon sociological and behavioural paradigms. Firm performance is often compounded by criteria such as profit margin or increased turnover. Manufacturing firms are managed by entrepreneurs who take the initiative to set up and manage a firm with the intention to succeed, considering the risk and

competitive challenges in the business environment. However, financial support has been seen as the ultimate obstacle to firms' growth and performance.

7.3 EMPIRICAL ACHIEVEMENT OF THE HYPOTHESES STATEMENTS AND ITS STATISTICAL SIGNIFICANCE

The empirical objectives were determined by statistically testing the significance of the hypothesis relationship. Structural equation modelling was conducted to determine the relationships between supply chain technologies (supply chain network design, supply chain information competency and supply chain integration) on supply chain agility and firm performance. These were statistically analysed and presented in the previous chapter (Chapter six, Table 6.17). The following empirical objectives are based on the hypothetical relationships between the research variables that this study sought to measure.

7.3.1 To determine the influence of supply chain network design on supply chain agility

H1: Supply chain network design has a significantly positive influence on supply chain agility.

The majority of the participating firms in this study believe that supply chain network design can enhance their agility capability to survive through uncertain environments, asserting that supply chain network design, processes, and electronic trade are quickly extending the capacity to accomplish intense intuitive connection among agile manufacturing firms. The majority of the firms also attest to the fact that supply chain network design serves as an opportunity to gain access into market-sensitive industries and markets in other industries. The influence of this relationship between supply chain network design and supply chain agility was supported and accepted at a significance level of $p < 0.001$ indicating a strong relationship between the construct. This was theoretically supported by Hollmann, Scavarda and Thome (2015:971), mentioning that supply chain network design has been proven to increase agility and reduce inventory across the entire supply chain, that is, overall lower inventories across linked suppliers, manufacturers, and customers. Hence, Alzaman, Zhang and Diabat (2018:203) stated that supply chain network design aims at formulating an objective function that minimises production, inventory, transportation, and/or other operational costs leading to an enhanced firm performance of the business.

7.3.2 To evaluate the influence of supply chain network design on firm performance

H2: Supply chain network design has a significantly positive influence on firm performance.

The performance of today's local and international supply chain network design is affected by an increased number of uncertainties in the business environment. Firms in supply chain networks with high levels of collaborative innovation capabilities are likely to harness more new knowledge from other firms to facilitate their innovative activities. Firms must have the capacity to absorb collaborative inputs in order to generate innovative products in this platform. Without such capacity, they cannot learn or transfer knowledge from one firm to another. In fact, an important component in supply chain network design and evaluation is the establishment of appropriate performance measures, including qualitative and quantitative ones, where customer satisfaction, flexibility, and effective risk management belong to qualitative performance measures and cost minimisation. The influence of this relationship between supply chain network and firm performance was supported and accepted at a significance level of $p < 0.001$, indicating a strong relationship between the construct. This was theoretically supported by Zebal and Goodwin (2012:352) stating that an improved firm performance is a consequence of higher levels of supply chain network design.

7.3.3 To determine the influence of supply chain information competency on supply chain agility

H3: Supply chain information competency has a significant positive influence on supply chain agility.

In today's hyper-competitive global environment, firms have begun to realise that delivering the best customer value at the lowest cost is not only related to the activities, functions and processes within the firm itself, but to the whole of the supply chain. In addition to the physical flow of goods and materials, supply chain involves the flow of information to contribute to the alertness dimension of supply chain agility; it is not enough to simply capture information from customers nowadays. The information must also be disseminated across the supply chain. Supply chain information competency capabilities acquire, analyse, store and even distribute tactical and strategic information, both inside the firm, and within an agile supply chain.

There is a need to leverage information exchange of market-related data in a timely manner for improved co-ordination and decision-making among supply chain members. This capability is deemed to be vital when conditions of uncertainty and/or volatility exist in the marketplace. The influence of this relationship between supply chain information competency and supply chain agility was supported and accepted at a significance level of $p < 0.001$, therefore indicating a strong relationship between the constructs. This was theoretically supported by Tafti, Mithas and Krishnan (2013:220) arguing that the supply chain structure and the nature of inter-relationships among firms in the supply chain may also influence the impact of supply chain information competency on supply chain agility. Furthermore, Ravichandran (2018:22) mentioned that an agile supply chain information competency infrastructure enables firms to connect with business partners easily, enable quick deployment of applications and tools and in general, permit firms to use information resources effectively.

7.3.4 To ascertain the influence of supply chain integration on supply chain agility

H4: Supply chain integration has a significant positive influence on supply chain agility.

This investigation reveals that the growth of economic globalisation, which is the integration of local, fragmented national economies into a single global market and the accompanying trade liberalisation has put significant competitive pressures on many firms. The need to respond to this and other market changes and stay competitive puts tremendous pressure on firms. Along with the increasing global competition, the need for supply chain integration and collaborative strategies has steadily grown in the last decade.

It can be argued that supply chain integration has the potential to enhance supply chain responsiveness in terms of agility. However, the effect of supply chain integration on supply chain agility tends to be more customer-oriented and leverage suppliers' abilities for greater customer satisfaction. The influence of this relationship between supply chain integration and supply chain agility was support and accepted at a significance level of $p < 0.001$ indicating a strong relationship between the construct. This was theoretically supported by Braunscheidel and Suresh (2010:119) who mentioned that supply chain agility cannot be developed without integrating key supply chain partners. Sabath and Fontanella (2002:24) also

suggested that supply chain integration provides greater benefits to the supply chain when environmental uncertainties exist and an agile supply chain is present.

7.3.5 To evaluate the influence of supply chain integration on firm performance

H5: Supply chain integration has a significant positive influence on firm performance.

The majority of the participating firms in this study believe that supply chain integration is the ability to work effectively with other entities for mutual benefit. The vast degree of turbulence and complexity in supply chains requires a firm's view with integration among all business functions within the firm. A high level of integration is required to identify and manage risks. An integrated network is the most advanced and demanding form of integration. It involves a joint process where the parties share information, resources, and responsibilities to plan, implement and evaluate activities to achieve a common goal. Integration implies mutual trust, and it takes time, effort and dedication.

It implies risk, resources, and responsibility and it gives an outside observer an image of a joint identity. However, if close working relationships can be established with other firms that can provide access to their resources, then a real opportunity exists for creating a high level of competitive performance. The influence of this relationship between supply chain integration and firm performance was supported and accepted at a significance level of $p < 0.001$, indicating a strong relationship between the construct. This was theoretically supported by Van der Vaart and Van Donk (2010:49) who stated that supply chain integration can lead to achieved cost saving and reduced duplication of effort by firms involved in the partnership. Supply chain integration in which business processes between a buyer and its key suppliers are unified as a whole is a primary driver for the firm's performance (Chen, Preston & Xia 2016:391).

7.3.6 To determine the influence of supply chain agility on firm performance

H6: Supply chain agility has a significant positive influence on firm performance.

The participated firms rated the relationship between supply chain agility and firm performance as highly important. Supply chain agility is a strategic ability that assists organisations to sense and initiate a response rapidly. Consequently, developing an agile supply chain can be considered as a key strategy for companies to thrive in today's

business context. An agile business is capable of configuring several parameters, including products, partners, relationships, and markets; and priorities such as time, cost, quality, and risk, to meet the needs of both the supply chain and the end customer. The influence of this relationship between supply chain agility and firm performance was supported and accepted at a significance level of $p < 0.001$, indicating a strong relationship between the construct. This was theoretically supported by Yusuf (2014:531) who mentioned that supply chain agility has a significantly positive influence on firm performance, including market share, customer loyalty, and performance relative to competitors. Moreover, Yang (2014:104) concludes that supply chain agility influences firm performance via cost efficiency, while Tse, Zhang, Akhtar and Macbryde (2017:140) indicate that supply chain agility affects firm performance directly.

Table 7. 1: Hypothesis Testing and Outcome

Hypothesis	Decision
H1: Supply chain network design has a significant positive influence on supply chain agility.	Hypothesis accepted
H2: Supply chain network design has a significant positive influence on firm performance.	Hypothesis accepted
H3: Supply chain information competency has a significant positive influence on supply chain agility.	Hypotheses accepted
H4: Supply chain integration has a significant positive influence on supply chain agility.	Hypothesis accepted
H5: Supply chain integration has a significant positive influence on firm performance.	Hypothesis accepted
H6: Supply chain agility has a significant positive influence on firm performance.	Hypothesis accepted

Source: Own work

The results in Table 7.1 show that there is a significant positive association between all the variables.

7.4 CONTRIBUTION OF THE STUDY

7.4.1 Theoretical Contribution

This study contributes to manufacturing firm research in general, and research on supply chain capabilities (supply chain network design, supply chain information competency, and supply chain integration), supply chain agility and firm performance. Given the dearth of knowledge on the impact of supply chain capabilities on manufacturing firm performance, this study provides vital insights into a largely blind spot of manufacturing firm research in South Africa. The findings point out that the research theory is valid and acceptable. Most importantly, the present study informs manufacturing firms on how supply chain capabilities and supply chain agility could increase firm performance. In addition, the conceptual model of this study will make a positive contribution to the growing body of expertise as well as assisting manufacturing firms' managers, and owners to focus on improving supply chain capabilities, developing supply chain agility in order to improve firm performance.

It is also evident that manufacturing firms and their suppliers should commit their effort toward supply chain capabilities, providing quality products and creating long-term relationships in order to improve or increase firm performance. Manufacturing firms and their suppliers should recognise that when the relationship between them is good, new modifications will appear and service will improve its quality, which will lead to supply chain enhancement and firm performance. The results contribute to the understanding of manufacturing firm performance when developing and maintaining quality products, establishing and maintaining long-term supplier relationship. Thus, manufacturing firms are more likely to adapt successfully to constantly changing business environments.

7.4.2 Practical Contributions

The research study further informs managerial implications in which manufacturing firms are most likely to prosper, thereby providing important information about the conditions for the development and maintenance of these antecedents of firm performance. This study has managerial implications for the manufacturing sector of Gauteng. Manufacturing firm managers and proprietors may be able to increase the level of firm performance by making improvements on supply chain capabilities, improving the quality of their products and cultivating sound and lengthy-lasting relationships with their key suppliers. This will also have

an impact on improving their performance. The findings of this research study will also help managers position, structure and utilise their supply chain capabilities in line with supply chain agility and firm performance which can be useful for strategic decision making for managers. The scale derived by this study can be utilised by the managers of manufacturing firms to assess the supply chain competitiveness of their enterprise and arrive at the strengths and weaknesses of their firms in respect of both supply chain capabilities, and agility and the likely impact of these components on the firm performance.

The research demonstrates that the connection between supply chain capabilities and firm performance, recommends that further investment in improving supply chain capabilities will enhance business and related financial performance of manufacturing firms. Manufacturing firms need to concentrate on opportunity creation and only with opportunity creation will manufacturing firms in Gauteng have the option to sustain increased firm performance.

The study likewise uncovers that the implication for policymakers are that competitive intensity to international markets should be improved. The primary reason for low competitive intensity can be credited to lack of market entrance by local firms. Barriers to entry include access to financial aids, inadequate incentives, technology and high transaction cost. All things considered, policy makers should likewise assume a noteworthy role by adding to the achievement of the manufacturing sector by creating strategies that will enable owners and managers to prosper in this sector. They are additionally required to give the essential support entities to support firms in overcoming the initial three years of trading given that these are the critical years for future achievement.

This study could also be used by other business sectors where the supply chain is mostly used as they will be aware of the antecedents that can improve firm performance. This study will assist other firms to gain more knowledge on how to enhance firm performance in the sector in which they are operating.

7.5 RECOMMENDATIONS OF EACH RELATIONSHIP

The findings of this study suggest that many challenges need to be addressed by the manufacturing sector in Gauteng with regard to its performance. It is therefore necessary to suggest recommendations that could be useful in meeting the recognised challenges.

H1. There is a significant positive direct influence between supply chain network design and supply chain agility.

The research findings also revealed a gap between supply chain network design and supply chain agility among manufacturing firms. The model showed that most firms within the Gauteng Province have more awareness about the importance of supply chain agility. Partnerships with key suppliers and customers may reduce uncertainty and complexity in an ever-changing global environment and minimise risk while maintaining flexibility. This is also supported by Thakkar, Kanda and Deshmukh (2008:140), that supply chain network design among small manufacturing firms are not strong, compared to the larger manufacturing firms.

The main recommendation for this relationship is to develop key suppliers in the firms supply chain network and potential suppliers to better leverage the supplier's core competencies which will improve the supplier's capability to respond quickly to unpredictable demand in order to minimise stock-outs. This activity will include sharing information on real-time, collaborative planning, and better visibility. It can likewise be recommended that a strategic training programme aimed at helping these small firms to design supply chain network to improve more effective agility and incorporation, ought to be implemented. This ought to likewise help with alleviating supply chain difficulties. Moreover, agility appears as a dynamic to drive fruitful supply chain network following innovation. It validates that a firm can reconfigure its supply chain network and make it progressively agile so as to help the manufacture of the innovative product.

In addition, there isn't enough trust between the firm and its local suppliers as a result of lack of quality controlling systems which helps both suppliers and firms to ensure that the products sent by their partners are possessing high-quality level. Therefore, determining the problem can be a starting point for solving it, which may lead to improvement in their relationship. Consequently, this can lead to improvement in their supply chain network. Manufacturing firms may keep on encountering difficulties in executing supply chain network design if managers and owners are not appropriately taught and trained. The government, therefore, should focus more on addressing the issues of continuous improvement of managers' skills as well as technical skills and more financial support.

H2. There is a significant positive direct influence between supply chain network design and firm performance.

The research findings indicate that manufacturing strategy is expected to be a competitive weapon and contribute to the long-term performance and competitiveness of a business. It is crucial for managers and owners to understand the nature of the supply chain network design they are involved in if they intend to take appropriate actions to devise the ideal supply chain. Knowledge from supply chain network partners leads to strong competitive advantages and enhances firm performance. It is recommended that supply chain network design be seen as an obvious choice rather than a simple option. Supply chain network design as a whole should be interpreted as an architecture of resources and expertise variously combined, able to improve firms' performance.

Supply chain network design is a crucial function in which it creates value through the creation and access to a variety of resources, such as new knowledge, which is a fundamental driver of value creation in the firm. Owing to today's competitive environment, firms must respond more promptly to customers' fluctuating demand by accelerating product designing, manufacturing, and distribution processes at minimum cost with higher efficiency levels. As such, the supply chain network design concept is an important solution to this problem for enhancing firm performance measures via various concepts, such as just-in-time (JIT). Firms often develop supply chain network design with supply chain partners from previous ventures since the trust that develops between them may reduce transactional costs. This is supported by Stuart (2000:791), stating that supply chain network design plays a significant role in shaping the resource-based competitive advantage of the firm, leading to higher performance.

H3. There is a significant positive influence between supply chain information competency and supply chain agility.

The research findings indicate that the basic foundation for network design and integration in supply chain is information competency amongst supply chain members (Rashed, Azeem & Halim 2010:61). Supply chain information competency is a prerequisite for knowledge sharing, and the close buyer-supplier relationship is a vital factor for escalating the suppliers' operational performance. Manufacturing firm's information competency can provide linkages

amongst members in the supply chain that can be used to synchronise all activities across the whole supply chain. For example, the impact of information competencies can increase supply chain agility of firms in the manufacturing sector by reducing inventory and smoothing production.

As the market continues to change pace, the manufacturing firms need to take competitive advantage of supply chain agility. It is recommended that manufacturing firms partner with supply chain experts who understand this and have the capabilities to continue to improve the flow of information on an on-going basis as it is clearly the only way to ensure and sustain success in this sector. Exchanging information with other manufacturing firms should be encouraged, especially exchanging production plans for specific products such as products with seasonal demand fluctuations. This will enable manufacturing firms to plan for production and routing, manage resources more efficiently, but also to optimise the stocks and reduce the lead time.

H4. There is a significant positive influence between supply chain integration and supply chain agility.

The research findings indicated that the ongoing supply chain network relationship among manufacturing firms may be less effective if strategical integration as a competitive strategy to enhance manufacturing firm performance is not used. The argument for effective supply chain integration as a competitive strategy significantly outnumbers the arguments against integration as a supply chain strategy (Mathumaramaytha 2011:1054). The increased market globalisation and increased competition has provoked manufacturing firms to be more integrative in the supply chain to allow them to gain mutual benefits. It is recommended that manufacturing firms adapt supply chain integration as a competitive strategy as this will include benefits such as tangible and intangible ones. Tangible benefits for manufacturing firm supply chain integration include improved revenue, cost reductions, and increased operational agility to cope with the high demand of uncertainties.

Intangible benefit for manufacturing firms is the ability to interlink systems and processes for enhanced information sharing. For example, this would be the information transfer of consumer buying patterns, or retailer buying models that would be shared and utilised by the manufacturing firms to develop demand plans, and manufacturing schedules. This would allow

the firms to optimise the inventory levels, to satisfy customer requirements timeously and in doing so, see the value chain “delivering a better deal for consumers through greater integration between retailers and suppliers” (Mason, Lalwani & Boughton 2007:190).

H5. There is a significant positive influence between supply chain integration and firm performance.

The research findings between supply chain integration and firm performance revealed that manufacturing firms should work more closely with suppliers in order to increase their performance through linking both suppliers and manufacturing firms with advanced information systems to facilitate the flow of material, information, and experience, in addition, to control the inventory. It is advisable for manufacturing firms to pay more attention to the strategic relationship with suppliers through enhancing joint programmes and activities to increase the coherence and harmony. Furthermore, the integration of a management system with supply chain partners can help manufacturing firms reduce the risk of environmental penalties, such as fines and relevant environmental cost, by reducing environmental accidents from work done during manufacturing processes.

Integration with other members in the supply chain is forcing manufacturing firms to consider environmental issues more fully, and it has been used to create environmental policy in many firms (Griffith & Bhutto 2009:569). Creating commitment and trust between firms makes them build long-term relationships and achieve long-term profitability and leads to sustainable for the firm. Therefore, supply chain as a source of competitive advantage should not be denied by managers/owners and should be considered as a strategic weapon in the manufacturing sector.

H6. There is a significant positive influence between supply chain agility and firm performance.

The research findings between supply chain agility and firm performance revealed that supply chain agility is a very important business strategy to the manufacturing firm's performance. It is recommended that manufacturing firms should redefine their business strategy to include supply chain agility strategy through research and development, benchmarking of business process and building integrative relationships within the supply chain. This would further enable manufacturing firms to proactively anticipate and develop future plans on how to further

satisfy changing customers' demands and offer good product designs. However, manufacturing firm's first need to understand the firm objectives and the competitive environment within internal and external environments; the reason being that the firm objectives are linked to the supply chain network objectives and performance.

Technological capabilities will also improve manufacturing customer service capabilities. The research model also revealed that higher strategy agility was also associated with a higher integration strategy. This indicates the need for manufacturing firms to improve their business agility strategy since being agile is the key to overcoming competitive rivals and unpredictable changes in the market environment. (Bertrand 2003:1172). Therefore, intervention leading to manufacturing firms' understanding of the supply chain strategy agility should be part of the South African government's plan to improve manufacturing firms. This will further enhance manufacturing the firms' sustainability and growth, and in turn, will efficiently and effectively contribute to the South African gross domestic product (GDP) output.

7.6 RECOMMENDATION TO MANAGERS

The manufacturing sector of Gauteng is a mature one, and the mindset of managers need to change; they need to be more pro-active because upgrading will only occur with active effort on their part. It is not automatic for merely being part of a value chain but rather this demands actions and plans to upgrade and stay part of a value chain. Managers need to make training a priority too. 'Learning by doing' is not enough.

Managers need to engage in more research and development and to make more such investments, perhaps by entering into more joint ventures, but they do need to take advantage of these opportunities to stimulate connections that they already know to new insights. They need to build more communicative relationships with buyers so that they are more ready to meet buyers' needs and in turn, have more supportive buyers. Managers too should focus on developing specialists and perhaps promoting the profession to younger age groups who are still in a position to focus and improve their knowledge. Managers must be encouraged to attract and use foreign specialised skills as this will help support the learning process for other employees and the advancement of the firm.

The research shows that managers should be more strategic in their relationships. Manufacturing firm managers should perhaps consider that there are more opportunities for small firms to supply to small buyers and where these buyers are more inclined to increase supplier responsibility. This allows a more dynamic learning curve.

The research has demonstrated that the number of years trading just as the degree of experience of owners and managers in the manufacturing sector has a significant part to play in its continued existence. Managers need to comprehend that representatives must be trained, and their performance measured and treated equally. Managers need to understand that innovation has changed the manner in which business is directed, the manner in which items and services are manufactured and conveyed. The need to embrace and acknowledge new innovation in the manufacturing processes will give a key favourable position to manufacturing firms that want to contend in the international market.

7.7 RECOMMENDATION TO GOVERNMENT

Increased support from government should be given that equips manufacturing firms to be more competitive. The policy focus for the South African government should be on strengthening the supply-side capabilities of local firms, as well as creating an investment climate that will encourage further upgrading activities.

Policies that encourage trade must not be the only focus. They must be complemented by policies aimed at skill development. At present, multinationals are drawn to the establishment of low-cost production facilities. Policies need to be implemented that encourage the transfer, development, and harnessing of design and engineering skills to their subsidiaries in South Africa.

The government should introduce an incentive to assist-up manufacturing firms by giving a partial exclusion of profit or a double deduction of a limited amount of costs or losses in the first two years of trading.

Further, it should introduce an incentive to motivating the extension of the manufacturing sector by giving partial or full exclusion for a constrained period of increased benefit coming about because of expanded capital investment.

An incentive to motivate foreign direct investment in the manufacturing sector should be devised, and the exchange of foreign innovation and skills promoted by giving a full exception of withholding tax on interest payment and technical fees payable to non-inhabitants.

Government additionally needs to expand and better regulate the different backings it gives to manufacturing firms in the context through putting resources into capacity development programmes, market linkages, and so forth, as well as moving in the direction of creating increased awareness among firms, might be through giving more formalised training on global markets, key resources and capabilities, key success factors, etc.

The government is in an ideal position to create an environment beneficial for the manufacturing sector.

7.8 LIMITATIONS OF THE STUDY

One of the major limitations in this research was accessibility of managers and proprietors in this sector. The challenge which the researcher encountered was to receive a consent letter from the firms as it took almost two months to meet the right persons to handle the request. Another limitation was identified as receiving a fixed scheduled date for appointment; this took some time to be granted in some firms. This predicament was encountered with firms that were unable to complete the questionnaire at the first meeting with the researcher assistants.

Other limitations encountered by the researcher emerged from the fieldwork whereby some of the managers and proprietors were not willing to listen or understand the significance and purpose of this study. They considered paperwork as a waste of time when compared with their daily activities, while others indicated that they could not disclose the firm's information to outside parties, and hence could not assist.

Owing to the limited time and resources, the study was conducted in a very short period of time from the start of April to the end of July, and those who took part in completing the questionnaires were not rewarded.

Some of the manufacturing firms in Gauteng were found to be branches of the main firm, mostly located in Cape Town and others in KwaZulu-Natal. Most of these branches were unable to complete the entire questionnaire due to lack of information on performance measures. They said that all related performance aspects of the firm was handled by the head offices. Hence, some of the questionnaires were returned incomplete.

7.9 FUTURE RESEARCH SUGGESTIONS

Variables, such as supply chain capabilities (supply chain network design, supply chain information competency, and supply chain integration), supply chain agility and firm performance, should be studied further within the South African manufacturing sector. Despite the various limitations, the study advances knowledge regarding manufacturing firm's supply chain technologies, supply chain agility and firm performance, considering that there is a noticeable absence of prior research within a South African context related to this study. The sample size was set at 600 manufacturing firms in Gauteng. The study only utilised a quantitative research approach. It is suggested that future research should use a mixed methodological approach technique, which may contribute to creating a more in-depth understanding of the relationships between the study constructs.

Another suggestion for further study would be to replicate this study by analysing the population using different test instruments and different research techniques other than the one used in this study, and then compare results with this study. The study could also be conducted in another geographical location in South Africa. Further research can be carried out in a similar context but in other developing countries in order to further validate the research model and findings.

With all the limitations mentioned above, the study has revealed the influence of supply chain capabilities and supply chain agility on manufacturing firm performance. In addition, this study empirically validates and confirms the research model. The research findings should be verified and refined in a new research context. This study also suggests to both manufacturing firm managers and proprietors and government in South Africa the importance of supply chain networking relationship for manufacturing firms' performance and economic growth.

7.10 SUMMARY OF THE CHAPTER

This chapter provided four concluding sections of this research study. First, it presented an introduction to the chapter. Secondly, it stated implications for academic and management practices, followed by limitations and suggestions for future research. Thirdly, the contribution to the field of study was outlined and recommendations to be followed by managers to improve the overall management of the manufacturing firms were made. Finally, a brief concluding remark for the research study is presented below.

The purpose of this study was to investigate the influence of supply chain capabilities (supply chain network design, supply chain information competency, and supply chain integration) and supply chain agility on firm performance amongst manufacturing firms in South Africa, specifically, Gauteng Province. The predictive relationships between firm performance and the three predictors plus one mediating construct were observed. Strong correlations were observed between firm performance and supply chain network design, supply chain information competency, supply chain integration, and supply chain agility.

The same four factors were statistically significant, which implies that they are antecedents of firm performance. The findings of this study suggest that in order for manufacturing firms to perform well in the emerging and challenging business environment it is important that manufacturing firms develop long-term relationships with key suppliers. Supply chain capabilities can enhance manufacturing firm's agility and help create a competitive advantage, and provide quality products, which is very important for many businesses operating within this sector.

It is appropriate then to conclude that the level of firm performance in the manufacturing sector is dependent upon the effectiveness of supply chain capabilities and the existence of a sound long-term relationship between partners in the supply chain. This study has managerial implications for the manufacturing sector. Manufacturing managers and proprietors may be able to enhance the levels of firm performance by making improvements to supply chain technologies and improving supply chain agility by cultivating long-lasting sound relationships with key suppliers and customers.

The time spent on this research study was worthwhile, and it culminated in the discovery of the best possible information, as per the objectives of the study. It is hoped that the developed model and recommendations will form an essential contribution towards the possible solutions of the specific problems at which this research study was directed.

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APPENDIX A: COVER LETTER



Vaal University of Technology
Your world to a better future



REQUEST FOR QUESTIONNAIRE COMPLETION

Dear Respondents

I hereby request assistance with the completion of my questionnaire. The reason for this request is that I am currently doing my PhD in Business Administration (logistics) at the Vaal University of Technology. The research topic of my study is the influence between Supply Chain Technologies, Supply Chain Agility and Firm Performance of Manufacturing Firms in a Developing Economy. Therefore, I believe your assistance with this matter will help me collect secondary data that is relevant to the study.

The purpose of this study is to find out if manufacturing firms in the Gauteng province adopt supply chain network design, supply chain information competency, supply chain integration and supply chain agility to their operation, will this lead to having higher performance and profitability.

The research is merely for academic purposes and the information will be kept confidential.

Your assistance will be highly appreciated.

Warm regards

MT Tlale

APPENDIX B: QUESTIONNAIRE



Vaal University of Technology

Your world to a better future



Promotor: Dr J.P van der Westhuizen

Contact numbers: 083 287 8052

Email address: johanvdw@vut.ac.za

Co-Promoter: Dr E. Chinomona

Contact numbers: 083 799 0936

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Questionnaire

Supply Chain Technologies, Agility and Firm Performance in a Developing Economy.

Thank you for giving consideration to this academic questionnaire. The intention of this questionnaire is to collect information about the influence that Supply Chain Technologies and Agility has on Firm Performance of manufacturing firms' in a developing economy. I am therefore, requesting for your assistance to complete the questionnaire below. The research is merely for academic purposes and the information will be kept confidential. It will take you approximately 10 minutes to answer the whole questionnaire.

Researcher: M.T Tlale

Contact numbers: 073 026 0480

Email address: giftanat@gmail.com

SECTION A

General Information

The section asks for your background information. Please indicate your answer by ticking (✓) in the appropriate box.

A1. Please indicate your Gender.

Male	
Female	

A2. Please indicate your Marital Status.

Single	
Engaged	
Married	
Divorced	
Widowed	

A3. Please indicate your Age Group.

25 – less		48 – 58	
26 – 36		59 – 69	
37 – 47		70+	

A4. Please indicate your Race.

Black		White	
Indian		Coloured	

A5. Please indicate your Home Language.

English		Afrikaans	
Sotho		Zulu	
Xhosa		Other	

A6. Please indicate your Educational Level.

Matric	
Diploma	
Degree	
Honours	
Masters	
Doctorial	

A7. Please indicate the number of Years in Operation.

0 – 1yr		6yrs – 10yrs	
2yrs – 5yrs		11yrs and above	

A8. Please indicate the type of Industry you are Operating in.

Agri-processing		Automotive	
Chemical		Metals	
Textile, clothing and footwear		other	

SECTION B

Supply Chain Network Design

Below are statements about supply chain network design. You can indicate the extent to which you agree or disagree with the statement by ticking the corresponding number in the 5 point scale below:

1	2	3	4	5
Strongly Disagree	Disagree	Moderately Agree	Agree	Strongly Agree

Please tick only one number for each statement.

Thinking of the type of supply chain network design in place at your firm, would you agree or disagree with the following statement?

SD1	Our firm has an absorptive boundary that facilitate better communication or relationship with key suppliers.	Strongly disagree	1	2	3	4	5	Strongly agree
SD2	We have an interdependence supply chain relationship with key suppliers.	Strongly disagree	1	2	3	4	5	Strongly agree
SD3	Our firms supply chain can be categorised as a flexible value-adding network.	Strongly disagree	1	2	3	4	5	Strongly agree
SD4	We have a supply chain network that does not involve power-based relationship.	Strongly disagree	1	2	3	4	5	Strongly agree

SD5	Our supply chain network is designed in such a way that its members can make decisions independently.	Strongly disagree	1	2	3	4	5	Strongly agree
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SECTION C

Supply Chain Information Competency

Below are statements about supply chain information competency. You can indicate the extent to which you agree or disagree with the statement by ticking the corresponding number in the 5 point scale below:

1	2	3	4	5
Strongly Disagree	Disagree	Moderately Agree	Agree	Strongly Agree

Please tick only one number for each statement.

Looking at the type of supply chain information competency in place at your firm, would you agree or disagree with the following statements?

SC1	We have a high level of electronic document interchange through the supply chain.	Strongly disagree	1	2	3	4	5	Strongly agree
SC2	Our firm has a department that evaluate information and its source critically.	Strongly disagree	1	2	3	4	5	Strongly agree
SC3	We have a search engine that determines the nature and extent of the information we need.	Strongly disagree	1	2	3	4	5	Strongly agree
SC4	Our firm is better able to acquire new customers.	Strongly disagree	1	2	3	4	5	Strongly agree
SC5	Our firm has a good data standardisation between supply chain partners.	Strongly disagree	1	2	3	4	5	Strongly agree

Section D

Supply Chain Integration

Below are statements about supply chain integration, you are required to indicate the extent to which you agree or disagree with the statement by ticking the appropriate number provided below:

1	2	3	4	5
Strongly Disagree	Disagree	Moderately Agree	Agree	Strongly Agree

Please tick only one number for each statement.

Looking at the type of supply chain integration in place at your firm, would you agree or disagree with the following statements?

SI1	Our firms' supply chain is structured in such a way that it is integrated with suppliers.	Strongly disagree	1	2	3	4	5	Strongly agree
SI2	We have a cross functional integration within our firm.	Strongly disagree	1	2	3	4	5	Strongly agree
SI3	We have a supply chain structure that is well integrated with our supplies logistics activities.	Strongly disagree	1	2	3	4	5	Strongly agree
SI4	Our firms' supply chain is integrated in such a way that follow-ups with our major customers for feedback is easy.	Strongly disagree	1	2	3	4	5	Strongly agree
SI5	Our supply chain integration is structured to share production plans with major suppliers and customers.	Strongly disagree	1	2	3	4	5	Strongly agree

SECTION E

Supply Chain Agility

Below are statements about supply chain agility, you are required to indicate the extent to which you agree or disagree with the statement by ticking the appropriate number provided below:

1	2	3	4	5
Strongly Disagree	Disagree	Moderately Agree	Agree	Strongly Agree

Please tick only one number for each statement.

Thinking of the type of supply chain agility in place at your firm, would you agree or disagree with the following statement?

SA1	We have a joined planning system with key suppliers that improving	Strongly disagree	1	2	3	4	5	Strongly agree
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	purchasing, productivity, and logistics.							
SA2	Our firm has a high level of customer service which is a priority.	Strongly disagree	1	2	3	4	5	Strongly agree
SA3	Our firm has a high level of delivery reliability which is a priority.	Strongly disagree	1	2	3	4	5	Strongly agree
SA4	Our supply chain is designed in such a way that inventory and demand levels are visible throughout the chain.	Strongly disagree	1	2	3	4	5	Strongly agree
SA5	We have a supply chain that is capable of forecasting market demand and responding to real market demand.	Strongly disagree	1	2	3	4	5	Strongly agree

SECTION F

Firm Performance

Below are statements about firm performance, you are required to indicate the extent to which you agree or disagree with the statement by ticking the appropriate number provided below:

1	2	3	4	5
Strongly Disagree	Disagree	Moderately Agree	Agree	Strongly Agree

Please tick only one number for each statement.

Looking at the type of firm performance in place at your firm, would you agree or disagree with the following statements?

FP1	Our previous year return on sales is higher compared to that of 3 years ago.	Strongly disagree	1	2	3	4	5	Strongly agree
FP2	The involvement of partners in the supply chain increases our profits beyond what could have been expected without integration.	Strongly disagree	1	2	3	4	5	Strongly agree
FP3	The involvement of partners in the supply chain increases our return on investment beyond what could have been expected without integration.	Strongly disagree	1	2	3	4	5	Strongly agree

FP4	Our return on asset has increased for the previous year compared to that of 3 years ago.	Strongly disagree	1	2	3	4	5	Strongly agree
FP5	The involvement of partners in the supply chain increase the growth in market share beyond what could have been expected without integration.	Strongly disagree	1	2	3	4	5	Strongly agree

Thank you for taking the time to complete this questionnaire, your input is highly appreciated.

**APPENDIX C:
CONFIRMATION OF PROOFREADING**

CONFIRMATION OF PROOFREADING

This serves to confirm that I have proofread this research report and made necessary corrections and emendations:

Supply chain technologies, agility and firm performance in a developing economy.


by

M.T Tlale

I have been proofreading Honours, Masters and Doctoral dissertations, research reports and theses for the past 10+ years for, *inter alia*, the following institutions: University of the Witwatersrand; GIBS; University of Cape Town; Milpark; Mancosa; University of KwaZuluNatal; University of Johannesburg; Unisa; Tshwane University of Technology; Henley Business School; .

I have also undertaken proofreading for publishers, such as Oxford University Press and Juta & Company, companies, institutions and non-governmental organisations.

I have a major in English, and excellent knowledge of Afrikaans, and can get by in French and Dutch.



Jennifer Croll

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