SUPPLY CHAIN INTEGRATION, RESILIENCE AND PERFORMANCE IN THE SOUTH AFRICAN RAIL INDUSTRY

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Dissertation submitted for the requirement for the degree

M. Tech

In the discipline of

Logistics Management

In the

FACULTY OF MANAGEMENT SCIENCES

At the

VAAL UNIVERSITY OF TECHNOLOGY

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May 2021

DECLARATION

I, the undersigned, Zodwa Bijana Maila, hereby declare that this dissertation entitled, Supply Chain Integration, Resilience and Performance in the South African Rail Industry, is my own original work. It has not been and will not be submitted or presented for any other degree, Diploma or similar title at any other institution.

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This dissertation is being submitted in fulfilment of the requirements for the degree of Magister Technologiae: Logistics Management

Signed: ……

Date: …06/08/2021……

ACKNOWLEDGEMENTS

The success of this dissertation was made possible through the support, advice, encouragement from the individuals mentioned below. I would like to offer my gratitude to the following:

- I would like to thank God for giving me the strength to complete this dissertation.
- Special thanks to my amazing mother, Miss Rachel Matsetse, for always being there and supporting me.
- To my amazing supervisor, Prof C Mafini, thank you so much for your time and patience. Your guidance is highly appreciated.
- To my Co-Supervisor, Dr JP Van Der Westhuizen, thank you for being part of my dissertation.
- To my sister and brother, Karabo and Phuti Matsetse, thank you for allowing me to be an inspiration to you two.
- To Prof Progress Hove, thank you for always uplifting me up when I felt like giving up.
- To all the companies that gave me permission to collect my data, and professionals who were keen to take part in this study, I thank you.

ABSTRACT

The rail industry in South Africa performs an important role in the transportation of goods and people. It also contributes in various ways to the socio-economic success of the country's economy. However, the industry faces various performance-related challenges in areas such as maintenance of rail lines, poor train availability and non-operation of long-distance rail service, the decline in fleet availability and accidents, most of which are linked to ineffective supply chain management. To resolve these challenges, this study proposes the implementation of supply chain integration as a method to improve the resilience and performance of the rail supply chain in South Africa. Hence, the aim of the study was to investigate the connection between supply chain integration, resilience, and performance in the rail industry.

To achieve the objectives of the study, a quantitative approach based on the positivist paradigm and deductive reasoning was followed. The sample consisted of 300 purposively selected supply chain management professionals including other departments working with supply chain, for example, the industrial department and engineering department drawn from the rail industry in Gauteng Province. The collected data were analysed using descriptive statistics, exploratory factor analysis and structural equation modelling.

The results of the study indicated significant positive relationships for the three components of supply chain integration, namely internal integration (β=0.132), supplier integration (β=0.369), customer integration (β=0.596) and supply chain resilience. Among these three independent constructs, customer integration emerged as the most significant predictor of supply chain resilience. Significant and strong positive relationships were also observed between supply chain resilience and the tangible (β=0.781) and intangible (β=0.673) dimensions of supply chain performance.

Among other things, the study recommends the training of professionals on the importance of supply chain integration, improvement of communications within the rail industry, adoption of relevant technologies and the nurturing of organisational cultures that promote both intra and inter-organisational collaboration. The study is significant in that it contributes new knowledge to the exiting literature in the South African rail industry. It also directs supply chain management research to the rail industry, which is an important economic sector and where there are many emerging issues

that require empirical attention. Practically, the study shows that if rail industries improve supply chain integration there will be benefits to the firm in the form of enhanced resilience and performance of the supply chain.

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LIST OF ABBREVIATIONS

ACRONYM	FULL ANNOTATION
AGFI	augmented goodness of fit
CFA	confirmatory factor analysis
CFI	composite fit index
CR	composite reliability
EFA	exploratory factor analysis
FMCGs	fast-moving consumer goods
GFI	goodness of fit index
GMA	Gauteng Management Agency
IFI	incremental fit index
II	internal integration
KMO	Kaiser-Meyer-Olkin
KPIs	key performance indicators
NFI	normed fit index
PRASA	Passenger Rail Agency of South Africa
RMSEA	random measure of standard error approximation
RSR	Rail Safety Regulator
SCI	supply chain integration
SCP	supply chain performance
SCR	supply chain resilience

SEM	structural equation modelling
SMEs	small and medium enterprises
SMS	safety management system
SPSS	Statistical Package for Social Sciences
TD	tangible dimension
TLI	Tucker-Lewis index

CHAPTER 1: OVERVIEW OF THE STUDY

1.1 INTRODUCTION AND BACKGROUND

South Africa has an extensive rail network, which is the 14th longest in the world, and connects to the sub-Saharan region network (Mathabatha, 2015:18). The country's rail infrastructure accounts for about 80% of Africa's total and connects the ports with the rest of South Africa. The South African government has made enhancing the country's rail network a top priority, which was aimed at increasing freight rail volumes and market share of rail container traffic (Mathabatha, 2015:18). The Department of Public Enterprises manages the rail network through Transnet. Transnet itself is the largest railroad and heavy haulier firm in Southern Africa. It has a rail network of about 21 000 km, of which 1 500 km are heavy lines and 8 200 km are electrified (South African Transport, 2014:1). According to Transport Statistics South Africa (2013:1), the railway industry plays a very important role in society, as proven in the statistics in that the total income from services for rail freight in 2013 was R30, 6 billion, and that the largest income from services by type of freight was: for coal R121, 1 billion or 39,6%; for mineral products R7, 1 billion or 23, 2%; and mineral products/ore R5,3 billion or 17,2%. The total income from services for railway freight represented an increase of 15,6% per annum over the value of R19,8 billion reported (Transport Stats South Africa, 2013:1). According to Statistics South Africa (2017:4), although the number of passenger journeys decreased by 7,2% in January 2017 compared with January 2016, the corresponding income increased by 3,5% over the same period (Statistics South Africa, 2017:4).

Rail operators are expected to operate more efficiently, maintain safety and service quality, meet the ever-demanding passenger needs and achieve more with shoestring budgets (Mathabatha, 2015:8). The competitive position of rail transport in the transport system is influenced by factors such as rail transport costs and quality of rail services (Brussels, 2014:42). Transport costs may affect efficiency and productivity improvements; for example, passing lowered operating costs to transport users can increase the attractiveness of the transport mode again and be used to enhance technologies and invest in rolling stock and the quality of rail transport services, which are also affected by various factors such as journey time, reliability, frequency, flexibility and customer information (Brussels, 2014:42). According to Havenga and De Bod (2010:91), South Africa's

development challenges remain a priority. For the region to achieve a 7% GDP growth rate required for a reduction in poverty, infrastructure investment has to be twice the amount invested in it. It is imperative for freight transport to be reliable, efficient and effective.

The pioneering research of supply chain integration and supply chain performance comprise an important point of the study, leading to an open mind for a new generation of researchers and practitioners to conduct current research today. Supply chain integration can be considered as one of the most important concepts of supply chain management and has become the most popular concept discussed by researchers and practitioners from diverse fields of management; for example logistics, information systems, operations and organisational behaviour (Ganbold, 2015:1). Supply chain integration is a key factor in achieving a firm's competitive advantage, and it is often believed that the higher the level, the better for the firm's supply chain performance. Organisations should integrate their supply chains to achieve positive supply chain performance. According to Annan, Boso and Mensah (2016:2), supply chain integration increased the flexibility of railway operation. For example, effective supply chain integration can give management operational flexibility to respond rapidly to external events (Annan et al., 2016:2). Integrated supply chains can lead to higher profits because in a well-integrated supply chain, it's easier for firms to maintain and even increase their revenue, resulting in higher profit margins (Annan et al., 2016:2). Many authors have conducted research on supply chain integration but no research has been done on supply chain integration, resilience and performance in the South African railway industry.

1.2 PROBLEM STATEMENT

The South African rail industry faces some challenges that negatively affect its performance. Kruger and Luke (2015:2) observed that within the commuter train industry, there had been a decline in the number of passengers on commuter trains and buses in favour of minibuses and cars. Also documented is that there has been irregular expenditures at the Passenger Rail Agency of South Africa (PRASA), leading to poor performance of the entire rail industry. Within both the freight rail and commuter rail industries, issues of note include delays in transporting both commuters and freight as a result of general disruptions to the flow of the rail transport system in the country (Chimusoro, Fourie, Twala & Tshabalala, 2017:2). The disruptions have been linked to maintenance issues, accidents, derailments and budgetary adequacies. However, the effects of these have been felt by the commuters, which include school children, the working class and the

public (Chimusoro *et al.*, 2017:2). In the case of commuters, some disgruntled commuters have resorted to the torching of trains in protest at the current levels of service delivery (Kruger & Luke, 2015:2). In the case of the delays in freight, where possible, some firms have resorted to the use of road transportation, which has become more efficient than the railway system, which has led to the loss of customers for the rail industry. For example, many firms have resorted to using heavy-duty trucks for transporting coal, which was previously dominated by the rail industry (Mathu, 2011:504).

Challenges facing the rail industry in South Africa include on-time performance, arrivals and departures, safety and asset utilisation (Mathabatha, 2015:8). Lack of effective maintenance engineering performance, which can result in endangering personal equipment, loss of production or service output, high repair costs (spare parts and materials), excessive machine breakdown, poor utilisation of maintenance staff, low service quality and shortened lifespan of assets are all issues experienced by the industry (Chimusoro et al., 2017:2). This study suggests that to counter the prevailing challenges, it may be necessary for the rail industry to integrate its supply chain, which can result in various benefits necessary to reverse the current situation. Hence, the study examined how supply chain integration can be harnessed to improve the supply chain within the rail industry in South Africa.

There is evidence of several studies in the South African rail industry that looked at various supply chain management-related issues. The first, conducted by Maluleke (2013:1), focused on instilling a safety culture in the passenger rail transport industry within South Africa. The second, conducted by Havenga, Simpson and De Bod (2014:1), examined how various reforms were implemented to improve the ability of the South African rail industry to transport freight effectively. The third, conducted by Kruger and Pisa (2017:1), focused on competitiveness and sustainability in the rail industry. The fourth, conducted by Chimusoro, Fourie, Twala and Tshabalala (2017:2; 2017:1) focused on the impact of supply chain management in the operations of a passenger rail transport system. However, none of these previous studies assessed the role of supply chain integration in improving the performance of the rail industry. Hence, this study is intended to provide some information for filling this gap. The study is important because supply chain management

managers and professionals in the rail industry can use the results to resolve performance-related challenges in their firms.

1.3 OBJECTIVES OF THE STUDY

The section below discusses the objectives of this study, namely the primary objective, theoretical objectives and empirical objectives.

1.3.1. Primary objective

The primary objective of the study was to investigate the relationship between supply chain integration, resilience and performance in the South African rail industry.

1.3.2. Theoretical objectives

Theoretical objectives were based on the literature review, and objectives formulated for this study were as follows:

- To review the literature on the rail industry in South Africa;
- To conduct a literature review on supply chain integration and its sub-dimensions, namely internal, supplier and customer integration;
- To analyse literature on supply chain resilience;
- To explore literature on supply chain performance and its sub-dimensions, namely the tangible and intangible dimensions; and
- To review literature on stakeholder theory.

1.3.3. Empirical objectives

Empirical objectives are based on the relationship between research variables that this study measured. The following empirical objectives were set for the study:

- To examine the level of supply chain integration, supply chain resilience and supply chain performance in the South African rail industry;
- To analyse the influence of supply chain integration on supply chain resilience in the South African rail industry; and
- To determine the influence of supply chain resilience on supply chain performance in the South African rail industry.

1.4 THE CONCEPTUAL MODEL

The study was based on the conceptual model indicated in Figure 1, which shows that supply chain integration was the predictor variable in this study and was represented by its three dimensions: supplier integration, internal integration and customer integration. The mediating variable was supply chain resilience. The outcome variable in this study was supply chain performance, which had two dimensions, the tangible and intangible dimension.

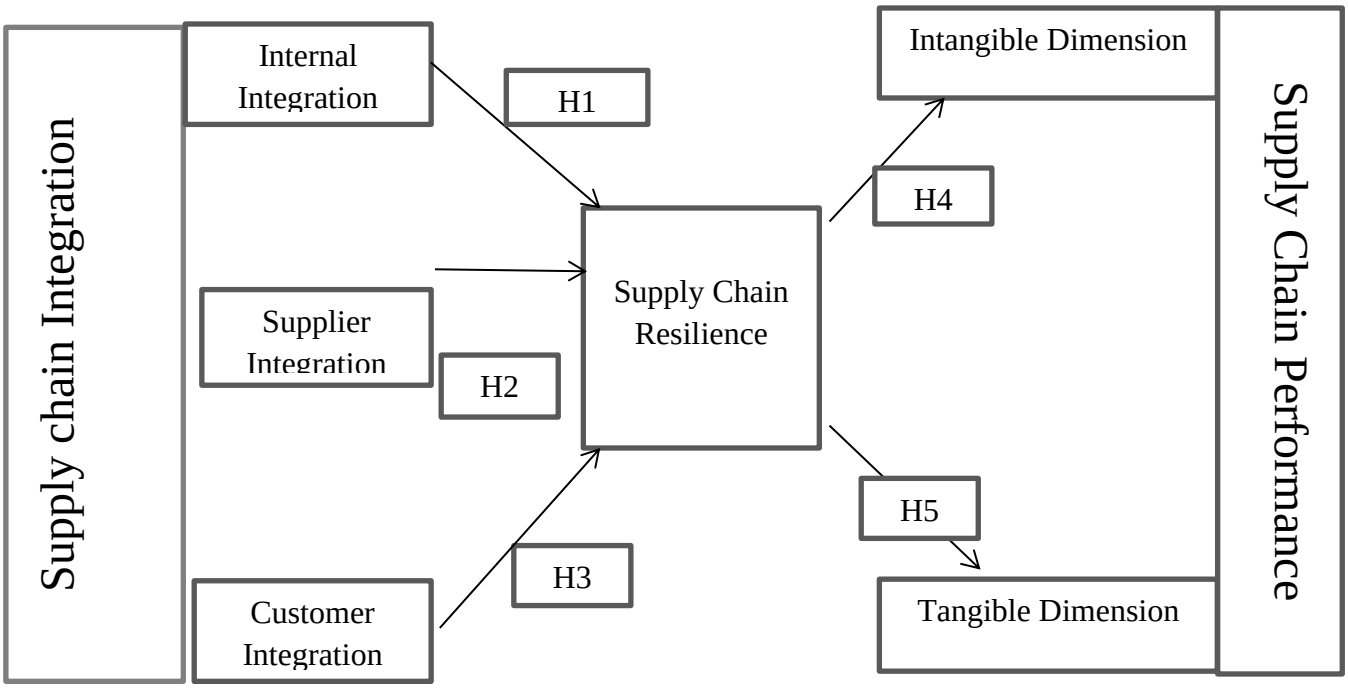

Figure 1.1: Conceptual model

1.5 RESEARCH HYPOTHESES

Based on the conceptual model, the following hypotheses are stated:

H1: Internal integration positively and significantly influences supply chain resilience.

H2: Supplier integration positively and significantly influences supply chain resilience.

H3: Customer integration positively and significantly influences supply chain resilience.

H4: Supply chain resilience positively and significantly influences the intangible dimension of supply chain performance.

H5: Supply chain resilience positively and significantly influences the tangible dimension of supply chain performance.

1.6 ABBREVIATED LITERATURE REVIEW

This section presents summary of the literature reviewed for this study. It covers the research theory, supply chain integration, supply chain resilience, and supply chain performance. A more detailed review of literature is provided in Chapters 2 and 3 of this dissertation.

1.6.1 Research theory

The research theory used in this study was the stakeholder theory, which suggests the sole purpose of a firm is to maximise economic value for shareholders (Argandona, 2011:10). It introduces value creation for all stakeholders which broadens the framework of management of an organisation by bringing it closer to a more realistic economic optimum, for example, by generating new cooperative value creation capabilities and overcoming some conflicts (Argandona, 2011:10). The objective of the stakeholder theory is to understand how managers deal with stakeholders, for example, in terms of how they represent their interests and the impact of these stakeholders in the achievements of various corporate goals (Miles, 2012:285). The stakeholder theory was used in this study because supply chain integration is about collaborating with various stakeholders such as the departments within the organisation, suppliers and customers.

1.6.2 Supply chain integration

Supply chain integration is expounded as the degree to which a manufacturer works together with its supply chain partners and collaboratively manages intra- and inter-organisational processes to achieve effective and efficient flows of products and services to provide the best service to the customer (Flynn & Huo, 2010:58). Tyagi and Agarwal (2014:284) added that supply chain integration includes activities from procurement, purchasing, inventory control, production scheduling, material management, and facility location and information technology by coordinating between suppliers, manufacturers, retailers and end users. Flynn and Huo (2010:59)

conceptualised and identified three reflective dimensions of supply chain integration, namely customer, supplier, and internal integration. They argued that a comprehensive understanding of supply chain integration involves both internal and external integration, which is the basis for their three dimensions.

Internal integration can be defined as the strategic system of cross functioning and collective responsibility across departments whereby collaboration across procurement, production and distribution functions takes place to meet customer requirements at a low-cost (Flynn & Huo, 2010:58). However, internal integration was further argued to break down functional barriers and facilitate the sharing of real-time information across various departments (Wong & Boonitt, 2011: 604). Supplier integration involves a collaboration between a focal firm and its suppliers in managing and controlling business processes, including information sharing, strategic partnership and collaboration in planning (Lai, Cheng & Tang, 2010:6). Customer integration enables a deeper understanding of market expectations and opportunities, which contributes to a more accurate and quicker response to customer needs and requirements by matching supply with customer demand (Wong & Boonitt, 2011:604).

1.6.3 Supply chain resilience

Supply chain resilience (SCR) is described as the supply chain's ability to be prepared for unexpected risk events by responding to and quickly recovering from potential disruptions and returning to its original situation, or to grow by moving to a new or better state to increase customer satisfaction (Abushaikha, 2014:44). SCR describes how organisations deal with disruptions. Abushaikha (2014:44) added that supply chain resilience can be described as the ability of the supply chain to respond and recover from unexpected disruption. The word 'recovers' indicates that sometimes supply chain resilience deals with events that could not always be prevented. However, supply chain resilience provides opportunities in case the firm's competitors are impacted, in that the firm that recovers first could potentially grow its market share (Abushaikha, 2014:44). Hohenstein, Feisel, Hartmann and Giunipero (2015:90) argued that SCR leads to an improved position compared to the positions of the firm's competitors. Organisations that excel in supply chain resilience are better and potentially quicker to return to the desired state.

1.6.4 Supply chain performance

Supply chain performance (SCP) can be defined as the ability of the supply chain to provide goods and services of the appropriate quality in the right quantities and at the right time and place and by also minimising the total costs of goods and services to the final customer in the supply chain (Zhang & Huo, 2013:544; Whitten, Green & Zelbst, 2012:28). Wu, Choi and Rungtusanatham (2010:115) described SCP as the ability of a supplier to deliver the right goods and services to the buyer or retailer with the right quality and quantity at the right place and time at the lowest possible cost. This definition highlights the time of delivery, cost and value for the end customer (Zhang & Huo, 2013:544). According to Chang, Tsai and Hsu (2013:40), there are two dimensions of supply chain performance, which are the intangible and the tangible dimensions. The intangible dimension refers to the capacity utilisation of the organisation, which are those services of the organisation that are not physical and so cannot be touched. The tangible dimension refers to the physical resources of the organisation, such as the appearance of physical facilities, equipment, personnel and communication materials.

1.7 RESEARCH METHODOLOGY

This study defines research methodology as a systematic way to solve a problem, a science of studying how research is carried out or the study methods by which knowledge is gained (Cresswell, 2014:13). Research methodology, therefore, assists in understanding the process of giving it a scientific merit. In this study, research methodology pertains to elements that include research design, research approach, sampling design, method of data collection, measurement instruments, data analysis techniques, validity and reliability and research ethics.

1.7.1 Research design

A research design is viewed as a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings (Burns & Grove, 2010:17). Polit and Beck (2012: 802) defined research design as the researcher's overall plan for answering the question or testing the research hypothesis. For this study, a survey research design was used, whereby a research questionnaire was used to collect the data from respondents.

1.7.2 Research approach

This study defines a research approach as a strategy which moves from underlying assumptions of the research design and data collection (Myers, 2010:64). Approaches used in research include:

quantitative, qualitative, and mixed method approaches. In this study, the quantitative approach was adopted. A quantitative approach involves using numbers and measurements to help formulate and test ideas or hypotheses (Baden & Major, 2013:525). Through the quantitative data collected, the study tested the relationships that exist between different variables, namely supply chain integration, internal integration, customer integration, supplier integration, supply chain resilience and supply chain performance.

1.8 LITERATURE REVIEW

For this research, a variety of literature was reviewed, including material from journal articles, completed theses and dissertations and other online sources. Seven variables are discussed, namely supply chain integration, supplier integration, internal integration, customer integration, supply chain resilience, and supply chain performance. From this, an understanding was developed of the concepts involved in the study and their influence on each other.

1.9 SAMPLING DESIGN

A sampling design is the provision of a plan for quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population (Creswell, 2014:145). A sampling design includes the target population, sampling frame, sample size and sampling method.

1.9.1 Target population

A target population is a specific group of people or objects that can be questioned, or observations can be made to develop required data structures and information (Quinlan, 2011:47). A target population includes individuals, groups, organisations, documents and companies (Quinlan, 2011:47). In this study, the target population consisted of supply chain management managers and professionals working in the rail industry of South Africa.

1.9.2 Sample frame

A sampling frame is a complete list of all the eligible sampling elements from which a sample will be drawn (Yin,2014:109). There was no sample frame used in this study, given the inaccessibility of the HR lists with the names of supply chain management managers and professional employees in the rail industry.

1.9.3 Sample size

Sample size refers to how many respondents should be included in the study, which is an important consideration for researchers as it affects the quality and generalisation of the data (Erdis 2011:117). In other words, the sample size is the number of respondents included in an investigation. In this study, the sample size was set at n=500 respondents. This sample size was consistent with the suggestion by Tabachnick and Fidel (2007:613) that the sample size when using structural equation modelling (SEM) should be greater than 300 elements, the number that is considered 'comfortable'.

1.9.4 Sampling method

A sampling method is a process of selecting participants from the population, which fall into two categories: probability and non-probability samples (Mcleod, 2014:1). This study focused on non-probability sampling, which is defined as samples in which members of the population do not have equal chances (probability) of being selected into the sample (Churchill, Brown & Suter, 2010:333). The convenience sampling technique, in which only those sampling elements that are easily accessible to the researcher, was used. This method was appropriate since there was no sampling frame.

1.10 METHOD OF DATA COLLECTION AND MEASUREMENT INSTRUMENTS

In this study, data was collected using a survey questionnaire. It was divided into five sections. Section A elicited participants' background information. Section B elicited information on supply chain integration, using questions adapted from Chang et al., (2013:39). Section C elicited information on internal integration, using questions adapted from studies conducted by Flynn and Huo (2010:58). Section D focused on customer integration, using questions adapted from Annan, Boso and Mensah (2016:9). Section E focused on supplier integration, using questions adapted from a previous study conducted by Ayoub, Abdallah and Suifan (2017:11). Section F focused on SCR, using questions adapted from Abushaikha (2014:44). Section G focused on supply chain performance, using questions adapted from Chang et al., (2013:39). Section I focused on the intangible and tangible. The questions in this section were adapted from Whitten *et al.* (2012:11) and Chang et al., (2013:39). Response options in Sections B to G were in five-point Likert-type

scale arranged as follows: Scale: 1 = strongly disagree, 2 = disagree, 3 = moderately agree, 4 = agree and 5 = strongly agree.

1.11 DATA ANALYSIS APPROACH

Data was collected then imported to the Statistical Package for Social Sciences (SPSS) Statistics and Analysis of Moment Structures (AMOS 25.0) Statistical software. This software allowed the researcher to systematically apply logical techniques to describe and illustrate, condense and recap and evaluate data (Jandagh & Matin, 2010:67). The use of this software helped the researcher make the research work more scientific and reliable as some different statistical techniques such as the confirmatory factor analysis (CFA) and SEM were applied to the study. The CFA is a type of SEM that deals specifically with measurement models that are the relationships between observed measures or indicators (Brown & Moore, 2013:2). The CFA provided evidence that all items were properly aligned with the correct latent variables within the general construct being measured (Holtzman, 2014:1651). During the CFA, the model fit was assessed. The indicators for checking model fit were included in Chi-square/degrees of freedom, goodness of fit index (GFI), augmented goodness of fit index (AGFI), normed fit index (NFI), incremental fit index (IFI), Tucker-Lewis index (TLI), composite fit index (CFI) and the random measure of standard error approximation (RMSEA) to assess the model fit.

Hypotheses developed for the study were tested using the SEM approach, the path analysis technique. Path analysis was an extension of multiple regression in that it involved various multiple regression models or equations that were estimated simultaneously (Lei & Wu, 2010:34). This provided a more effective and direct way of modelling mediation, indirect effects and other complex relations among variables. Path analysis was considered a special case of SEM in which structural relations among observed variables were modelled.

1.12 RELIABILITY AND VALIDITY OF MEASUREMENT SCALES

Reliability was defined as the extent to which a measurement instrument is repeatable and consistent (Maree, 2010:215). In other words, through reliability, any measurement procedure produces the same results on repeated trials. In this study, scale reliability was assessed using the Cronbach alpha and the composite reliability indices. A minimum cut off at the value of 0.7 was applied each time these indices were used (Tavakol & Dennick, 2011:53).

Validity is often defined as the extent to which an instrument measures what it is supposed to measure. Validity requires that an instrument is reliable, but an instrument may be reliable without being valid (Taherdoost, 2016:12). Convergent validity was examined by item loadings, which included standardised regression weights (Minimum=0.5) and the average variance extracted (minimum =0.4) (Kubai, 2019:2). Kimberlin and Winterstein (2008:2278) further added that discriminant validity would be established through interactor correlation between the research constructs and by comparing the average variance extracted (AVE) and shared variance.

1.13 ETHICAL CONSIDERATIONS

Ethics refers to the branch of philosophy that deals with how people ought to live, with the idea of good and with the concepts such as wrong and right (Fieser & Pojman, 2012:1). In other words, ethics were principles and guidelines that clarified the conditions under which the research was conducted (Oates, Kwiatkowski & Coulthard, 2010:4). The following ethics issues that were important for this study were adhered to:

- Participation in the study was voluntary, and all participants signed an informed consent form before they participated in the study.
- The privacy of the respondents was respected, and personal information from the respondents was not ascribed to any individual.
- The questionnaires did not contain the names of the respondents. The anonymity of the respondents was maintained throughout this study.

1.14 OUTLINE OF THE DISSERTATION

The chapters in this dissertation are divided as follows:

Chapter 1: Overview of the study

The whole overview of the study is covered in this chapter. The problem statement of the study, its purpose, research objectives, hypothesis and background, are highlighted. The research methodology of the study is also briefed.

Chapter 2: Overview of the rail industry in South Africa

This chapter presents the literature reviewed concerning its research context by providing a background on the importance, and the role played by the rail industry in the economy of South Africa.

Chapter 3: Research constructs and hypotheses formulation

This chapter examines the theoretical and empirical review of the following variables – supply chain, internal integration, customer integration, supply chain resilience and supply chain performance. The conceptual model and hypothesis are also be outlined.

Chapter 4: Research methodology

In this chapter, the method and design of the study are discussed, including the research philosophy, approach, strategy, sampling techniques and data collection method. Data analysis and ethical considerations are covered in detail.

Chapter 5: Data analysis, presentation and interpretation of results

Data analysis, interpretations and evaluations of the research results are addressed.

Chapter 6: Conclusions, recommendations, limitations and suggestions for further research

The conclusions and recommendations of the research results are discussed in this final chapter, followed by the limitations of the study and suggestions for future research.

CHAPTER 2: OVERVIEW OF THE SOUTH AFRICAN RAIL INDUSTRY

2.1. INTRODUCTION

The first chapter of this research paper focused on the problem statement of the supply chain integration, resilience and performance in the South African rail industry. The objectives of the study were discussed, the conceptual model of the study was developed, and the literature review of the variables were discussed. The data collection method was also discussed in detail. The current chapter is a literature review of the research environment, which is the rail industry in South Africa. The chapter places emphases on subjects such as the development of the rail industry in South Africa, the relevant legislative framework, the economic contributions of the rail industry in South Africa, its challenges and previous empirical studies focusing on this sector within the country.

2.2. DEVELOPMENT OF THE RAIL INDUSTRY IN SOUTH AFRICA

The interior landscape of South Africa is generally high lying and it is largely separated from the coastline by a high mountainous escarpment (South Africa Railway, 2015:01). In the early years, the ox and horse played an important part in opening the interior, but the development that was soon to be needed to exploit the newly discovered mineral wealth called for a vastly more efficient mass transport mode. The obvious – and only – choice was rail transport. Even today, despite the development of other modern and sophisticated transportation modes, rail transport still ranks as the most efficient means of transport for the conveyance of bulk freight over medium and long distances and for mass commuter traffic (South Africa Railway, 2015:10).

By the mid-1800s the small town of Durban on the southeast coast of Africa was little more than a village with a motley collection of thatched cottages and buildings. The small settlement was situated among sand dunes and bushes, and wild animals freely roamed the surrounds. That this far-flung outpost of Queen Victoria's mighty empire would provide South Africa with its first railway is quite remarkable (South Africa Railway, 2015:1001).

After much planning, debating and quibbling, the newly formed Natal Railway Firm finally laid the rails from the Market Square in the town to the Point in the harbour area, some three kilometres away. Even though rail enterprise had been launched earlier in the Cape Colony, the Natal colonists

had made more rapid progress: a fact that gave them no small measure of pride and satisfaction. On Tuesday, 26 June 1860, Durban was lively with excitement. Dignitaries including the Acting Lieutenant-Governor, Major Williamson, and the chief clergyman Bishop Colenso, gathered in the town's Market Square to provide the necessary pomp and sense of occasion. The great moment had finally arrived: the first official train journey was about to take place on South African soil (South Africa Railway, 2015:10).

From the Leith works in Scotland, a small steam engine built by Hawthorne and Co. arrived in Cape Town harbour in September of 1859. It had been imported by Edward Pickering, and the British contractor commissioned to build a rail from Cape Town to Wellington, a distance over the mountainous terrain of just over 70 kilometres (South Africa Railway, 2015:10).

In September 1896 the Orange Free State government under President Steyn decreed that all rail within its boundaries would be taken over by the Orange Free State. Arrangements were amicably drawn up with all parties and locomotives, and rolling stock was purchased from the CGR. Thus, the Orange Free State Government Rail came into existence (South Africa Railway, 2015:10).

In 1915, South Africa took over the administration of the rail of this former German colony, but it was only in 1922 that the rail of South West Africa practically became part of the South African network. The rail network was augmented further with the takeover of the last privately-owned railway line – the New Cape Central Rail – between Worcester and Voor Bay in 1924. In 1947 South Africa was honoured by a visit of the British Royal Family, and a train was especially built for their use. The high manufacturing standards were soon passed on to other rolling stock.

The year 1960 marked one hundred years since the first public train ran between Durban and the Point, and on 31 May the Union of South Africa celebrated its centenary (South Africa Railway, 2015:01).

It was also the year that diesel locomotives were introduced on a large scale to the South African Rail. This heralded the gradual end to steam traction. In January 1963 the South African Railways took delivery of its first locally manufactured electric locomotive. The technology to achieve this feat in such a short span of time was truly astonishing. Few undertakings have done so much to stimulate the development of the local industry as the country's transport services (South Africa Railway, 2015:01).

1994 became a year whereby Transnet kept pace with fast-changing society, dealing with a multitude of challenges in an emerging democracy. Transnet dealt with these challenges by investing heavily in infrastructure and integrating and coordinating programmes within the country (South Africa Railway, 2015:01). From its humble beginnings, it was evident that the South African transport system had come a long way. Transnet played a vital role every day and also in the national economy and economics.

The need to address the underperformance of rail passenger services and the historical under investment in this sector became the reason why passenger rail entities were consolidated. The establishment of PRASA came against the background of major changes in the world and present opportunities for the railway industry to play a positive role in global development. However, it is important for the passenger rail agency of South Africa to acknowledge South Africa's strong railway tradition to use past knowledge and experiences to enable PRASA in dealing with new challenges and providing effective and efficient public transport in this country (PRASA, 2016:01).

2.3. COMPOSITION OF THE RAIL INDUSTRY IN SOUTH AFRICA

There are four companies that operate in the railway industry in South Africa. These are Metrorail, Transnet, Gibela, Prasa and Gautrain. An overview of the four mentioned companies is discussed next.

2.3.1. Metrorail

The Metro project started as a Swedish research project about infrastructure protection in mass transport underground rail and metro systems (Ingason, Kumm, Nilsson & Meyer, 2012:17). The focus was on tunnels and subway metro stations, and both fire and explosion hazards were studied. It is a multidisciplinary project where researchers and postgraduate students from nine different disciplines cooperated with practitioners with the common goal to make underground rail mass transport systems safer in the future. The main objective of METRO was to create a safer environment for passengers, personnel and first responders in the event of fire or terror attack in underground mass transport systems (Ingason et al., 2012:17). Today, Metrorail is an operator of commuter rail services in the major urban areas of South Africa. Metrorail is a division of the

Passenger Rail Agency of South Africa, a state-owned firm responsible for most passenger rail services in South Africa (Metro-rail, 2019:01).

2.*3.1.1. Objectives*

Metrorail has to ensure efficient movement of people through safe, reliable, clean, affordable rail passenger services and to develop the country's rail network in the interest of all South Africans. Its corporate values are to deliver excellent service, focus on its customers, and ensure safety and communication of its customers (Metrorail, 2011:04). Metrorail further aims to provide value through change management programmes in order to encourage staff, passengers and stakeholders to see these values as a way of life. The goal is to focus on turnaround and manage rail transport demand on behalf of the government and drive key objectives in its terms integrated, efficient, affordable and safe transport. Further, the aim is to manage assets through investments in rail infrastructure, rolling stock fleet and operations. And to operate rail transport services, provide integrated business systems, ensure efficient operations and play a key integration role in public transport (Metrorail, 2011:04). The corporate objectives of Metrorail are to boost revenue by reducing non-payment of fares and rebalance of fare structure, increase the number of passengers, invest in human capital, customer focus improvements and these objectives aims to provide commuters with reliability, convenience, speed, communication, compliance and improved efficiencies, making the most of the firm assets and strengthening corporate governance (Metrorail, 2011:04).

2.3.1.2. Division of Metrorail

The Metrorail operations division is sub-divided into five Metrorail regions. Metrorail has several governance and support functions, which enable the firm to comply with regulatory and operational safety requirements, manage train stations and network operations as well as the related logistics and benchmarking services (Metrorail, 2011:09). The Metrorail network covers more than 15% of South Africa's rail network and operates more than 470 stations. Metrorail (2011:09) highlighted that they run more than 2.2 million passenger trips every day. The business plan of Metrorail focuses on stabilisation and improvement of objectives with emphasis on stabilising the reliability of the train services by designing and implementing a preventative maintenance programme for rolling stock.

Metrorail (2011:09) highlighted that logistics and benchmarking helps to develop and drive key operational efficiency measures which include integrating train operations and rolling stock under technical operations, focusing on improvement of service delivery to address predictability and punctuality issues of train service, continuous improvement of the safety management system, improving protection services through prioritisation and sequencing of areas that will lead to improvement of service delivery (Metrorail, 2011:09).

2.3.2. Transnet

Transnet is a state-owned firm and the custodian of the country's freight railway, ports and pipelines (Transnet, 2017:03). Transnet is accountable not only to the South African Government as the sole shareholder but to society at large for the long-term sustainable value it creates for the economy, society and the environment through its day-to-day business activities. In line with the Government's National Development Plan, Transnet is required to contribute to the Government's Medium-term Strategic Framework outcomes. By balancing these developmental outcomes with building a commercially viable business (Transnet, 2017:03). Transnet aims to achieve the following:

- Contribute to economic growth through the provision of world-class infrastructure and technologies
- Expand economic infrastructure
- Create jobs
- Build a skilled and capable workforce
- Protect and enhance environmental assets and natural resources and
- Provide a better South Africa, contributing to a better Africa and a better world.

As the custodian of ports, rail and pipelines, Transnet's objective is to ensure a globally competitive freight system that enables sustained growth and diversification of the country's economy. Transnet is currently transitioning from its market demand strategy characterised by capital investment towards the Transnet 4.0 strategy, which focuses on repositioning Transnet and the country s freight system for competitiveness within the changing technology-driven context of the fourth industrial revolution. The strategy's main growth includes geographic expansion,

product and service innovation, diversification and expansion of the scope of Transnet's manufacturing business (Transnet, 2017:05).

Transnet has further highlighted that the key objective of their effort is directed towards increasing the connectivity, density and capacity of the integrated port, rail and pipeline network. Transnet stated that the 4.0 strategy aims to grow Transnet to a 100 billion business by 2020. Organic growth of the current freight transport and handling divisions will account for the bulk of this growth and Transnet will continue to focus on improving operational efficiency and reliability to grow its market share. Consequently, capital investment to modernise and expand the port, rail and pipeline network and operations will continue to be a key priority, as will continued development of our people (Transnet, 2017:05). Significant growth is being targeted from new markets, particularly in integrated logistics, the development of logistics hubs and clusters, natural gas midstream infrastructure, manufactured products and new digital businesses. Transnet will increasingly make use of strategic partnerships to drive these new ventures. Transnet has a critical role to play in furthering South Africa's strategic and economic objectives and is actively refreshing its brand as it moves into new markets, expands and diversifies its service offering, and redefines its market position (Transnet, 2017:05). Transnet operates as an integrated freight transport firm, formed around a core of five operating divisions that complement each other. These are supported by a number of firm-wide specialist units – Transnet Group Capital, Transnet Property and Transnet Foundation – which underpin the firm (Transnet, 2017:05).

2.3.2.1. Transnet's operating divisions:

- Transnet freight rail
- Transnet rail engineering
- Transnet national ports authority
- Transnet port terminals
- Transnet pipelines.

As a state-owned firm, Transnet continues to leave an indelible mark on the lives of all South Africans. With a geographical footprint that covers our entire country, Transnet is inextricably involved in all aspects of life in South Africa. As such, they ensure that they play a pivotal role in enhancing the quality of life in all areas where they operate. This extends not just to their

employees, but to communities and environments as well. Through the Transnet Foundation which is the Corporate Social Investment arm of Transnet – Transnet has invested time and money in several diverse programmes around the country that provide much-needed assistance to communities.

The national ports authority is responsible for safe and effective economic functioning of the national port system which manages in a landlord capacity. The national ports authority provides port infrastructure and marine services at the eight commercial seaports in South Africa (Transnet, 2017:06). It operates within a legislative and regulatory environment created by the National Ports Act 2005 (Act No. 12 of 2005).

The core functions of the national ports' authority are as follows:

- To plan, provide, maintain and provide port infrastructure
- To provide or arrange marine – related services
- To ensure the provision of port services, including the management of port activities and the port regulatory function at all South African ports
- To provide aid to navigation and assistance to the manoeuvring of vessels within port limits and along the coast.

Transnet further continued to explain that the National Ports Act creates a dual role for the National Ports Authority whereby they are responsible for the port regulatory function at the ports. An example of this is controlling the provision of port services through licensing or entering into agreements with port operators to ensure that efficient port services are provided.

The National Port Act also established the port regulator of South Africa who was charged with the responsibility of exercising economic regulation of the ports system in line with government's strategic objectives, which are to promote equity of access to the South African commercial seaports and the facilities and services provided by these ports. The port regulator has to monitor the activities of Transnet National Ports Authority to ensure that it performs its functions in accordance with this act (Transnet, 2017:06).

The national ports authority's service offering is targeted mainly at port users (which include terminal operators, shipping lines, chip agents, cargo owners, clearing and forwarding agents). It manages the eight commercial seaports along South Africa's 2954 km coastline. Its service

offering is divided mainly into two categories, the provision of port infrastructure and the provision of maritime services (Transnet, 2017:06).

Transnet Port Terminals was established in 2000, when Transnet's then single port division, Portnet, was divided into operations and landlord businesses, namely Transnet port terminals and National Port Authority. Since its inception, Transnet port terminals have played a key role in supporting the South African government's export-led growth strategy. Most Southern African import and export commodities were handled through South Africa's seven logistics ports, Richards Bay, Durban, Saldanha, Cape Town, Port Elizabeth, East London and Port of Ngqura. Port Terminals handle the container sector, mineral bulk, agricultural bulk and Roro sectors (Transnet, 2017:07). Port Terminal's major customers represent a broad spectrum of the economy and include the shipping industry, vehicle manufacturers, agriculture, timber and forest products, the mining industry and exporters of minerals, metals and granite.

Transnet Engineering is an engineering division of Transnet Ltd, based in South Africa, comprising a group of product-focused businesses in the assembly, upgrading conversion, repair and maintenance of railway rolling stock, as well as spares and associated transport equipment. Through its seven well-equipped, ISO certified factories and workforce of 14 500 qualified personnel, Transnet Engineering extends its railway customer portfolio to Africa and the world.

Transnet Pipelines, formerly known as Petronet, the custodian of South Africa's strategic pipeline assets, is currently servicing two key industries (fuel and gas) by transporting petroleum and gas products over varying distances (Transnet, 2017:07). The business handles an annual average throughput of some 16 billion litres of liquid fuel and more than 450 million cubic metres of gases. The liquid products include crude oil as well as diesel, leaded and unleaded petrol and aviation turbine fuels (Transnet, 2017:07).

2.3.2.2. Financial review of Transnet

Transnet (2018:08) highlighted that revenue for the period under review increased by 11,7%, R43, 7 billion (2017: R39, 1 billion). This was mainly attributable to the 3,3% increase in volumes, complemented by a fair increase in the average R/ton (R186, 75 in 2018 compared to R174, 95 in 2017). The average 6, 7% increase in R/ton was slightly higher (averaged 4,64% over the reporting

period), which was mainly attributable to the prioritisation of a high yield commodity mix (Transnet, 2018:08).

2.3.2.3. Transnet operating expenses

The year-on-year increase in operating expenses was 6,3%, with costs rising to R23 236 million (2017: R21 851 million). This was achieved despite some above inflation increases in operating expenses such as fuel and electricity. Freight Rail's general cost-containment mindset and consequent actions resulted in significant savings in discretionary spend (i.e. consultancy costs, telecommunication costs, advertising and promotion costs, periodicals and printing costs, travel, accommodation and refreshments) as well as other operating expenses (Transnet, 2018:09).

2.3.3. Gibela

Gibela was established as a consortium between Alstom, Ubumbano Rail and New Africa Rail. In a contract signed in 2013, the Passenger Rail Agency of South Africa assigned Gibela the task to replace its ageing metro fleet with a modern service − delivering 600 modern commuter passenger trains into the South African rail network over the next ten years. Fully black-empowered, Gibela is conscious of its role as a catalyst for economic development and skills development through its majority shareholder, Alstom (Gibela, 2017:01). Gibela's factory – also its corporate office – occupies a site covering more than 78 hectares at Dunnottar, Ekurhuleni, Gauteng. This factory, a cornerstone for the revitalisation of the rail manufacturing industry in South Africa's industrial heartland, is being built to the highest international standards and will be a centre of excellence in its own right.

In December 2016, Gibela was awarded a Provisional Acceptance Certificate from PRASA for its first X-Trapolis MEGA train. The train entered a trial run of off-peak service in February 2017, paving the way for the start of full commercial service with nine trains in March 2017 (Gibela, 2017:01). The firm has already delivered most of the 20 first trains being built in Brazil for testing at PRASA's depot at Wolmerton, north of Pretoria, where they are undergoing various stages of testing and commissioning ahead of the first train going into commercial service.

2.3.3.1. Employment at Gibela

Gibela currently employs 800 people, the majority of whom are artisans, technicians and engineers. A total of 229 of these employees have received intensive offshore training at Alstom's

centres of manufacturing excellence in Europe, South America, Asia and Australia to learn the latest in train manufacturing and maintenance technology. At full ramp up, the plant will employ 1 500 employees (Gibela, 2018:01).

As a critical catalyst in the rejuvenation of the local rail manufacturing industry, Gibela is cognizant that much of its economic impact will occur through the supply chain. The firm currently relies on 118 suppliers to supply critical components for its trains. For each train set built, Gibela will spend 80% of the train's procurement value suppliers (currently 71).

With a 65% local content contractual commitment, Gibela is heavily invested in sourcing components from local companies. However, over the past few decades, there was no investment in the rail industry, resulting in the loss of capacity and expertise. This is where the Gibela supplier development programme comes in to plug these gaps and bolster the skills of budding South African suppliers. So far, thousands of hours of offshore industrial expertise have been spent on developing local suppliers.

The firm's impact extends beyond the boundaries of its factory, most immediately to its nearby communities. Gibela's community initiatives focus on education – from early childhood development to providing maths and science classes to over 500 pupils from local schools. To build skills across South Africa, Gibela has awarded 650 bursaries to the value of R48 million and hosted 300 students at its Rail Introduction Course to give them exposure to the rail industry (Gibela, 2018:01).

2.3.4. Passenger rail agency of South Africa (PRASA)

PRASA was established in terms of Section 22 of the legal succession to the South African Transport Services Act of 1989 as amended in 2001 (Passenger Rail Agency of South Africa, 2015:03). It is a public entity wholly owned by Government and reports to the Minister of Transport. The legal mandate directs PRASA to deliver commuter rail services in the Metropolitan areas of South Africa, long-distance (inter-city) rail and bus services within, to and from the borders of the Republic of South Africa. This mandate is implemented in consultation with and under the guidance of the Minister of Transport (Prasa, 2015:03).

The main objective and the main business of the agency are to ensure that, at the request of the Department of Transport, rail commuter services are provided within, to and from the Republic in the public interest; and to provide, in consultation with the Department of Transport, for long haul

passenger rail and bus services within, to and from the Republic in terms of the principles set out in section 4 of the National Land Transport Transition Act, 2000 (Act No. 22 of 2000) (Prasa, 2015:03). The second objective and secondary business of PRASA are that the entity shall generate income from the exploitation of assets acquired by it. PRASA shall have due regard to key government social, economic and transport policy objectives (Prasa, 2015:03).

2.3.4.1. Operating principles of PRASA

PRASA contributes to sustainable public transport solutions by providing high-quality passenger services founded on an integrated network of mobility routes. PRASA shall provide quality rail, bus and property management services that enable individuals and communities to access socio-economic opportunities and contribute to a better quality of life of people (Prasa, 2015:03).

2.3.4.2. Operating environment of PRASA

PRASA – a public entity reporting to the Minister of Transport, derives its mandate from the legal succession of the South African Transport Services (Prasa, 2015:07). The main objective and the main business of the agency are to ensure that, at the request of the Department of Transport, rail commuters are provided within, to and from the republic in the public interest. The second objective is for PRASA to generate income from the exploitation of assets acquired by it. Other legislation of the PRASA may include the National Land Transport Act (Act 5 of 2009) as government policy driver and the public transport strategy and Green Paper on rail transportation; also the Labour Relations Act, Employment Equity Act and Conditions of Employment Act. The National Development Plan as the platform for 2014/15- 2016/17 platform (Prasa, 2015:07) – assumes that by 2030 investments in the transport sector will bridge geographic distances, foster reliability and safety so that all South Africans can access previously inaccessible economic opportunities, social spaces and services. The plan also needs to support economic development by allowing the transport of goods from points of production to where they are concerned. Further, it needs to promote a low-carbon economy by offering transport alternatives that minimise environmental harm (Prasa, 2015:09).

PRASA mentioned that due to the suffering caused by the economic recession, the effect of quantitative easing by the United States Federal Reserve Bank might limit foreign direct investment in rand. PRASA further mentioned that the growth of the South African economy will

be expected to be slow down, further compounded by the electricity crisis. The inflationary impact is caused by increases in administered prices (electricity, toll roads, fuel levy etc.).

2.3.4.3. Economic development by PRASA

PRASA has quantified massive economic development benefits. The local manufacture of new trains will see the skilling of approximately 19527 individuals over the next 10 years (Prasa, 2015:20). This includes the development of artisans, engineers, train drivers, designers and technicians as well as the creation of 8 088 jobs over the next coming 10 years. PRASA stated that the Broad Based Black Economic Empowerment spend on skills development would amount to R 923 million throughout the modernisation programme, while several initiatives were identified and agreed upon between the Board and Executive (Prasa, 2015:20).

The strategy supporting the key deliverables on the corporate plan set to grow market share at 3% by the year 2018 with passenger numbers growing up to 574 million passengers. The acquisition of new locomotives and the commissioning of 48 refurbished locomotives planned to see long distance passenger service increasing its passengers to 1.1 million and a rating of at least 72% passenger satisfaction (Prasa, 2015:21).

2.3.4.4. Financial overview of PRASA

In previous years, Prasa forecasted a shortfall of R587 m and budgeted a shortfall of over R1 billion for 2015/16 financial year. It had a shortfall of R336 million for 2012/13 and 2013/14. The shortfall was a result of motorail services being underfunded, especially with mainline passenger services not being funded (Prasa, 2015:23).

Prasa has three main sources of revenue – fare revenue, rental income and government subsidy (2015:24). The metro fare revenue was expected to grow by 13% in the 2015/16 financial year. The increase was mainly driven by an increase in passenger trips and improvement in fare collection by reducing fare evasion. Rental income is currently a small part of the total revenue of PRASA and shows a high increase year by year. However, it was expected to grow by an average of 24% a year to R976 million in year 2017/18. This increase is mainly from rentals due to modernisation and commercialisation of the station and new income streams. Government subsidy

has been increased over the years by an average of 4.5% which was always less than the inflation rate and was expected to be R12.8 billion (Prasa, 2015:24).

2.3.5. Gautrain

The Gauteng Management Agency (GMA) was established in 2006, in terms of the GMA Act (Act 5 of 2006). The vision of GMA is to provide an innovative, integrated and efficient public transport system that promotes sustainable socio- economic growth in Gauteng (Gautrain, 2018:01).

The main objectives of the GMA are to manage, co-ordinate and oversee the Gautrain project, to achieve this the GMA must enhance the integration of the Gautrain with other transport services and public plans. In relation to the Gautrain, the GMA must maximise the Socio-Economic Development and Broad Based Black Economic Empowerment. Further, GMA has to make sure that the policy and legislative environment of the Gautrain project are monitored (Gautrain, 2018:01).

The GMA Board is the foundation of the GMA's corporate governance systems and is accountable and responsible for the GMA s performance. The day-to-day management of the Agency includes independent adjudications and internal auditors to ensure good governance. And other functions in the structure are finance, technical, legal services, communication, marketing, information, communication technology and corporate services (Gautrain, 2018:01).

2.3.5.1 Economic development

The Gauteng project plays a very important role in South Africa by creating job opportunities, providing good quality and service delivery, ensuring good governance, and ensuring development and investment in black economic empowerment (Gautrain, 2018:01). According to Gautrain (2018:02), 34 000 direct jobs were created during the construction of the Gautrain and about 87 000 indirect jobs for each year of Gautrain's operations resulted in R1.7 billion being added to the Provincial economy and R10 billion retail property development close to Gautrain stations.

2.3.5.2 Major achievements

The development period of the Gautrain system stretched from September 2006 until June 2012 (Gautrain, 2013:09). During this period contributions were made towards socio-economic development in Gauteng.

2.3.5.3. Black equity participation

Twenty-five percent committed shares were held in the concession firm during the development phase, 10% committed shares in the civil contractor, electrical and mechanical contractor were held by the Turnkey contractor and the operator (Gautrain, 2013:09).

2.3.5.4. Procurement and sub-contracting

About 390 BEs have benefited from the project to date. R5 450 million was procured from or subcontracted to BEs compared to an obligation of around R2630 million. R2 780 was procured from and subcontracted to new BEs, compared to an obligation of about R1 390 million. R1 420 was procured from, or sub-contracted to small, medium and micro enterprises compared to an obligation of about R330 million (Gautrain, 2013:09).

2.4. LEGISLATIVE FRAMEWORK FOR THE RAIL INDUSTRY IN SOUTH AFRICA

This section discusses the legislative framework for the rail industry in South Africa. The rail environment in South Africa is best described as monopolistic competition (Mashoko & Shivambu, 2011:10). The former South African Rail and Harbours, which later became Transnet Freight Rail was and still is the only role player. Transnet was able to develop regulations and standards to manage their operations (National Rail Policy, 2017:50). The Railway Safety Regulator was established in 2002, and has been in operation since 2005, promoting and regulating safety in the railway environment Mashoko and Shivambu (2011:10).

2.4.1 The Railway Safety Regulator Act of 2002

The primary set of legislation for safety regulations is the National Rail Safety Regulator Act, 2002 (Act No. 16 of 2002). This Act has been amended twice, once in 2007 by the Transport Agencies General Laws Amendment Act, 2007 (Act No. 42 of 2007), and once in 2008, by the National Rail Safety Regulator Amendment Act, No. 69 of 2008. In essence, the National Rail Safety Regulator Amendment Act is permission based, meaning that the persons who are subject to its jurisdiction are not allowed to undertake activities unless they obtain rail safety permits to this effect (Mashoko & Shivambu, 2011:242).

Further, Mashoko and Shivambu (2011:243) explained that the Act is reasonably modern because it was only published in 2002 with amendments as recent as 2008. However, operators are

primarily responsible for railway safety and the Rail Safety Regulator Act is mainly responsible for regulatory oversight. The Rail Safety Regulator Act, 2002, empowers the Rail Safety Regulator with regulatory tools that ensure that the regulator is able to deliver on its mandate. These regulatory tools include the following:

- Safety permits
- Safety management system
- Standards, regulations and guidelines.

These regulatory tools are described in brief in the next section.

2.4.2 Safety management system

Rail operators in South Africa are required to develop and implement a National Rail Safety Regulator Act in order to comply with the National Rail Safety Regulator Act, 2002. To manage safety in a more structured and formalised way and to be issued with an operator permit, operators are duly required to have a fully documented and implemented safety management system (National Rail Policy, 2017:50). The content of the safety management system (SMS) is directly proportional to the size and complexity of railway operations, which in turn determines the risks to be managed (Mashoko & Shivambu, 2011:246).

2.4.3 Rail safety permits

The Act requires all rail operators to apply for a safety permit from the Rail Safety Regulator (RSR), prior to engaging in any railway operation including the construction phase. This is a requirement for all operators involved with the operation of any railway within the Republic with a track gauge of 600 mm or more. The safety permit is issued once the RSR has satisfied itself that the operators have a sound SMS in place. The safety permits are classified into Class A (High risk) and Class B (lower risk). This classification allows for the reduction of the administrative burden placed on smaller operators (Mashoko & Shivambu, 2011:246).

2.4.4 Occurrence reporting and investigation

An operator must report to the Rail Safety Regulator Chief Executive Officer the category and type of all rail occurrences, in the manner and form prescribed by the Minister. An operator is expected to investigate every rail occurrence that takes place directly or indirectly in connection

with that operator's railway operations (National Rail Policy, 2017:50). The operator should identify the root cause or causes thereof, within a reasonable time after that occurrence and must, upon request, furnish any occurrence investigation report to the RSR. The RSR may also on its own accord, or upon receipt of a directive from the Minister, be obliged to investigate any railway occurrence to prevent similar occurrences in the future (Mashoko & Shivambu, 2011:246).

2.4.5 Standards, regulations and guidelines

The RSR is empowered to fulfil a broad range of regulatory functions built around the safety permit system, including developing of standards and regulations (or adopting those set by other bodies). These regulatory tools are important in ensuring that the RSR delivers on its mandate (Mashoko & Shivambu, 2011:246).

2.4.6. Conducts inspections and audits

The Rail Safety Regulator (2015:03) is mandated to play a safety role in the rail industry. This law conducts safety-related audits and inspections of operators in the rail industry.

2.4.7. Development of regulations, safety standards and regulatory prescripts

According to Sections 29, 30 and 50 of the acts, the Rail Safety Regulator is mandated to develop regulations and safety standards and related regulatory prescriptions (Railway Safety Regulator, 2015:03).

2.4.8. Supports and promotes occupational health, safety and security

This law addresses occupational health and safety and security issues that impact the rail safety. The occupational health and safety legal requirements are included in the management of the human factor (Railway Safety Regulator, 2015:03).

2.4.9. Issues notices of non-conformance and non-compliance

Operators are issued with such notices to indicate conditions within operators' systems that are deemed to be substandard or not in compliance with regulatory prescriptions that insure safe rail operations. They are penalties for noncompliance with the act and safety standards (Railway Safety Regulator, 2015:03).

2.5. ECONOMIC CONTRIBUTION OF THE RAIL INDUSTRY IN SOUTH AFRICA

The rail industry contributes to the economy of South Africa in different ways. This section discusses some of these contributions, namely transportation, skills development and employment.

2.5.1. Transportation of goods and people

South Africa's population growth average is 1.3% a year while its gross domestic product growth is under 4% a year (Borralho, 2013:50). However, rail corridor traffic has declined by 20% over the past 15 years because people and businesses are opting to use road transport instead of rail transport. As a result, the road corridor traffic has doubled, now comprising 89% of freight volume with only 11% for rail (Borralho, 2013:50).

2.5.2. Skills development

Local manufacture of new trains will see the skilling of approximately 19527 individuals over the next 10 years. This includes the development of artisans, engineers, train drivers, designers and technicians as well as the creation of 8 088 jobs over the next coming 10 years (Passenger Rail Agency of South Africa, 2015:20).

2.5.3. Employment

Passenger rail is primarily operated by the PRASA, which employed 15,000 people in the year to March 2011 (Cohen, Barrett & Kane, 2013:02). PRASA carried 472 million commuter passenger trips and 1.6 million long-distance passenger trips in that year (Passenger Rail Agency, 2011). These figures include passenger rail agency-owned long-distance bus services. Satwu has estimated that 50,000 people are employed to provide passenger bus services and that about 9% of commuters use bus services (DoT, 2005; Cohen *et al.*, 2013:02). Transnet Freight Rail employed 24,000 people in their financial year ending March 2011 (Transnet, 2011:12). In 2018, Transnet employed 26 694 permanent employees (Transnet, 2018:07).

2.5.4. Promote and upskill employees

Part of the economic contribution is to embed the productivity 2020 programme for improved employee productivity, utilisation and efficiency (Transnet, 2018:12). The following need to take place:

Develop and implement an operational performance framework to drive productive operational behaviour; implement the time and attendance system and development skills, leadership capabilities through apprentice rail operations management, customer service and coaching of mentorships programmes; and promote the development of skills and competencies in the infrastructure environment through the Engineer-in-Training, Technician-in-Training and Engineering Empowerment programmes Transnet (2018:12).

2.6. CHALLENGES FACING THE RAIL INDUSTRY IN SOUTH AFRICA

Transportation can be seen as an integral part of the development of any country. Against the backdrop of rapid urbanisation and lack of resources, African countries face an uphill battle to find viable transport solutions to tackle some general challenges. According to Maparu and Mazumder, (2017:319), a modern transport system aspires to be an environmentally sustainable network that is integrated, safe, reliable, affordable and intermodal. A system like this facilitates the efficient movement of goods, people and services, thus improving a city's competitiveness as a destination for investment. It also acts as a medium that connects citizens to employment and other economic opportunities (Maparu & Mazumder, 2017:319).

2.6.1 Maintenance of rail lines

Several challenges are facing the rail industry which include the maintenance of the railway lines, service delivery which is below customer expectations and has contributed to the business community preferring road transport to rail because of the need for flexibility and on time deliveries (Borralho, 2013:50).

2.6.2 Accidents

The existing issue of accidents is caused by more trucks on the roads (Borralho, 2013:54). For example, 24 people lost their lives in field Hill accidents in KwaZulu- Natal in 2014. These kinds of accidents result from truck drivers working long hours without rest to transport thousands of tons of goods per day. Furthermore, Borralho stated that there is an increase in environmental costs as well. Additional greenhouse gas emissions caused by a large number of trucks on the road throughout the country are a problem. If rail transportation can be improved, these kinds of problems can be reduced (Borralho, 2013:54).

2.6.3 Decline in fleet availability

Rail operations experienced severe operational challenges during the period under review, characterised primarily by the decline in fleet availability (Passenger Rail Agency of South Africa, 2011:24). The main contributing factors were the dispute with Transnet pricing of services and access to the network, unresolved contractual and pricing issues with companies involved in the refurbishment of coaches and supply of key components, as well as poor maintenance practices. The result has been a major decline in passenger trips from 633.99 million in 2009/10 to 492 million passenger trips for the Metrorail service in 2010/11. Metrorail ran fewer trains after October 2010 than it did the previous two years, while the Mainline Passenger service or long-distance service has effectively been paralysed by the dispute with Transnet, with a reduction of passengers from 3.78 million in 2009/10 to 1.54 million in 2010/11. The performance of the Accelerated Rolling Stock Investment (Prasa, 2011:24).

2.6.4 Poor train availability and Non-Operation of the long-distance rail service

Poor train availability and the non-operation of the long-distance rail service resulting in the decline in passenger trips contributed to the failure of the rail division to realise its revenue target by over R600 million for the 2010/11 financial year. The fare revenue target for Metrorail in the year under review was R1.9 billion. However, only R1.4 billion was achieved, while the long-distance had a revenue target of R500.2 million, but actual fare collected was R229.16 million (Prasa, 2011:24). Overall, the revenue target for the rail division was R2.4 billion, but only R1.63 billion was realised. Management implemented a far-reaching programme to reverse and overcome the key challenges. However, the impact, even though not significant, given the realities of the business as outlined above, will only be realised in subsequent years (Prasa, 2011:24).

2.7. PREVIOUS MANAGEMENT SCIENCES OF RESEARCH IN SOUTH AFRICA

There is evidence of several studies in the management sciences area within the rail industry in South Africa. Mathabatha (2015:01) conducted a study to understand the views of freight rail transport consumers and the impact of rail transport on the economic competitiveness of South Africa. Another important objective was to present the study in a format that is easily understandable. The approach adopted for the study was quantitative and a survey research questionnaire was distributed to freight rail transport customers and providers. The overall findings

from the study were that companies use roads to transport freight because of the unavailability and unreliability of the freight rail transport provider, Transnet Freight Rail, and that these companies opt for road transport because they use a just-in-time system whereby a small quantity of stock is transported. The study further noted that freight rail transport should concentrate on improving service delivery and not only on increasing capacity. The objective was to move freight back to rail which would lessen the burden and damage to South African roads and reduce traffic congestion and accidents caused by trucks on the roads. It would also increase employment opportunities and the country's economic competitiveness while reducing transport costs. All these aspects will make a significant impact on the economy of the country (Mathabatha, 2015:01).

A study by Havenga, Simpson and Bod (2014:01) examined South Africa's freight reform from a demand driven perspective. They concluded that there have been major tangible advances that should enable the fast-tracking of an integrated freight transport vision. One-third of public-sector infrastructure expenditure over the period 2010/2011 to 2014/2015 was allocated to transport and logistics infrastructure spending. Over the past two decades, Transnet has sold off its non-core assets, focusing solely on freight transport, introduced separated reporting and commercialised management and has made unprecedented infrastructure investments, culminating in a record R23 billion capital investment in 2013 (Transnet 2013). The management of national roads is under a separate entity, the South African National Roads Agency Limited, and major road investments are ongoing. Global logistics players are on board with the imperative for the development (Havenga *et* al., 2014:05).

A recent study by Mashoko and Shivambu (2017:1) investigated the rail safety regulatory environment in South Africa. They placed major emphasis on the regulatory framework of the railway in South Africa and discussed the funding institutional and the arrangements of the regulator. The research highlighted key issues about the railway safety regulatory environment in South Africa and compared it to other countries in terms of roles and functions according to the different institutions that perform them. The aim was not to adopt what other countries were currently doing but rather to learn from them and adapt practices that fit with our local conditions, thereby improving our railway regulatory regime. The information used in the study was obtained from the literature review as well as strategic documents obtained from the Rail Safety Regulator. Some of the information was also obtained from rail operators in South Africa

2.8. CONCLUSION

This chapter focused on the development of the rail industry in South Africa and how the industry has development in the previous years. The composition of the rail industry in South Africa was also discussed in detail, for example, how many and which companies operate in the rail industry. Furthermore, the legislative framework for the rail industry in South Africa was discussed in detail, i.e. the laws and rules of the rail industry. Most importantly, the challenges facing the rail industry were discussed in detail. These challenges include the prevalence of accidents, maintenance of infrastructure and fleet availability, amongst others. The economic contribution of the rail industry was also discussed in terms of how the rail industry assists and develops the country's economy. The chapter wound up by discussing a few previous studies on the rail industry in South Africa.

CHAPTER 3: RESEARCH CONSTRUCTS AND HYPOTHESES FORMULATION

3.1 INTRODUCTION

The second chapter of this research dissertation focused on the development of the rail industry in South Africa, the composition of the rail industry in South Africa, legislative framework of the rail industry in South Africa, the economic contribution of the rail industry in South Africa and its challenges. This chapter focuses on the literature review and research constructs for the study. Supply chain integration along with is sub-dimensions, importance or benefits of supply chain integration, types or forms of supply chain integration which are internal integration, supplier integration, customer integration are all discussed in detail. Supply chain resilience and factors determining supply chain resilience, and the importance or benefits of supply chain resilience are discussed in detail. Further discussions focus on supply chain performance and factors determining it, types or forms along with its importance and benefits.

3.2 SUPPLY CHAIN INTEGRATION

This section reviews the literature on the definitions of supply chain integration. Factors determining supply chain integration, the importance of supply chain integration as well as its benefits and types will also be reviewed.

3.2.1 Definitions of supply chain integration

Companies have ever been searching for new business paradigms that would lead to a competitive advantage (Hussain & Nassar, 2010:01). Just-in-time, supply chain management, and total quality management are examples of strategies that helped companies improve their production processes and to reduce costs and successfully compete in a variety of business environments. Companies soon realised that to improve competitiveness, they need to invest more in the potential of information technology to dramatically transform their business.

A supply chain includes a manufacturer, supplier, transporters, warehouses, retailer, third party logistics provider and a customer. The objective of supply chain management is to maximise the overall value generated rather than profit generated in a supply chain. Supply chain management

encompasses the planning and management of all activities involved in sourcing and procurement, conversion and all logistics management activities. Importantly, it includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers and customers, and this may all be referred to as supply chain integration (SCI) (Hussain & Nassar, 2010:02).

SCI can be defined as the degree to which a manufacturer strategically collaborates with its supply chain partners, manages its processes to achieve effective and efficient flows of products and services, and provides maximum value to customers (Barbara, Huo, and Zhao, 2010:58). The term integration can be defined as a unified control of several successive or similar economic or especially industrial processes formerly carried out independently (Barbara et al., 2010:59). This definition includes several important elements. First, the importance of strategic collaboration is highlighted, which can be an ongoing partnership to achieve mutually beneficial strategic goals. It engenders mutual trust, increases contract duration and encourages efficient conflict resolution and information sharing.

Supply chain integration is further defined as the interrelationship among the departments, functions or business units within the organisation that source, make or deliver products and external relationships with entities outside the enterprise and their suppliers (Flynn, Huo & Zhao, 2010:01). Mose (2015:12) shared that supply chain integration can also be defined as the extent to which all activities within an organisation and activities of its suppliers, customers and supply chain members are integrated together. Supply chain integration is a useful approach to improve various measures of firm performance. The basis of integrating can, therefore, be characterised by cooperation, collaboration, information sharing, trust, partnerships, shared technology, and a fundamental shift away from managing individual functional processes, to managing integrated chains of the process (Mose, 2015:12).

More definitions are added; supply chain integration refers to the degree to which a firm collaboratively manages intra- and inter-organisational processes with channel partners. It was further noted that supply chain helps firms to improve partner-related routines and processes through global and real time collaboration and to eventually respond to technological and market changes (Liu, Ke, Wei & Hua, 2013:07). However, scholars and practitioners have increasingly

realised that supply chain integration is a great innovation in supply chain management and a new frontier of opportunities to enhance firm performance (Liu et al., 2013:07).

They noted that supply chain integration links a firm with its customers, suppliers and other channel members by integrating their relationships, activities, functions, processes and locations. It has two stages which are internal integration between functions and external integration with trading partners. Internal integration establishes close relationships between functions such as shipping inventory or purchasing and raw material. While external has two directions which are forward integration for physical flow of deliveries between suppliers, manufacturers, customers and backward coordination of information technologies and the flow of data from customers to manufacturers and suppliers (Sundram, Chandran & Bhatti 2016:03).

3.2.2 Factors determining supply chain integration

This section reviews the literature on all the factors that determine supply chain integration. The factors include technology, information sharing, commitment, trust, adaptations, business strategy, processes integrated, dependence and independence, long-term relationship, joint relationship and management support (Hudnurkar, Jakhar & Rathod, 2014:04).

3.2.2.1 Commitment

Commitment refers to the willingness of trading partners to exert effort toward the relationship and suggest a future orientation in which firms attempt to build a relationship that can be sustained in the face of unanticipated problems (Hudnurkar et al., 2014:04). Commitment can influence supply chain integration in many ways because every organisation has a goal or target that has to be met and one department cannot fulfil the goal of an organisation – so every department needs to commit to the deliverables because if any department is unable to contribute/commit this can affect the supply chain integration of the firm.

3.2.2.2 Trust

Trust can be a positive belief, attitude or even expectation of one party concerning the likelihood that the action or outcomes of another will be satisfactory. Trust is one of the factors determining supply chain integration because for a supply chain to be a success parties involved must be able

to trust one another. And know that other departments will deliver deliverables satisfactorily. If there is no trust in an organisation then there cannot be any SCI (Mbaisi, 2016 :26).

3.2.2.3 Collaborative communication

Collaborative communication can be described as the contact and the message transmission process among supply chain partners in terms of frequency, direction and mode (Hudnurkar et al., 2014:04). Collaborative communication is one of the most important factors that influences supply chain integration, because if goals and deliverables are miscommunicated then that would be a clear indication the organisation will not meet its goals and objectives. Information should be well communicated between departments for a positive supply chain integration.

3.2.2.4 Dependence and interdependence long-term joint relationship

Firms need to maintain an exchange relationship to achieve their desired goals; however, the structure (magnitude and relative symmetry) of this reciprocal dependence characterises the level of interdependence in the relationship and has important implications for interaction, joint efforts, such as planning, goal setting, performance measurement and problem solving which are essential for successful collaborative relationships (Hudnurkar *et al.,* 2014:04).

3.2.2.5 Legal protection coordinative and structures collaborative agreement

Legal protection coordinative structures and structures collaborative agreement depends on the extent to which detailed formal legal rules and doctrine exist, the structure and operations of the institutions that implement them, and the so-called legal culture encompassing customs, opinions, and the ways of doing and thinking that define people's practices and attitudes toward laws (Mbaisi, 2016:26). Collaborative agreement is another essential element to manage differences in an integrative inter-firm relationship in which coordinative structures and mechanisms consist of a series of activities.

3.2.2.6 Information availability

Information availability refers to the extent to which relevant information is equally available to all participants within a supply chain, other than the information which is actively shared between partners within the supply chain. For any organisation to meet its goals and objectives, information should be easily accessed (Sweeney, 2012:11).

3.2.2.7 Information quality

Information quality includes aspects such as the accuracy, timelines, adequacy, reliability, creditability, understandability and the ease of use of the information exchanged. The quality of information should be of a high standard because high information quality will lead to a better supply chain integration (Mbaisi, 2016:26). Let's take for example a shop selling clothes – if the quality is low then the clothes will not last for long. In the same way each organisation needs quality information to produce better results.

3.2.2.8 Management controls integrated policies

Management controls integrated policies includes updating of the formal agreement, a comprehensive plan outlining the common goal, requirement and expected benefits which determine the extent of sharing rewards or a risk-sharing scheme. This concept influences supply chain integration because every organisation needs policies and systems and if they are not in place there will not be any direction in the firm and this will result in poor supply chain integration (Sweeney, 2012:11).

3.2.2.9 Resource sharing asset specificity dedicated investment

Resource sharing refers to the process of leveraging capabilities and assets and investing in capabilities and assets with supply chain partners. Resources include physical resources, such as manufacturing equipment, facility and technology (Hudnurkar et al., 2014:04). Dedicated investments refer to investments made by a buyer or supplier that are dedicated to a relationship with a specific supplier or buyer, respectively.

3.2.3 Importance or benefits of supply chain integration

This section reviews the literature on the benefits of supply chain integration.

3.2.3.1 The flexibility of an organisation

Supply chain integration in a firm can be very beneficial because it allows the organisation to be flexible; the ability to be flexible and adapt to different situations is important in any competitive industry. Having an integrated supply chain allows companies to do that much more quickly and fluidly than would be possible with traditional logistics. One example of flexibility is just-in-time capability in which just enough freight is used to meet daily demand. This limits the amount of

warehouse space and helps keep costs down. This is very beneficial to a firm's costs and space (Hussain & Nassar, 2010:05).

3.2.3.2 Waste elimination

SCI helps companies eliminate waste because reducing or eliminating waste is a constant goal for most companies, partly for the long-term costs savings. Integrating supply chain will dramatically reduce waste in several areas – because space will be saved in warehousing due to better route management. This will also save on emissions helping organisations to meet new low-waste environmental goals (Lam, 2015: 04). For example, trucks will be filled on every leg of the route, maximising cube and ensuring that no empty trucks are driving around. This means that the firm will be more efficient and save more money. Supply chain integration thus helps a firm to lower costs. Being flexible and getting rid of waste can help a firm to lower its costs. Cost sharing by using supply chain management providers instead of working independently is a great way to cut cost without any quality or deadline requirements (Lam, 2015: 04).

3.2.3.2 Improved financial performance and profitability

One of the most important benefits of firms integrating their supply chain is improved financial performance and profitability. Supply chain integration can be one of the major facilitators of financial performance, highlighting the role of management taking advantage of the strategic relationships of supply chain integration to boost financial figures. Companies that have strong internal integration within the business processes create enough requirements for the organisation to improve their financial performance. When members of a supply chain are integrated and there is proper communication flow the firm can quickly adjust to any changes in the marketplace whether in the long run or short run (Kumara, Chibuzob, Reyesc, Kumaria, Lonad & Torrese, 2017:03).

Supply chain integration is a facilitator of shortening the lead times between processes and can improve product availability (Kumara et al., 2017:03). Supply chain integration with partners involves a win-win situation helping organisations to look for the best possible ways to reduce costs across the supply chain whether it is manufacturing, inventory or transaction costs and to boost the profitability of every member in the supply chain.

3.2.3.3 Ability to respond to changing demands of the customer

The ability of a firm to integrate its processes internally and externally with its supply chain partners aids its ability to respond to the changing demands of the customer. When firms do not trust supply chain partners, it makes them keep an arm's length distance from their links and partners in the supply chain. Integration can also be impeded by conflicting goals and interests in the supply chain. Sometimes within a firm, the conflicting goals exist with different departments having different objectives and goals (Pellathy, Burnette & Meline, 2018:13).

3.2.4 Types or forms of supply chain integration

The types or forms of supply chain integration are presented in Figure 3.1

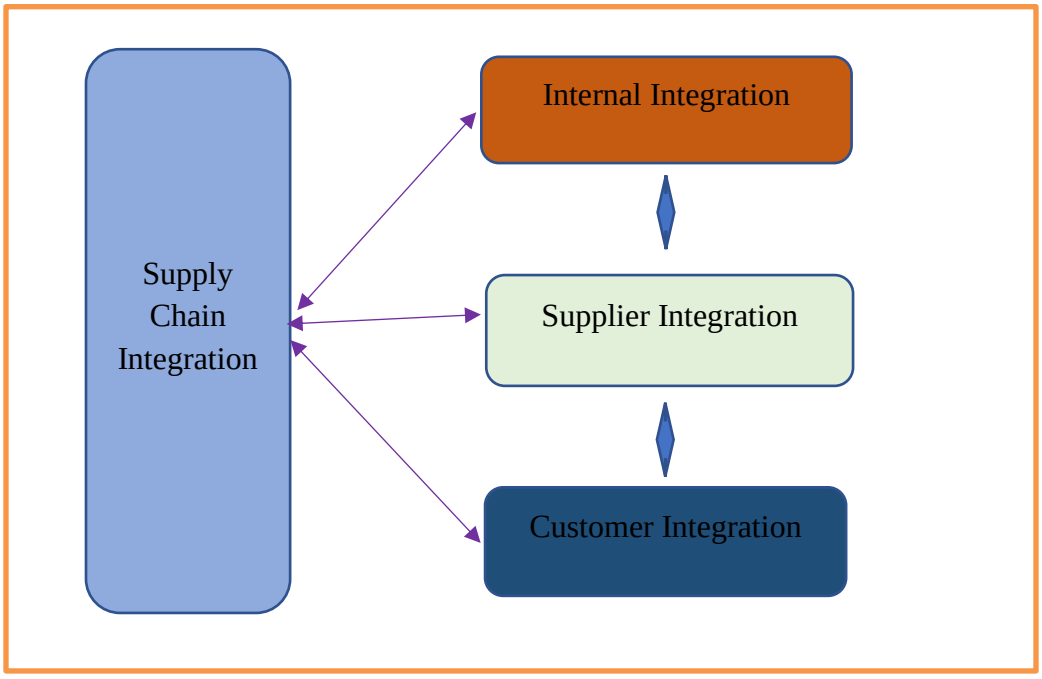

Figure 3.1: Supply chain integration model

Source: Hussain and Nassar (2010:10)

Figure 3.1 shows that supply chain integration is made up of three forms which are internal integration, supplier integration and customer integration. For any firm to have a supply chain integration, these forms must be present. It is important for the departments to be working together. In each firm supplier integration must be present so that materials and all equipment needed by the

firm can be supplied. Any firm that does not integrate with their customers has no purpose since companies operate to always satisfy the end user (Hussain & Nassar, 2010:10).

3.2.4.1 Internal integration

The question to be asked is whether internal integration is present, or whether it should be present when specialised functions or departments in a firm are interdependent, and operations and procedures occur which enable and require cooperation. Internal integration aims to eliminate traditional functions and calls for better coordination between functions. Internal integration is when at least two or more complementary firm functions operate as a unified entity even though they are not integrated as such (Mostert, Niemann & Kotze, 2017:10). Two departments or two functions in a firm are complementary when they compete and have a certain set of functions that are interconnected and need to be complemented with other functions from complementary departments (Orthaber & Topolsek, 2011:03).

Internal integration can be defined as practices of merging together and developing the internal resources and information to generate a shared knowledge that goes beyond the boundaries of individual factors or sections, and through doing so, helping external integration and achieving goals (Pakurar, Haddad, Nagy, Popp a& Olah, 2019:05). Furthermore, the efficient collaboration between the manufacturer and suppliers that is achieved through processes, activities, and strategies to satisfy customer needs is called internal integration. Joint planning, functional collaboration, information sharing, and teamwork boost the performance of organisations and their internal integration to ensure customer's expectations can be met and deliveries are on time (Pakurar et al., 2019:05).

Internal integration means forming a long-term plan linking processes and practices into organised and synchronised processes to meet customer needs and preferences and transact efficiently with suppliers (Mostert *et al.,* 2017:11). Internal integration aims to smooth the movement of resources, money, product and information to satisfy customers quickly and at a very low cost (Pakurar *et al.,* 2019:06). Internal integration can further be viewed as the integration among the departments and processes inside the organisation to satisfy and meet customer needs. Internal integration is the coordination between departments and functions, creating an integrated system to satisfy the expectations and need of customers, as well as boost performance. However, more attention needs

to be paid to cooperation among functional departments, such as inventory sales and distribution. Internal integration can also be a mix of various departments and starts with raw materials and converting processes and continues until distribution. The most important factor that affects supply chain positivity is internal integration. Moreover, internal integration relies on cooperation among the departments and functions of an organisation which creates value (Pakurar et al., 2019:07).

Complex organisations are composed of many varied interconnected parts. Complexity hinders the capability of organisation members to identify and act concerning issues of strategic significance. Information barriers and unusually narrow-minded interests are all possible negative effects of structural complexity, and they present significant challenges to the quest to achieve alliances, knowledge sharing, and agreement in decision-making (Pakurar et al., 2019:08). Mangers who have a wide range of experience and skills are better prepared to work across functional and departmental lines. The exposure to various functions inside an organisation that managers obtain from structural processes, such as job rotation, is a significant facilitating factor for internal integration. A manager who gains experience within a broad set of organisational units is in a better position to cooperate with personnel from any organisational units. Such a manager understands the barriers impacting communication and collaboration internally and externally (Kumar, Nwakama, Reyes, Kumari, Lona, & Lope-Torres, 2017:05).

Internal integration can be defined as the degree to which a firm can structure its own organisational strategies, practices and procedures into collaborative and synchronised processes to meet customer requirements (Feng, Li, Sun & Wang, 2013:05). Internal integration involves data and information system integration, real time searching of supply, operation and demand information, and integration of activities in different functional departments. Internal integration also involves cross-functional cooperation or working together across different functions in process improvement. Internal integration recognises the need for different functions within a firm to act as part of an integrated process (Feng et al., 2013:05).

The importance of internal integration in enhancing performance has been increasingly emphasized. With a lack of internal integration, different functions may work at cross- purposes and result in effort redundancy and waste of resources, which can have a detrimental impact on organisational performance. Internal integration breaks down the hierarchical barriers and

improves the linkages among different functions (Wong, Boon-itt & Wong, 2011:05). The improvement of horizontal linkages allows for information sharing and collaboration among people from different departments within the firm. Internal integration is also argued to foster better intra-firm goal alignment among different functions through better information sharing and cross-functional collaboration (Wong et al., 2011:05).

Moreover, internal integration enables the utilisation of each function's strengths and competencies which can improve organisational performance. Internal integration also increases the amount and variety of information available to the manufacturer which reduces much of the uncertainty in dealing with customer demand (Mosert et al., 2017:05). These advantages from internal integration provide the basis for sound decision making. For example, early information from marketing and purchasing departments can facilitate a time-efficient preparation of the resources needed by fulfilling customer demand. Furthermore, frequent interactions and confrontation with different perspectives may reduce mistakes and wastes, eliminate unreasonable steps, prevent delays, present opportunities for simplification and achieve fast market response (Pakurar *et al.*, 2019:05).

3.2.4.2 Supplier integration

Supplier integration is defined as a process of acquiring and sharing operational, technical, and financial information and related knowledge regarding the state of synergy accomplished through a variety of integration practices among the supplier, purchasing and manufacturing constituents of an organisation, as the degree to which a firm exchanges information and develops partnerships with suppliers (Ellstrom, 2015:24). A disinclination that is not made explicit in previous supplier integration research is whether supplier integration only takes place in activities normally carried out by the customer or if it can also concern activities traditionally carried out by the supplier. Danese (2013:24) stated that the objective of supplier integration is to smoothen and optimise the procurement and production processes of the customer firm, implicating that supplier integration takes place in activities normally carried out by the customer.

Supplier integration aims to align the actions of a supplier with those of a buyer and thereby to be able to provide more customer value and reduce costs. Supplier integration can also achieve effective and efficient flows and thereby provide maximum value to the customer (Zhang,

2018:24). One of the definitions of supplier integration identified in literature specified that when the firm initiates supplier integration it is often implicitly understood that the buyer is the active firm that integrates its suppliers. When a supplier initiates integration in its customers' operations, this is often referred to as customer integration. However, supplier integration is broader and can also include initiatives taken by the supplier to integrate into the operations of the buyer (So & Sun, 2010:25).

Supplier integration is not a binary phenomenon in the sense that it either does or does not exist. Instead, there can be different levels of supplier integration, and suppliers can be integrated into the business of a retailer. This is also acknowledged in quantitative research, where supplier integration is often measured by Likert-type scales and the intensity of integration is determined based on the extent to which respondents agree to several statements (Zhang, 2018: 10).

Supplier integration can be defined as a focal buying firm, and its supplier synchronises firm to firm supply processes for mutually acceptable outcomes (Yang, Kull, Abraham & Benbo, 2017:03). Wang, Huo, Qi and Zhao (2016:06) view supplier integration as a sub-dimension of supply chain integration and this can be defined as the degree to which a manufacturer cooperates with its key suppliers to fulfil its customers' requirements by shaping inter-organisational structures, strategies and practices into collaborative and synchronised processes.

Supplier integration involves core competencies that are related to collaboration with critical suppliers such as strategic alliances, information sharing, and process coordination to jointly resolve problems and facilitate operations. However, through close integration with key suppliers a manufacturer can leverage the resources and capabilities of its suppliers and reconfigure both parties' resources and capabilities to achieve better competitive advantage Wang *et al.,* (2016:06).

3.2.4.3 Customer integration

Previously, physical goods were produced far away from the customer (Edvardsson, Kristensson & Sundstrom, 2010:06). Raw materials and products were scarce and customers' options were limited. However, today attention is given to how products, as well as immaterial resources, collaborate in a co-creation process of service. Time and customers have become scarce resources; customers demand unique solutions to unique needs. Being able to adapt to various customers' needs is key and companies of today need to know and understand their customers to accomplish

this. To co-create value together with customers, their preferences and positions are very important (Edvardsson et al., 2010:06).

For companies to learn about customers, their needs, habits and intentions for service, two methods can be used which are situation and context. With such situations, customer information can be generated when the customer is in a value-creating situation. Context can be physical resources that make service possible, experience from resources creates possibilities for customer information that is different from that where the customer does not have the same experience. These two methods are suitable to collect different kinds of customer information, for example a small number of methods are constructed to collect customer information that is generated and reported in the service situation when the customer has direct access to enabling resources (Yu, Jacobs, Salisbury & Enns, 2013:05). Edvardsson et al., (2010:06) mentioned developing and offering new services that create value for existing customers, and attracting new customers, which is fundamental to increase the competitiveness of an organisation. Customer integration enables a firm to establish long-term relationships with key customers which reduces the search cost. It reduces contracting costs by reducing the costs of negotiation and writing contractual agreements and reduces enforcement cost by formulating collaborative strategies with major customers; hence firms with a high level of customer integration have the potential to lower the net costs of conducting business due to reduction in total transaction costs (Afshan & Motwani, 2018:05).

Companies need to have customer integration because customer integration helps the manufacturer in becoming more responsive to the need of customers, create greater value and detect demand change quickly. Customer integration has been found to impact satisfaction both directly and indirectly through its relationship product innovation performance and product quality performance. Manufacturers who are well integrated with customers can reduce inventories and decrease delivery times and become more flexible to customer demands, hence they make the supply chain more efficient (Ramesh, Kumar & Sindhu, 2014:10). Leyer and Moormann (2012:3) highlighted that service is only delivered after a customer has placed an order because the service is dependent on the customer and their input and cannot be delivered in advance. However, customers are integrated into actual service delivery activities as well. While some service processes have only marginal customer integration and can be automated, operational control of most services is a challenging task (Leyer & Moormann, 2012:07). Customer integration can also

be used in designing new innovative services, collaborating through sourcing or joint marketing activities. Customer integration also implies that customers are a resource which must necessarily provide input during the delivery of a service.

3.3. SUPPLY CHAIN RESILIENCE

This section reviews the literature on the definitions of supply chain resilience (SCR), factors determining SCR, its importance as well as types and benefits of SCR.

3.3.1 Definitions of supply chain resilience

Supply chain resilience is one of the variables that has been broadly studied during the last decades; however, its focus was mostly on supply chain performance (Bevilacqua, Ciarapica and Marcucci, 2017:01). The study of this variable has resulted in many definitions being developed by the research community, drawing aspiration, and from other fields of study such as ecology, sociology and economy (Bevilacqua et al., 2017:1).

SCR can be defined as the ability of a system to return to its original state or move to a new or more desirable state after being disturbed (Christopher & Peck, 2004:01). However, Ponomarov and Holcomb (2009:01) defined SCR as the adaptation capability to prepare for unexpected events, respond to interruptions and recover from them to maintain continuity of operations at the desired level of connection and control over the structure and function. The two authors continued to state that supply chain managers strive to reach the fully integrated, efficient and effective supply chain ideals that create and sustain a competitive edge. However, they must balance the downward pressure on costs and the need for efficiency with effective means all to handle market demands and the risks of bankruptcy in the supply chain (Ponomarov & Holcomb, 2009:01). Ponis and Koronis (2012:01) continued to define SCR as the ability to plan and design the supply chain network to anticipate disruptive and unexpectedly negative events, proactively respond adaptively to interruptions, maintain control over structure and function, and arrive at a robust final state of operation. The supply chain can be resilient if its conditions remain stable at the original state or if a new stable situation is obtained. However, resilience can, therefore, be understood as the ability of a supply chain to change with scope (Wieland & Wallenburg, 2013:15).

Disruptions in the supply chain can be related to any potential or actual disturbance to the flow of goods, material and services. Therefore, organisations engage in traditional supply chain risk

management, for example identification and quantification of risk resources to reduce the probability of disruption occurrences using methods such as interpretive structural modelling, an analytical hierarchy process or fault tree and event tree analysis (Scholten & Schilder, 2015:3). Disruptions have been recognised as inevitable events in today's business environment, for example an organisation can try to mitigate some risk through traditional supply chain risk management but cannot prevent all disruptions from happening. Therefore, the proactive and holistic approach of supply chain resilience builds the adaptive capacity to be able to deal with the unforeseeable to date.

Supply chain resilience needs to be designed into a supply chain which requires trade -off between redundancy and efficiency. However, creating and maintaining resilience is not a one-time event but rather a process itself (Scholten &Schilder, 2015:03).

Supply chain resilience is a proactive and a holistic approach to managing supply chain risks enhancing traditional risk management strategies, for example risk assessments, vulnerability analysis and continuity planning as it does not require risk identification and quantification (Scholten, Scott & Fynes, 2014:03). Cheng and Lu (2017:02) emphasized that SCR has increasingly become an issue of strategic importance in supply chains. Supply chain resilience can be defined as the system's ability to return to its original form after interruptions; there are two ways for manufactures to cope with disruptions, proactive and reactive. A proactive dimension of SCR is a system's ability to maintain its function, including internal or external interruptions. A proactive strategy allows for continued operation despite disruption. A reactive strategy is the capability to adjust quickly to unexpected market changes in a competitive environment described by uncertainty. For a supply chain to be successful, manufacturers must be able to rely on its proactive and reactive strategies. The adequate proactive and reactive dimension of SCR results in enough exploitation and exploration to ensure a supply chain's current and future viability (Cheng & Lu, 2017:02). For firms to improve their competitive advantage and customer value, they often demand that their partners, including subcontractors and suppliers, implement common processes to maintain supply chain resilience. To achieve the advantages imparted by increased SCR, it is strategically important to understand the factors that affect partners' behaviour in this area. Previous researchers have focused on modelling the precursors of SCR or independent variables from the relationship exchange and uncertainty perspectives (Cheng & Lu, 2017:2).

3.3.2 Factors determining supply chain resilience

This section reviews the literature on the factors that determine supply chain resilience.

3.3.2.1 Supply chain visibility

For firms to achieve agility, they need visibility for better identification of changes and speed for faster response to changes. Visibility enables managers to know about changes and it is, therefore, the prerequisite to responding to those changes and visibility is also an outcome of investment in information sharing (Benjamin, Mark, Busby & Zorzini, 2015:15). Visibility also ensures confidence in the supply chain and prevents overreactions, unnecessary interventions and ineffective decisions in a risk event situation (Ouabouch, 2015:02).

3.3.2.2 Information sharing

The absence of information necessary for decision making can harm the efficiency of the firm. The SCR of a supply chain firm may be obtained by reducing the probability of occurrence of disturbance. Managers must, therefore, take measures to mitigate the potentially negative effects of risks, whether on the directly affected firm or other supply chain companies that may be affected due to the relationship of dependency between supply chain companies (Ouabouch, 2015:02).

3.3.2.3 Supply chain agility

Being responsive is an increasingly important skill for firms in today's global economy; therefore, firms must be agile. Supply chain agility can be defined as the firm's ability to adjust to its supply chain tactics and operations quickly. It comprises the ability to cope with unexpected challenges, to survive unprecedented threats of the business environment and to take advantage of opportunities (Bhatia, Lane & Wain, 2015:6).

3.3.2.3 Collaboration among players

Collaboration among players through transparent communication and cooperation enables suppliers and manufacturers to act in concert. Industrial complexity generated by many actors, and multiple interactions generate a strong need for coordination. Relationships between supply chain members rely on the availability of information that is visible along the supply chain. Collaboration is an approach based on reciprocity of partners. This implies that not only the gains and profits

will be shared as part of a collaborative relationship but also the costs and risks (Benjamin *et al.*, 2015:5).

3.3.2.4 Supply chain structure

Supply chain design needs a balance between resilience and normal measures of efficiency. Supply chain resilience calls for rapid reconfiguration and the elimination of waste as much as possible. Supply chain resilience focuses on the system's adaptive capability to deal with disruptive events (Bhatia, 2013:16). The dynamic nature of adaptive capability allows the supply chain to recover after being disrupted, returning to its original state or achieving a more desirable state of supply chain operations.

3.3.3 Importance or benefits of supply chain resilience

In this section, the importance or benefits of supply chain resilience are discussed.

3.3.3.1 Competitive advantage

A resilient supply chain is a competitive advantage because it reduces customer perception of assumed risks and moves companies from simple risk management. Any firm that has a competitive advantage can compete in a very high performing market with its competitors and still be the best because of its resilient supply chain (Timothy, Fiksel & Croxton, 2010:8).

3.3.3.2 Availability

Availability can be the second benefit of supply chain resilience in a firm because, for systems to work for you they need to be on, and they need to be accessible all the time with real-time inventory data and adaptability to global constraints (Simba and Menash, 2014:05). Flexibility and configuration, for example if facilities are available on a single network allowing to configure, if flooding occurs, they can respond by shifting operations to alternate facilities. SCR enables the organisation to be in control, for example solutions can be organically built on a platform integrated with a common data base that provides a single view of inventory across the entire supply chain network (Timothy et al., 2010:6).

3.3.3.3 Redundancy

Redundancy in SCR focuses on limiting the risks and its consequences by keeping reserves such as safety stock and sourcing from multiple suppliers (Simba et al., 2017:6).

3.3.3.4 Flexibility

Flexibility ensures speedy responses to risk that may materialise. Firms can invest in a strong supplier relationship that motivates suppliers to take extraordinary measures to mitigate risks. However, to increase resilience, businesses should invest in mechanisms that facilitate both flexibility and redundancy. This is because a strategy that implements only redundancy or only flexibility would increase the risk occurrence costs (Botes, Niemann & Kotze, 2017:10).

3.4 SUPPLY CHAIN PERFORMANCE

This section reviews the literature on the definitions of supply chain performance (SCP), factors determining SCP, its importance as well as types and benefits of SCP.

3.4.1 Definitions of supply chain performance

Supply chain performance refers to the evaluation of supply chain management which includes both tangible, for example cost, and intangible capacity utilisation (Chang, Tsai and Hsu (2013:2). Firms have been unable to maximise the potential of their SCP primarily due to their inability to integrate the needs of the respective partners (Cadden, Marshall and Cao (2013:5). However, it is known that SCP is difficult to define largely because each of the supply chain participants must understand such measures. A variety of SCP measures have been recommended. These measures include operational measures such as operating cost, inventory costs and flexibility and financial measures such as profitability, the return of assets including cash to cash cycle (Cadden et al., 2013:5).

In a study by Cadden et al., (2013:5) SCP was measured by accessing the buyers' supply chain metrics, encompassing both operational and financial measures. Semi-structured interviews with both key buyer and supplier personnel with supply chain relationship responsibilities were used to correlate the results of the organisational culture instrument with the buyer s supply chain metrics for both the best performing and underperforming supply chain (Cadden et al., 2013:5).

Supply chain performance can be defined as the ability to satisfy the ultimate customer in terms of both quality and cost (Whitten, Kenneth, Green and Zelbst (2012:6). However, organisational managers are ultimately held accountable for organisational performance; organisational success first depends upon the performance of the supply chains in which the organisation functions as a partner (Whitten, Kenneth, Green & Zelbst, 2012:06). SCP is dependent on the supply chain partners' ability to adapt to a dynamic environment. Previous research has based SCP on the ability of the supply chain to deliver quality products and services in precise quantities and at precise times and to minimise the total cost of the products and services to the ultimate customers of the supply chain (Whitten et al., 2012:6).

Supply chain performance manufacturers have long strived to set up supply chain goals with well-defined performance indicators, but the complexity and frequency of supply chains complicate the choice of adequate supply chain indicators (Seo, Dinwoodie & Kwak, 2014:3). Few supply chains are effective and efficient often overlooking performance measurement in critical supply chain contexts. Cost, activity time, customer responsiveness and flexibility as supply chain performance measurers either singly or jointly appear to be completely based on the criteria such as inclusiveness, universality, measurability and consistency. A comprehensive framework for SCP measurement was broadly divided into strategic, tactical, and operational processes. The six categories were as follows: metrics for order planning, evaluation of supply link, measures and metrics at the production level, measuring customer service and satisfaction and supply chain logistics (Seo et al., 2014:4).

3.4.2 Factors determining supply chain performance

This section reviews factors determining SCP in an organisation.

3.4.2.1 Firm environment

Firm environment is related to the firm's relationship with suppliers and their level of trust and commitment. Firm environment can also be related to the firm's expectations of quality, on time delivery, competition in the sector and the level of rivalry among firms. To respond effectively to demand, companies have realised that imports are a good option for obtaining flexibility (Quesada, Gazo & Sanchez, 2012.3).

3.4.2.2 Information technology

Telecommunications and computer technology allow all factors in the supply chain to communicate with each other. The use of information technology allows suppliers, manufacturers, distributors, retailers and customers to reduce lead time, paperwork and other unnecessary activities. Therefore, if there is no communication, the supply chain of the firm will be very poor (Ngoto & Kagiri, 2016:6).

3.4.2.3 Relationship with suppliers

Companies are inclined to work with different suppliers in different ways. It is, therefore, important that the relationship with the supplier satisfies the needs of the firm (Mehmeti, Musabelliu & Xholxhi, 2016:3). If suppliers supply what is needed at the right time and the right place, that can help the firm because the firm will meet its objectives.

3.4.2.4 Relationship with customers

The global markets offer a variety of products of different quality and cost. Therefore, companies are always competing and trying to reduce costs and quality. Customers look for more choices, better service, higher quality and faster delivery. A relationship with customers has become a strategic issue for today's companies (Quesada et al., 2012:4).

3.4.2.5 Quality

Quality is not a bonus for the customer; it is important for the acceptance of a product (Mehmeti et al., 2012:5). High costs, low productivity, and loss of market share are directly related to poor quality. Achieving better efficiency, quality and productivity, and acquiring the highest value of a product at lower costs will improve the supply chain performance of a firm.

3.4.2.6 Process strategy

Process strategies are used by most companies to improve their manufacturing and supply chain performance. Process strategy requires identification of objectives, the creation of policies and assigning of resources for implementing the plans (Ngoto & Kagiri, 2016:7). Process strategy improves the SCP of a firm because if policies and processes are in place, then the firm has a road map of where it is going, and this helps the performance of the supply chain.

3.4.3 Importance or benefits of supply chain performance

This section focuses on the benefits of supply chain performance.

3.4.3.1 Competitive advantage and sustainable growth

Supply chain management in firms is a source of sustainable growth and gaining a competitive advantage over their rivals. The need for an effective and efficient supply chain system has emerged in many of today's organisations because of changing customer preferences and intense competition among organisations. Improved supply chain management can lower costs through greater operating efficiency, reduced waste generation, and reduced consumption of energy and water. Supply chain management practices can also lead to increased revenue and shareholder value by generating more repeat business and attracting new business from customers who value good environmental and social performance (Auma, 2015:11).

3.4.3.2 Reduction of risks

A sustainable product can also help a firm to reduce the risk of conflict or problems with suppliers, governments, staff, local communities and customers and improve its status as a respected partner in destinations. Effective supply chain management is key to efficient resource utilisation and customer satisfaction in service sectors (Auma, 2015:11).

3.4.3.3 Improved product and material flow

Time to the consumer is a crucial indicator of product flow efficiency. The less time it takes for a product to reach the end customer, the more efficient the product flow. However, there are many factors to consider such as quality of the materials or goods that reach customers, the supply and demand balance, shipment options and costs (Al-Doori, 2019:10).

3.4.3.4 Seamless information flow

Companies with effective supply chain management can avoid the bottle neck to supply chain information flow. It can help them evaluate the quality of information sharing, then implement solutions to best fill the gaps. Supply chain management helps design effective best practices to facilitate different types of supply chain information which leads to best supply chain performance (Khare, 2012:5).

3.4.3.5 Enhanced financial flow

Financial management challenges include slow processing due to unreliable, unpredictable cash flows because of the lack of timely information. Costly processes are often due to compliance and lack of employee empowerment, and high day sales outstanding caused by invoice reconciliation delays. Implementing supply chain management can help companies address these challenges allowing them to carefully evaluate their current processes which leads to a successful supply chain performance in an organisation (Auma, 2015:11).

3.4.4 Types or forms of supply chain performance

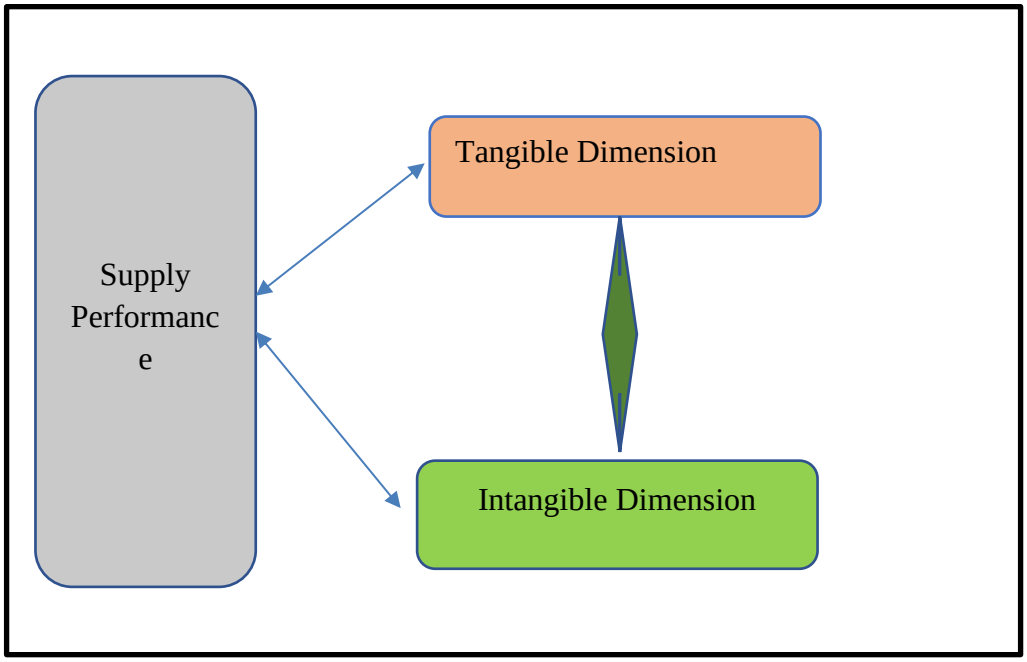

Figure 3.2: Supply chain performance model

Source: Jiayuan, Rahman, Haque, Osman and Purushothaman (2018:2)

Figure 3.2 presents a supply chain performance model with its intangible dimension and tangible dimension. For any organisation to have good supply chain performance or measure its supply chain, performance tangible and intangible dimensions must be presented. Tangible dimensions include anything that can be tangible in an organisation such as its building and working machines and intangible dimension includes anything that one cannot touch, for example the customer service of any organisation. These two are needed to make up the SCP of a firm.

3.4.4.1 Tangible dimension

Tangible dimension refers to the physical appearance of employees, the location of the building and the interior decorations of the firm. The components of a service are grouped into two halves, those factors that meet the customer and those which do not, in other words, what is visible to the customer and what is not. The internal organisation system of the process facilities and the delivery of the service affect performance, while in the performance of the service the customer only sees

and evaluates the physical support and the contact staff concerning the tangible aspects (Jiayuan *et al.*, 2018:02).

Firms' resources are either tangible or intangible or a combination of both. Therefore, to investigate inequality in customer-supplier project collaborations, relationship specific inputs and outcomes are grouped as either tangible or intangible resources (Coley, Lindemann & Wagner, 2012:03). Companies' relationship-specific tangible inputs in customer supplier project collaborations are financial inputs and those related to personnel and infrastructure resources such as salaries and expenses or the costs of capital equipment. Tangible outcomes are the measurable financial benefits received from the collaboration, such as price reductions for procured parts or inventory reductions. In competitive business markets, most tangible resources are must haves while intangible resources can be leveraged towards a competitive advantage. Relationship-specific intangible inputs include employees' knowledge, such as specific insights into the product or process best practices. Examples of relationship-specific intangible outcomes are enhanced knowledge and new patents that extend to benefit other collaborations (Coley *et al.*, 2012:3).

The following are the most important tangible factors any firm should be aware of.

3.4.4.1.1 Volume

As an example – in the food industry, two factors apply when loading a vehicle, volume and weight, and in most cases, volume is the most limiting factor regarding the loading of a truck. This means that even if there is a limit on a truck or any vehicle, most often it will be full before reaching the limit (Peng, Trienekens, Omta, & Wang, 2012:7).

3.4.4.1.2 Weight

Coley et al., (2012:3) mentioned that the weight of a product must also be part of the decision for any organisation. As example is – a train is expected to carry a certain amount of weight; train operators cannot exceed the normal carrying amount.

3.4.4.1.3 Fragility

Fragile products should not be transported with products that are not insensitive to rough handling when loading and unloading; it should be easy for the people unloading and loading products (Saber, Bahraami, & Haery, 2014:10).

3.4.4.1.4 Route

A close analysis must be done regarding the transportation routes, for example with trains. They must take a certain route all the time. Trains should depart at the time promised to the customers. Should they be delayed, they affect everyone because most people use trains to get to work (Coley et al., 2012:03).

3.4.4.2 Intangible dimension

Intangible dimension relates to service quality such as a customer's judgment about a service. Service quality evaluations are not made solely on the outcome of a service, they also involve evaluations of the process of delivery (Culiberg, 2010:3). Service quality can further be defined as the gap between customer perception of what happened during the service transaction and their expectations of how the service transaction should have been performed.

Dimensions of service quality are reliability in delivering the promised outputs at the stated level. Responsiveness is providing prompt service and help to customers; the reaction speed plays a vital role here. Assurance is the ability of a service firm to inspire employees' trust and confidence in the firm through knowledge, politeness and trustworthiness (Culiberg, 2010:3), as well as empathy, willingness and capability to give personalised attention to a customer.

Service quality is increasingly changing the way a firm interacts with customers to create service outcomes. The level of interaction is descried as the extend of interpersonal interaction between the customer and service satisfaction to (Suharto & Sulistiyono, 2015:1). However, since a basic characteristic of service is the participation of the customer in the production process, the customer is said to be an important resource of the firm. Therefore, many companies consider their quality of service as a means of increasing customer commitment and building customer loyalty (Khare, 2012:5).

Excellence in customer service can be the hallmark of success among manufacturers of products and services. Customers compare their perceptions with expectations when judging a firm's service. Customer satisfaction with a service failure encounter affects cumulative satisfaction judgment intentions. Customer satisfaction process is more likely to be raised to a conscious level and evoke a positive or negative emotional response (Kazemkhanlou & Iran, 2014:10). Therefore, negative satisfaction could increase negative word–of-mouth and consumer's likelihood of

reacting to product purchasing. Receiving positive or negative word-of-mouth feedback from satisfied or dissatisfied customers can influence the potential customer and create costs or benefits and have consequences toward customer extra-role behaviour. As customers often react strongly to service failures it is critical that an organisation's responsiveness effort is equally strong and effective (Suharto & Sulistiyono, 2015:2).

Service quality has an impact on customers' behavioural responses and intention (Gamme & Johansson, 2015:100). It relates to the retention of customers at the aggregate level, while perceived quality is a consumer judgment and a form of attitude and results from comparisons that consumers make between their expectations and their perception of the actual service performance. One effective means of achieving competitive advantage and differentiating strategies involves superior service quality. To determine service quality organisations examine customer evaluations of overall excellence or superiority. Service quality can be described as the overall customer judgment and evaluations regarding the quality and excellence of service (Suharto & Sulistiyono, 2015:2).

Services are characterised as intangible activities rather than things, produced and consumed simultaneously, and the customer participates in the production process. The physical environment of service quality can affect customers' evaluations of the service experience and subsequent behavioural intentions. Service quality and customer satisfaction are widely known as key influences in the information of customers' purchase intentions in service environments. (Saber *et al.,* 2014:9).

The following are the most important intangible factors any firm should be aware of.

3.4.4.2.1 Information sharing

This applies to how information is shared in a firm and how much information the firm is willing to share with others. For example, scheduling of time and dates for the trains is the kind of information that should be communicated and shared (Peng et al., 2012:10).

3.4.4.2.2 Level of service

The role of customer service is to provide time and place utility in the transfer of goods between the buyer and the seller. This means that there is no value in a product until it reaches the hands of

a customer. For example, the question to ask is ‘did we send the right materials, did we give the right direction so that our customers can be happy?’ (Al-Doori, 2019:10).

3.4.4.2.3 Strategic position

Another issue to consider relates to how the deployment of distribution would affect the firm’s strategic position within the market, that is, which customers the firm is aiming at (Suharto & Sulistiyono, 2015:02). One method of how to do this is to study the firm’s value chain which could help understand how value is created within the firm.

3.5. PREVIOUS STUDIES ON RESEARCH CONSTRUCTS IN SOUTH AFRICA

Several previous studies have been conducted in South Africa that examined some of the concepts that the present study considered. For instance, Mathabatha (2015:3) focused on rail transport and the economic competitiveness of South Africa and timeous delivery of goods and demurrage. The main objective of the study was to reach a detailed understanding of the views of freight rail transport consumers and the impact of rail transport on the economic competitiveness of South Africa. Another important objective was to present the study in an understandable format. The approach adopted for the study was quantitative and a survey research questionnaire was distributed to freight transport consumers and providers. The data collected from the questionnaire was submitted to a statistical consultant service at North-West University. The overall findings of the study were that companies use roads to transport freight because of the unavailability and unreliability of freight rail transport. And companies choose road transport because they apply the just-in–time principle.

Omoruyi and Dhurup (2016:3) researched the influence of supply chain networks, flexibility and integration on the performance of small and medium enterprises in Southern Gauteng in South Africa. The study examined the influence of supply chain network, flexibility and integration on the SMEs’ (small and medium enterprises) business performance in the Southern Gauteng region. A quantitative research survey was conducted among 401 SMEs’ owners and managers. SPSS 25.0 was used to analyse the data, and structural path modelling was conducted to assess the proposed model fit and test the statistical relationship of the hypothesis. The study found that for SMEs to compete successfully they need to implement and understand the right business strategies. The study also emphasises to both SME owners and government or policy makers in South Africa

how important a supply chain network relationship is for SMEs' business performance and economic growth.

Mashiloane, Mafini and Pooe (2018:1) conducted a study to examine the relationship between supply chain dynamisms, information sharing and inter-organisation relationships and supply chain performance in the manufacturing sector in South African. The empirical data was collected from a purposive sample of 340 supply chain management professionals. The results of the research indicated a significant positive relationship between supply chain dynamism and both information sharing and inter-organisational relationships, between information sharing and both inter-organisational relationships and supply chain performance, and between inter-organisational relationships and supply chain performance.

Anthea, Echendu and Kruger (2016:1) conducted research on supply chain integration in the South African conveying environment. The article described a supply chain perspective of the conveying processes in South Africa and reported some of the factors that influenced and delayed conveying transactions. The research used the exploratory and mixed method approach. The study found that many different types of delays occur at various entities across the whole supply chain involved in property transfers.

Fourie and Chimusoro (2018: 142) did research to examine the relationship between supply chain management practices and business performance. The study aimed to investigate the situation in the passenger rail firm in South Africa to determine whether its supply chain management practices can influence business performance. A quantitative method was used in this study whereby research questionnaires were distributed. Results of the study show a positive influence of supply chain management practices on business performance.

Mhelembe and Mafini (2019:01) wrote on modelling the link between supply chain risk flexibility and performance in the public sector. The objective of the study was to test the relationship between supply chain risks, flexibility and performance in the South African public sector. The study adopted a quantitative method whereby survey questionnaires were administrated to 307 supply chain practitioners who were based in the public sector in Gauteng. A structural equation modelling procedure was utilised in testing the proposed relationships. The study reveals that six supply chain factors, namely government policies, supply complexity, availability of skills,

supplier performance monitoring, information security and process efficiency exert influence on supply chain flexibility. In turn, supply chain flexibility exerts a positive influence on the performance of the public supply chain.

Mathu and Phetla (2018:1) wrote on supply chain collaboration and integration to enhance fast-moving consumer goods' manufacturers and retailers to meet consumers' requirements. The objective of the study was to establish that supply chain collaboration enhanced fast-moving consumer goods (FMCGs) and the retailer's response to customer requirements. The problem statement, therefore, looked at how a collaborative relationship enhanced the delivery of products or services to customers. The theory of collaboration and integration underpinned the study. The study pursued a qualitative research methodology to investigate whether supply chain and supply chain integration enhanced FMCGs retailers' response to consumer requirements. The study entailed examining whether supply chain and supply chain integration enhanced FMCGs' service to their customers, who are retail stores, and enhanced service to their customers, who are the end users of the products or services provided. The outcome of the study indicated that supply chain collaboration and integration of the retailers of FMCGs enhanced response to the customer's requirements.

3.6 FORMULATION OF HYPOTHESES

This section formulates hypotheses derived from the conceptual framework.

3.6.1 Supply chain integration and supply chain performance

Past researchers observed that integration between manufacturers and suppliers positively influences different performance outcomes (Flynn et al., 2010:60). The development of strong strategic partnerships with suppliers helps in facilitating their understanding and anticipation of the manufacturers' needs to meet their changing requirements better. The exchange of information between suppliers and manufacturers about processes, products, schedules and capabilities helps manufacturers in developing their production plan and in producing goods on time, leading to improved delivery performance. Information sharing among supply chain partners provides several logistics benefits. Supplier integration helps in reducing production costs, administrative costs and logistics costs. Integration with suppliers promotes cooperation and joint problem-solving routines that reduce waste and redundancy of efforts in managing supply chain activities

across partner firms. Integration with suppliers and customers helps in improving time-based performance such as product development time and procurement lead time (Flynn et al., 2010:60). Flynn et al., (2010:60) continued to add that supplier integration is important to deliver superior value to customers. The close coordination with suppliers is proven to reduce lead time and buffer stock in an organisation. Supplier integration has proven to be very critical in an organisation in terms of delivering on time, shorter cycles and lead time.

Fernandez and Jimenez (2017:3) wrote a research paper which focused on interpreting the relationship between supply chain integration and performance and also finding evidence of the moderating factors that affect the relationships, as well as to describe, classify and discuss the empirical evidence. They found that there was a positive relationship between supply chain integration and SCP; however, the moderating effects analysed showed lack of consistency since their effect and importance vary depending on the measurement used. Kumar, Zeidan, Kumari, Garza-Reyes and Tupa (2018:01) investigated SCP and integration of supply chain in Jordanian manufacturing firms and found that there was a positive correlation between supply chain integration and the overall performance of the chain. Osei and Kagniciogl (2017:01) focused on supply chain integration and performance in the food delivery industry and their findings were that there is a positive relationship between supply chain integration and performance.

3.6.2 Internal integration and supply chain resilience

The importance of internal integration has been widely highlighted in supply chain integration literature and internal integration has been found to have a positive impact on supply chain performance of the firm, including logistics performance. It has also been found to have a positive impact on time-based performance constructs such as time to market, time to product and achieving high customer responsiveness (Flynn et al., 2010:60). Zhao, Huo and Zhao (2013:05) mentioned that internal integration emphasizes the coordination among internal functions and firm-wide standards and norms. Internal integration improves process efficiency, demand management and materials management. Internal integration is very helpful in product scheduling attainment – through cross-functional coordination and working together, production planning and scheduling, customer order management and demand planning. With the help of internal integration, knowledge can be created and transferred effectively. Experts from different functions work together as a team to meet the requirements of customers, especially for new product

development and improvements in product quality. Internal integration includes the application of enterprise software systems, such as SAP, production planning and scheduling and other integrated software platforms. Osei and Kagnicioglu (2018:01) did a study on the impact of supply chain integration on firms' business and operational performance in the food industry and found that there is a positive relationship between internal integration and supply chain performance. This leads to the following hypothesis:

H1: Internal integration positively and significantly influences supply chain resilience.

3.6.3 Customer integration and supply chain resilience

Close relationships between manufacturers and customers help in improving the accuracy of demand information which helps in reducing design and production planning time for manufacturers. Tight integration with customers reduces inventory obsolesces and costs. Customer integration helps manufactures in becoming more responsive to the needs of customers, creating greater value and detecting changes quickly. Customer integration has been found to impact customer satisfaction, both directly and indirectly through its relationship with product innovation performance and quality performance. Manufacturers who integrate with customers can reduce inventories and decrease delivery times and become flexible to customer demands, hence making the supply chain more efficient (Flynn et al., 2010:69).

A study by Zhao et al., (2013:06) emphasized that strategic integration with customers highlights frequent customer interactions, during which firms discover customer preference and improve demand forecasts. When manufactures work together with their customers, their production schedules can be more accurate, and can reduce frequent schedule modifications. Bullwhip effects can also be reduced through effective communication information sharing and cooperation between manufactures and customers. The purpose of Porter's (2019:3) study on supply chain integration was to identify relationships between organisational culture types, supply chain integration and firm performance. The study found that there is a positive relationship between customer integration and supply chain performance. This leads to the following hypothesis:

H2: Supplier integration positively and significantly influences supply chain resilience.

3.6.4 Supplier integration and supply chain resilience

Development of strong strategic partnerships with suppliers helps in facilitating their understanding and anticipation of the manufacturers' needs to meet their changing requirements better. The exchange of information between suppliers and manufacturers about processes, products, schedules and capabilities helps manufactures in developing their production plan and in producing goods on time, leading to improved delivery performance. Integration with suppliers promotes cooperation, coordination and joint problem-solving routines that reduce waste and redundancy of efforts in managing supply chain activities across a firm's partners. The involvement of suppliers in the early stage of product development facilitates quicker product development and introduction time (Flynn *et al.*, 2010:69).

Manufacturing firms constantly face problems of on-time delivery (Zhao *et al.*, 2013:4). The production capacity of manufactures is limited, and they will, therefore, need to allocate their production resources to meet the requirements of varying demands at a reasonable cost. Regarding production, schedule firms need to receive the materials and components on time. Through integration with suppliers, manufacturing firms share order and inventory information with suppliers which helps the suppliers to prepare high quality materials and services on time. With high level supplier integration, manufactures are more likely to be satisfied with material or services provided by the supplier. Porter (2019:3) conducted a study on supply chain integration, and the purpose of the study was to identify relationships between organisational culture types, supply chain integration and firm performance. The study found that there is a positive relationship between supplier integration and supply chain performance. Zhang, Lettice, and Nguyen (2018:09) researched supplier integration and firm performance and their findings were that there is a positive relationship between supplier integration and supply chain performance. This leads to the following hypothesis:

H3: Customer integration positively and significantly influences supply chain resilience.

3.6.5 Supply chain resilience and supply chain performance

Globalisation in the twenty-first century has brought vitality in supply, as well as in the demand and sales of manufactured products (Aigbogun, Ghazali & Razali, 2018:1). This however has made competitions stiffer and has led business organisations to search for strategies that impact

capabilities in targeted areas of their operation. Supply chain disruptions due to events such as the loss of crucial raw materials, a major fire at a production facility or an act of terrorism have the potential to affect both cost and revenue adversely. To reduce risks, supply chains must be designed to incorporate event readiness, and provide an efficient and effective response. There is a positive relationship between supply chain resilience and supply chain performance.

Supply chain resilience entails a proactive approach which helps business organisations to sidestep avoidable risks and bounce back quickly from unexpected or unavoidable risks in the supply chain which will lead to positive supply chain performance (Aigbogun et al., 2018:3). Therefore, there is a relationship between supply chain resilience and supply chain performance. Pavel and Lenort (2012:03) stated that building a resilient supply chain is not an easy or short-term goal. It has been proven to be a strategic decision that requires a lot of effort and financial resources from all parties involved. If an organisation intends to increase their resilience and the resilience of a supply chain, their partners in the organisation must work together with a common goal and common efforts that will lead to a positive supply chain performance (Pavel & Lenort, 2012:3). Also, Kariuki, Ngugi and Odhiambo (2018:15) did a research study on the influence of supply chain resilience on the performance of hospitals in Kenya and found that there is a positive relationship between supply chain resilience and supply chain performance. This leads to the following hypotheses:

H4: Supply chain resilience positively and significantly influences the intangible dimension of supply chain performance.

H5: Supply chain resilience positively and significantly influences the tangible dimension of supply chain performance.

3.7 CONCLUSION

The present chapter focused on a literature review of the research constructs of the study. Definitions of supply chain integration were discussed in detail, and factors of supply chain integration were also discussed including its benefits. More importantly, the types of supply chain integration were discussed in detail, namely internal integration, customer integration, supplier integration. The chapter then discussed the definitions, factors influencing and outcomes of supply chain resilience which is the mediating variable. The review of literature also focused on supply chain performance, and two dimensions, namely tangible and intangible. The final part of the

chapter focused on the formulation of hypotheses, using previous literature. The next chapter presents the research methodology.

CHAPTER 4: RESEARCH METHODOLOGY

4.1. INTRODUCTION

The previous chapter of this dissertation discussed the insights from the literature on the research constructs of the research study. Supply chain integration along with its factors, importance and benefits of supply chain integration, and types/forms of supply chain integration were discussed in detail. Further, supply chain performance and factors determining supply chain performance and types, along with its benefits, were also discussed in detail. This chapter focuses on the research methodology of the research. Subjects that receive attention include the research reasoning, the research paradigm, research approaches, specifically the one chosen for this study. Research designs for the study are detailed, and the research strategy of the study are discussed.

4.2 RESEARCH REASONING

Research reasoning refers to the ability to think logically and to formulate fair judgements and justify a position. Simply, research reasoning is about analysing, identifying and evaluating arguments (Malhotra, 2017:01). Research reasoning is important because it helps the researcher identify what is recurring. This is important for the researcher as it helps to predict what will happen based on the knowledge collected (Armat, Assarroudi, Sharifi & Heydari, 2018:03). The two types of reasoning in research are inductive and deductive reasoning.

The deductive (hypothetico-deductive or falsificationist) approach is the reverse of an inductive approach. The deductive approach first builds a set of hypotheses so it can form a theory to give the best possible answer or explanation for the problem (Malhotra, 2017:2). The deductive argument can move from a general statement to a conclusion that is a singular statement. A deductive approach forms a hierarchy from theoretical to observational; from abstract to concrete. Therefore, deductive reasoning works from the more general to the more specific.

This study was based on the deductive approach to reasoning. As mentioned by Armat et al., (2018:04), the deductive approach uses previous theories, findings and conceptual models to find a solution to the current problem statement. In this study, previous articles written by various researchers were consulted, and conceptual models by previous studies were also consulted to find a solution to the research objectives and question.

4.3 RESEARCH PARADIGM/PHILOSOPHY

A research paradigm/philosophy is defined as an approach or a research model that is used by the researcher to conduct their research (Pham, 2018:1). Paradigms are important in research because they guide researchers on how to make decisions and carry out the research. A paradigm is simply guiding a way in which things should be done in research. The most common paradigms are positivism, post-positivism, phenomenology and pragmatism**.**

Pham (2018:1) described the positivism paradigm as a methodological philosophy in quantitative research whereby all methods of natural resources are applied to discover the study of social science. The positivism method helps researchers understand the objects by using empirical tests and methods as sampling – measurement, questionnaire, and focus group discussion. Grace (2018:22) mentioned that post-positivism offers a sophisticated approach. This research approach claims that a theoretical framework derived from anti-foundationalism has a key role to play in political analysis. This method focuses on developing causal explanations with insights from the interpretivist tradition.

Phenomenology is a qualitative research method that is used to describe how humans experience a certain phenomenon. A phenomenological study is a study that attempts to set aside biases and assumptions about human experiences to a situation (Giorgi, 2012:1). This method of study allows researchers to put themselves in the shoes of people who have experienced the feelings of the situation of interest. Therefore, the term phenomenology can be defined as the direct investigation and description of phenomena as consciously experienced by people living with those experiences. Kivunja and Kuyin (2017:4) mentioned pragmatism as a deconstructive paradigm, and this method of study advocates the use of mixed methods in research. This method of study focuses on what works as the truth regarding the research questions under investigation.

The current study was based on the positivism paradigm. This is because this study tested relationships between different variables and a quantitative method of study was be used to collect the data. Questionnaires were distributed for the data collection and results were tested, and conclusions were made based on these results.

4.4 RESEARCH APPROACH

Research approaches are defined as a plan or procedure that consists of steps of broad assumptions to a detailed method of data collection interpretation and analysis (Khaldi, 2017:1) A research approach is important because it guides the researcher on how to collect data and which method to use to collect the data to answer the research problem (Creswell, 2014:23). The three types of research are qualitative, quantitative and the mixed method approach.

The qualitative approach is defined as a research process whereby questions and procedures are involved (Khaldi, 2017:01). Data is collected through interviews with a selected sample and interpretations are made from the data to give solutions to the problem or answer the research question. This type of research method relies on collecting non-numerical or categorical data such as words and pictures and it can also be interactive or non-interactive. Khaldi (2017:5) defined the quantitative research approach as a means for testing objective theories by examining the relationship among variables. These variables can be measured by instruments so that numbered data can be analysed using statistical procedures

The mixed method approach is comprised of both the qualitative and quantitative approach components that direct the theoretical drive, with qualitative or quantitative supplementary components. These components of the research fit together to enhance description, understanding and can either be conducted simultaneously or sequentially (Khaldi, 2017:8). Creswell (2017:41) added that mixed methods involve the integration of the qualitative and quantitative methods in a research study

In this research study, a quantitative approach was followed. This was necessitated by the need to generalise the study to the rail industry in South Africa. Additionally, the study tested various relationships between separate constructs. Research questionnaires were distributed in the rail industry and then tested to come up with the solution for the research problem.

4.5 RESEARCH DESIGN

A research design can be defined as a set of methods that are used in collecting and analysing measures of the variables specified in a research problem (Ritchie & Lewis, 2013:1). Research designs are important in research because the design allows flexibility of various research

operations. There are several types of research designs which are surveys, cross-sectional survey designs, longitudinal survey designs, trend studies, observation, and participant observation. Survey research designs are procedures in quantitative research in which investigators administer a survey to a sample or the entire population of people to describe the attitudes, opinions, behaviours or characteristics of the people. Ritchie and Lewis (2013:2) mentioned that with cross-sectional design the researcher collects data at one point in time.

With trend studies, the researcher tries to study changes within some general population over a period. Trend studies identify a population and examine changes within that period (Ritchie & Lewis, 2013:6). Longitudinal survey design involves the procedure of collecting data about the same trends with the same population. In this kind of study, participants may be different or the same kind of population, for example a longitudinal design would involve a follow-up with graduates from a programme or school to learn their views about educational experiences (Ritchie & Lewis, 2013:5).

This research study used the cross-sectional survey method of study. Research questionnaires were distributed to respondents in the South African rail industry once at a specific period of time.

4.6 LITERATURE REVIEW

A literature review can be defined as a comprehensive study and interpretation of literature that addresses a specific topic. Literature reviews are generally conducted in one of two ways (Aveyard, 2010:1). First as a preliminary review before a larger study in order to critically evaluate the current literature and justify why further study and research are required. In this case, the researcher must search critique and combine the literature to demonstrate a gap in the existing research base while demonstrating their understanding of both the research and the methods previously used to investigate the area. Second, the literature review can be defined as a project itself that provides the comprehensive survey of the works published in a discipline or area of research over a specific period. This type evaluates and interprets all available research evidence relevant to a question.

The importance of a literature review is that it creates a rapport with the audience of the researcher. A literature review helps create support with the audience of the researcher so they can trust that the researcher has done their homework. It helps to avoid plagiarism because before writing on a specific topic, the researcher must first research and see whether the research question has been

dealt with or not. A literature review also helps to sharpen the research focus because it helps to determine what the researcher is doing in a historical context of the research (Aveyard, 2010:05).

In this study, a comprehensive review of literature was conducted and reported in Chapters 2 and 3.

4.7. SAMPLING DESIGN

A sampling design can be defined as a framework of methods chosen by the researcher to bring together components of research so that the research questionnaire can be answered (Asiamah, Mensah & Oteng-Abayie, 2017:1). The main purpose of a sample design is to provide a plan of study where accurate assessments between relationships can be conducted.

4.7.1 Population

A population can be described as a large collection of individuals that is the focus of the research (Asiamah et al., 2017:5). In this study the population was composed of supply chain and operations professionals in the rail industry in South Africa. Hassan and Madugu (2015:2) view the population as an aggregation of elements from which a sample survey is selected. Hassan and Madugu (2015:2) added that the population can be made up of subjects or observations relating to a specific situation.

4.7.2 Target population

A target population is seen as a group of people the researcher wants to serve in order for the results to be effective. The purpose and objectives of the research should be driven by the target population. Hassan and Madugu (2015:5) mentioned that researchers must understand the purpose of a target population and agree to the goals and objectives. To remain focused and achieve goals and objectives a target population that supports these goals and objectives should be defined. The needs of the proposed target population should be examined against overall goals. And additional goals and objectives can be defined more specifically to reflect the needs of the target population. In this study, the target population was composed of supply chain and operations professionals in the rail industry in Gauteng Province (Asiamah et al., 2017:8).

4.7.3 Sample size

The sample size can be defined as the number of participants that will be included in the study (Bala & Etikan, 2017:03). The sample size of a study is important because it influences the conclusion drawn from the study (Ajay & Micah, 2014:6).

Sample size depends on the study parameters such as the minimum expected difference or effect size, estimated measurement variability and desired statistical power. On the basis of minimum expected or size effects – if the minimum expected difference is made smaller, the sample size needed to detect statistical importance increases. The setting of this parameter is subjective and based on judgement of the problem being investigated (Ajay & Micah, 2014:10). Estimated measurement variability – for this parameter, as the statistical variability increases the sample size needed to detect the minimum differences increases. The estimated measurement variability should be determined on preliminary data collected from the study population (Ajay & Micah, 2014:010). Statistical power – for this parameter, as the power increases the sample also increases. While the power is high, there is an obvious trade off with the number of individuals that can be investigated given enough time and resources available to conduct research or a study of investigation (Ajay & Micah, 2014:10).

The sample size pegged for this study was 350 respondents. Several studies conducted on SCM in South Africa, for example Mathabatha (2015:100); Hutching (2017:08); Madubanya (2015:60); Dibakoane (2013:45); Kayster (2014:45), used sample sizes ranging between 200 and 500. Hence the sample size used in this study was within these thresholds.

4.8 SAMPLING APPROACH

Sampling approach is the way in which observations are selected from a population. The main purpose is for the researcher to avoid being biased in their study. There are two types of sampling approach, probability sampling and non-probability sampling (Taherdoost, 2016:04). With probability sampling, each item in the population has an equal chance of being included in the sample. For example, putting names of people in one hat and then taking out any person's name to maybe start with a certain game. Probability sampling has the greatest freedom from bias but may represent the costliest sample in terms of time and energy for a given level of sampling error. Non-probability sampling can be associated with a case study research design and qualitative

research. Case studies are intended to examine a real-life situation, and they focus on a small sample. With this kind of sampling, a sample of participants or cases does not need to be representative or random but, a clear rationale is needed for the inclusion of some cases or individuals rather than others (Taherdoost, 2016:4).

In this study research, the probability sampling method was applied. Examples of probability sampling techniques include the simple random, systematic, stratified and cluster sampling. Non-probability techniques include quota, snowball, convenience and purposive sampling techniques. In this study, respondents were selected using purposive sampling, which is a technique in which events are selected deliberately in order to provide important information that cannot be obtained from other choices. It is where a researcher includes participants or cases because they believe that they should be included (Taherdoost, 2016:06). In this study, only supply chain and operations professionals were chosen because of their knowledge of the subject under investigation in this study.

4.9 DATA COLLECTION INSTRUMENT

Data collection is a means of collecting data from the respondents (Maloi, 2016:70). In this study, data was collected using a structured survey questionnaire.

The questionnaire was divided into four sections. The four sections included information on demographic characteristics of individual respondents, supply chain integration, supply chain resilience and supply chain performance.

Section A focused on demographic characteristics and occupational area of respondents in the organisation, their gender, age, educational level, the period they worked in the organisation and the race of respondents. Section B focused on the supply chain integration and its elements – internal integration, supplier integration and customer integration. This construct was measured with six items using a five-point scale: 1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5=strongly agree, adapted from Hooshang, Oghazi, Mostaghel and Hultman (2014:04).

Section C focused on the supply chain resilience, which was measured with six items using a five-point scale: 1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5=strongly agree, adapted from Liu and Lee (2018:06).

Section D focused on supply chain performance using a five-point scale: 1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5=strongly agree, adapted from Hooshang *et al*. (2014:03). Supply chain performance had two dimensions, the tangible dimension was measured using four items, and the intangible dimension was measured using six items.

Items in Sections B to D were measured on a five-point Likert scale: 1= strongly disagree to 5= strongly agree to express the degree of agreement. The Likert-type scale was chosen because it is appropriate when assessing questions for a research study.

As indicated above, measurement scales used in this study were adapted to suit the need of this study. Teresa and Hagan (2014:5) stated that the adaptation of measurement instruments is significant because reliability is important for the researcher to have confidence in their study because their measures taken will be close to the true measure. The constructs in this study are already known which was helpful because it facilitated the accurate adaptation of measurements scales. In adapting the measurement scales, attention was paid to selecting suitable instruments that fit the context of the study and the respondents that were targeted. The actual process of adapting the scales included reducing number of words and adjusting the language to make the questionnaire suitable and less complex for the respondents.

4.10 PROCEDURES FOR DATA COLLECTION

This study made use of the purposive probability sampling technique to collect data from respondents. Muhammuad and Kabir (2016:10) stated the various methods used to collect quantitative data in survey research, which include email, telephone, postal, group administered and online questionnaires. This study made use the physical distribution of questionnaires or drop and collect method which refers to the researcher physically distributing questionnaires by dropping them off and then collecting them once they have been completed.

Questionnaires were distributed in person by the researcher during the months of April to September 2019. The researcher was assisted by two assistants in the distribution process to ensure a speedy and effective process. While respondents were initially given two weeks to complete the questionnaires, some respondents took a month to complete the questionnaires. However, eventually, they still completed the questionnaires and gave them back to the researcher. Funds used in preparation and administration of the questionnaire were provided by the research office

at the Vaal University of Technology, Vanderbijlpark campus located in Southern Gauteng. Initially, 350 questionnaires were issued and distributed to respondents. Out of the 350, 300 were retrieved, and 280 had been properly completed which became evident after screening and recording the data on an Excel sheet. Twenty questionnaires were not completed and were subsequently discarded from the study.

4.11 DATA ANALYSIS AND STATISTICAL APPROACH

In analysing the collected data, the first step taken was to screen the questionnaires. Questionnaires that had errors or were not completed fully were discarded. The second step was to code the data on an Excel spreadsheet. Then the data was cleaned to be able to identify and correct missing entries. The data was then imported into SPSS version 25.0 format. Descriptive statistics were used to analyse data pertaining to the demographic profiles of the respondents and to explore their perceptions of the research constructs. The final stages of data analysis included confirmatory factor analysis to test for scale accuracy and path modelling using Analysis of Moment Structures (AMOS version 25.0) statistical software to test the hypotheses.

4.11.1 Descriptive statistics

Descriptive statistics are a summary that describes or summarises features of a collection of information. Examples of descriptive statistics include mean, mode, median, range, variance and standard deviation. The demographic profile of respondents in this study was analysed using simple frequency table and percentages (Henseler, Hunona & Ray, 2016:15).

4.12 CONFIRMATORY FACTOR ANALYSIS

For construct validation, researchers often use confirmatory factor analysis, which is completed by means of structural equation modelling and is only used for measurement parts of the model (Author Prudon, 2015:03). Confirmatory factor analysis is also seen as a statistical procedure for testing the psychometric properties of measurement scales to determine reliability, assessment of validity and model fit. These three phases were followed in this study.

4.12.1 Reliability (Internal consistency)

Reliability refers to the ability of research methods to provide stable and consistent results. The reliability of instruments of the present study was assessed using Cronbach's alpha value and composite reliability value (Flake, Pek & Hehman, 2017:5).

4.12.2 Cronbach's alpha coefficient

Cronbach's alpha coefficient (α) determines the mean reliability coefficient for all possible ways of splitting a set of items in half (Bonett &Wright, 2014:2). The value is between 0 and 1, and it represents the level of reliability in the measurement. However, the value of α is considered better when it gets closer to 1, and a minimum value of 0.7 is expected. If reliability of the study is low, the cause can be due to only choosing a few items to analyse. The Cronbach alpha results for the present study are provided in Chapter 5 of this study.

4.12.3 Composite reliability

Composite reliability is a method used to assess the internal consistency of a measurement model (Bacon, Sauer & Young, 2015, 5). The formulae used to calculate composite reliability is

(CR): CRη= (Σλyi) 2 / [(Σλyi) 2 + (Σεi)]

Composite reliability = (square of the summation of the factor loadings) / {(square of the summation of the factor loadings) + (summation of error variances)}.

The acceptable minimum threshold for composite reliability is 0.7 (Olivares, 2014:4).

4.12.4 Validity

Validity means that the findings of the research truly represent the fact the researcher is trying to measure (Flake *et al,* 2017:5). There are three measurement properties for validity in research which are: construct validity, content validity and criterion validity. This study focused on content and construct validity.

4.12.4.1 Construct validity

Construct validity occurs when a measure relates to other measures that it should be related to (Brown, 2010:05). There are two types of validity in construct validity which are convergent validity and discriminant validity. Chinomona, Dhurup and Chinomona (2013:08) mentioned that convergent validity occurs when measures that are supposed to be related are related, items should be related to other items that measure the same construct. In this study, convergent validity was assessed using item loading values (standardised regression weights) and AVE values (which refer to the overall amount of variance in the indicators accounted for by the latent construct). Standardised regression weights greater than 0.50 show that the indicators are a good representation of the latent construct while AVE values should be greater than 0.4 (Chinomona *et al,* 2013:11).

4.12.4.2 Discriminant validity

Discriminant validity refers to the extent to which measurers of different constructs correlate with each other (Engellant, Holland and Piper, 2016:3). Discriminant validity tests whether constructs that are not supposed to be related are unrelated. A correlation matrix was used to discover the discriminant validity of this study, which indicated a threshold of correlation value between constructs to be less than 0.7 (Engellant et al., 2016:4).

4.12.4.3 Content validity

Content validity refers to the extent to which all facets are represented in a given construct. In this study, content validity was ascertained through a review of the questionnaire by the research study supervisor and feedback was used to modify the questionnaire (Chinomona et al., 2013:8).

4.12.4.4 Face validity

Face validity refers to the researcher being able to answer whether the measurements are measuring what they claim to measure. Face measure represents how a project is at face value. It assesses what it superficially appears to measure (Hassan, Sulaiman, & Kamarudin, 2018:11). Face validity assesses whether the test "looks valid" to the examinees who take it, the administrative personnel who decide on its use, and other technically untrained observers. In this study, face validity was

established through a pilot study involving a convenient sample of 50 respondents (Chinomona *et al.,* 2013:08).

4.13 RESEARCH MODEL FIT ASSESSMENT

The main goal of model fitting is to determine how well the data fit the model (Karakaya & Asku-Dunya 2018:15). On how to determine the statistical significance of a theoretical model, three criteria are used. The first is non-statistical significance of the chi-square test and a non-statistically significant chi-square value indicates that the sample covariance matrix and the model-implied covariance matrix are similar. Second, the statistical significance of each parameter estimates the oaths in the model. They are known are critical values and are computed by dividing the unstandardised parameters. If the critical values or *t* are more than 1.96, they are significant at the .05 level (Hoofs, Van De Schoot, Nicloe & Kant, 2018:9). Thirdly, one should consider the magnitude and direction of the parameter estimate to ensure they are consistent with the substantive theory.

The model fit criteria used are: (1) Comparative fit index (CFI), (2) Goodness of fit index (GFI), (3) Incremental fit index (IFI), (4) Normed fit index (NFI), and (5) Root mean square error of approximation (RMSEA) (Chinomona et al., 2013:15).

The GFI assess the relative amount of the observed variances and covariances explained by the model. For a good fit, the recommended value should be GFI> 0.95 (1being a perfect). NFI is concerned with the proportion by which the researcher's model improves fit compared to the null model (random variables), and its acceptable value should be equal or greater than 0.90 to be acceptable. IFI's threshold should be equal or greater than 0.9. RMSEA focuses on the error of approximation in the population. This value provides insight about how well the model would, with unknown but optimally chosen parameter values, fit the population covariance matrix if it were available. As such, the acceptability of the RMSEA is established if its value is less than or equal to 0.08 (Hoofs, Van De Schoot, Nicloe & Kant, 2018:9). Results of these respective model fit criteria are reported in Chapter 5 of the research study.

4.14 PATH MODELING

Path modelling can be defined as a statistical method which can be used in studying relationships among research variables (Sanchez, 2013:13). The actual testing of the hypothesis requires the implementation of structural equation modelling (SEM) (Henseler, Hunona & Ray, 2016:12). In this study, the AMOS 25.0 software was used to perform SEM, which provided results of the path modelling and hypotheses testing of the current study. Results of the actual analysis are reported in the next chapter, Chapter 5.

4.15 ETHICAL CONSIDERATIONS

The following ethical considerations were followed during the study;

- Confidentiality and privacy. This is one of the ethical considerations that any researcher should apply in their research (Fouka & Mantzorou, 2011:04). The researcher treated each questionnaire from respondents confidentially and avoided revealing to others the private details of respondents as well as the identity of organisations that participated to this investigation (Akaranga & Makau, 2016:8).

- Prevention from harm. The researcher was mindful of the well-being of the respondents in their investigations. The researcher of this study ensured that all respondents did not suffer any harm in their participation in the study (Fouka & Mantzorou, 2011:4).

- Informed consent and voluntary participation. Informed consent and voluntary participation can be viewed as the respondents participating voluntarily in the research without being forced to do so (Roshaidai & Arifin, 2018:02). Respondents were not forced to participate in this study, were not given any incentives for participating and could withdraw from participating in the study at any time. All respondents signed an informed consent form before participating in the study.

4.16 CONCLUSION

This chapter presented the research design and methodology. The research paradigms, approach and design, were discussed. It emerged that the study followed deductive reasoning and was based on the positivist paradigm. The study also followed a quantitative approach and used a cross-

sectional survey design. The sampling design with aspects such as target population, sampling frame and size as well as data collection methods and techniques with ethical considerations were discussed in this chapter. Respondents were purposively selected supply chain and operations professionals from the rail industry in Gauteng province. A measurement instrument adapted from various previous studies was used to collect data. Lastly, a review of the procedures for data analysis was also conducted and the collected data was analysed using a combination of descriptive and inferential statistics. Various ethical considerations in this study such as informed consent, privacy and confidentiality and protection from harm were also discussed. The next chapter comprises the presentation, analysis and interpretation of the collected data.

CHAPTER 5: DATA ANALYSIS, PRESENTATION AND INTERPRETATION OF RESULTS

5.1. INTRODUCTION

Chapter 4 of this study focused on the research methodology where the research paradigm and research approach of the study were discussed, with the research design of the study also being detailed. The ethical considerations related to this study were highlighted in the previous chapter. Chapter 5 of this study deals with the data analysis, presentation and interpretations of results. The chapter also provides information on the demographic profile of the respondents, descriptive statistics for constructs, confirmatory factor analysis, reliability, conceptual model fit assessment, path analysis results and hypothesis testing of the study.

5.2. RESULTS OF THE PILOT STUDY

Prior to the collection of primary data, a pilot study was conducted in order to test the suitability of the measurement instrument (questionnaires). A pilot study refers to a mini version of a full scale also called a feasibility study as well as a specific pre-testing of a research instrument such as a questionnaire (Van Teijlingen, 2014:01). Pilot studies are a crucial element of a good study design (Fraser, Fahlman, Arscott & Guillot, 2018:01). The data for the pilot study was collected between February 2019 and March 2019. The pilot study included supply chain management and operations professionals employed by Gibela Rail Transport Consortium, Alstom Ubunye and Passenger Rail Agency of South Africa. The respondents that participated in the pilot study were selected using the convenience sampling technique. The results of the pilot study are presented in Table 5.1 and briefly analysed thereafter.

Table 5.1: Results of the pilot study

Constructs	Number of items	Cronbach alpha	Number of items deleted	Actions taken & reasons
Internal Integration	6	0.911	0	-
Supplier Integration	6	0.470	6	Scale replaced with new items Low reliability Low -item total correlations
Customer Integration	6	0.859	0	-
Supply Chain Resilience	6	0.911	0	-
Tangible Dimension	4	0.909	0	-
Intangible Dimension	6	0.934	0	-

Source: Author's own compilation

As indicated in Table 5.1, in the pilot study, internal integration had six items and attained a Cronbach alpha value of 0.911. As such, no items were deleted from this scale. Supplier integration had six items and attained a Cronbach alpha value of 0.470. Because of a low reliability (alpha=0.470), all six items were deleted from this scale and replaced with new items. Customer integration had six items and attained a Cronbach alpha value of 0.859. No items were deleted from this scale. Supply chain resilience had six items and obtained a Cronbach alpha of 0.911 and no items were deleted in this scale. The tangible dimension of supply chain performance had four items with a Cronbach alpha of 0.909 with no items deleted in this scale. The intangible dimension had six items and achieved a Cronbach alpha of 0.934 with no items deleted in this scale.

5.3 DEMOGRAPHIC PROFILE OF RESPONDENTS

This section discusses the results of the analysis of the demographic profile of respondents. The demographics that were considered in the analysis include the occupational position, gender, age group, educational level, employment and race. These questions were presented in Section A of the questionnaire.

The percentages and frequencies of results related to gender, age, race and highest academic qualification are presented in Table 5.2.

Table 5.2: Descriptive statistics for the demographic profile of respondents

Variable	Category	Frequency (n)	Percentage (%)
(A1) Gender	Male	123	43.9
	Female	157	56.1
Total		n=280	100
(A2) Age	18-25 years	42	15
	26-30 years	110	39.3
	31-35 years	83	29.6
	36-40 years	30	10.7
	41-50 years	13	4.6
	50 years and above	2	7
Total		n=280	100
(A3) Highest qualification	Matric	26	9.3
	Diploma	88	31.4
	Degree	132	47.1
	Postgraduate diploma	23	8.2
	Masters	8	2.9
	PHD	1	.4
	Professional qualification	1	.4
	Others	1	.4
		n=280	100
(A4) Employment period	Less than 2 years	120	42.9
	2-5 years	119	42.5
	6-10 years	26	9.3
	11-15 years	11	3.9
	16-20 years	2	.7
	20 years and more	2	.7
		n=280	100
(A5) Race	Black (African)	234	86.6
	White	23	8.2
	Indian	15	5.4

	Mixed Race (Coloured) Other	8 0	2.9 .
		n=280	100

The discussion of each specific category are provided in Section 5.1.

5.3.1 Gender distribution of respondents

Figure 5.1 provides a graphical illustration of the gender structure of the surveyed respondents being shown in the pie chart below. The male population registered a total of 123 respondents which amounts to 43.9% if converted to percentages whereas the female gender registered a total of 157 which is 56.1% if recorded in percentages. The percentages of both genders show an equal representation of males and females in the South African Rail Industry in Gauteng.

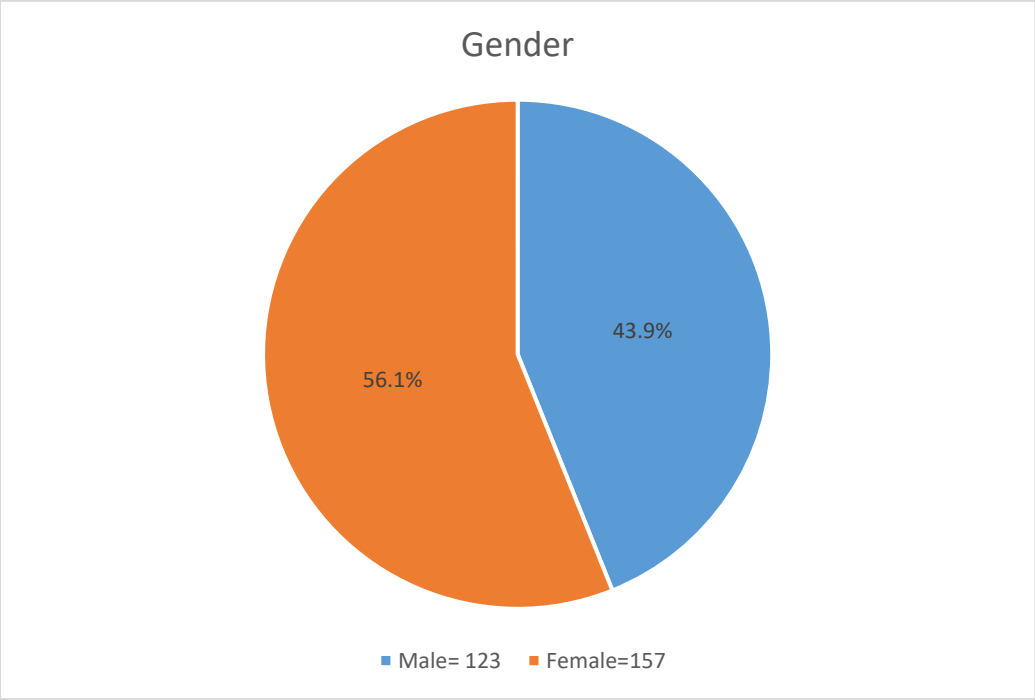

Figure 5.1: Gender distribution of respondents

Source: Author's own compilation

5.3.2 Age distribution of the respondents

In terms of the age distribution, the results show that a large portion of professionals in the rail industry are aged 26-30 years (n=110) amounting to 39.3%. This is followed by the ages 31-35 years which totals (n=83) with 29.6%. A total number of 42 respondents which amounts to 15% of the total sample are aged between 18-25 years. This is followed by 10.7% which represents 30 respondents between the ages of 36-40 years. Thirteen respondents aged between 41-50 years amounts to 4.6% and two respondents from 50 and above amounts to 7%. The results are shown in Figure 5.2.

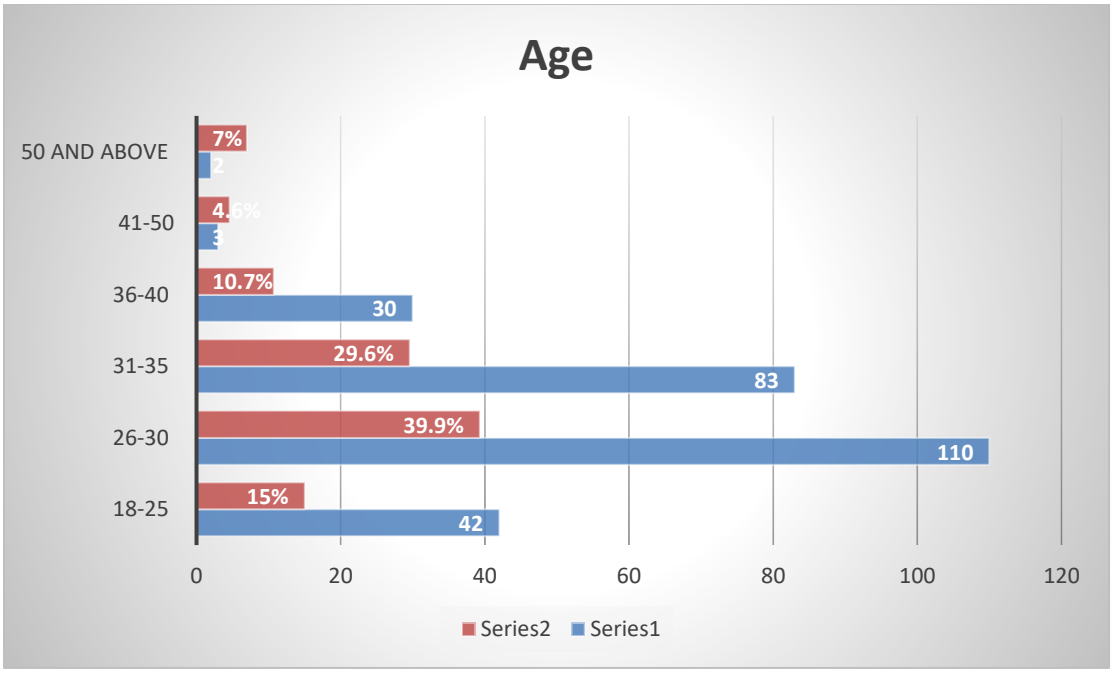

Figure 5.2: Age distribution of respondents

Source: Author's own compilation

5.3.3 Highest qualification distribution of respondents

Based on the results of this study, the qualifications of the respondents show that out of n=280, 9.3% (26) are matriculates whilst 31.4% (88) have a diploma. The results also indicate that 132 respondents which amounts to 47.1% are degree holders. Twenty-three respondents have a

postgraduate diploma which amounts to 8.2%. Only eight respondents hold a master's degree which amounts to 2.9%. Regarding a PHD, professional qualification and other, only one respondent was in each of these categories which if converted to a percentage amounts to 0.4%. The results are shown in Figure 5.3 below.

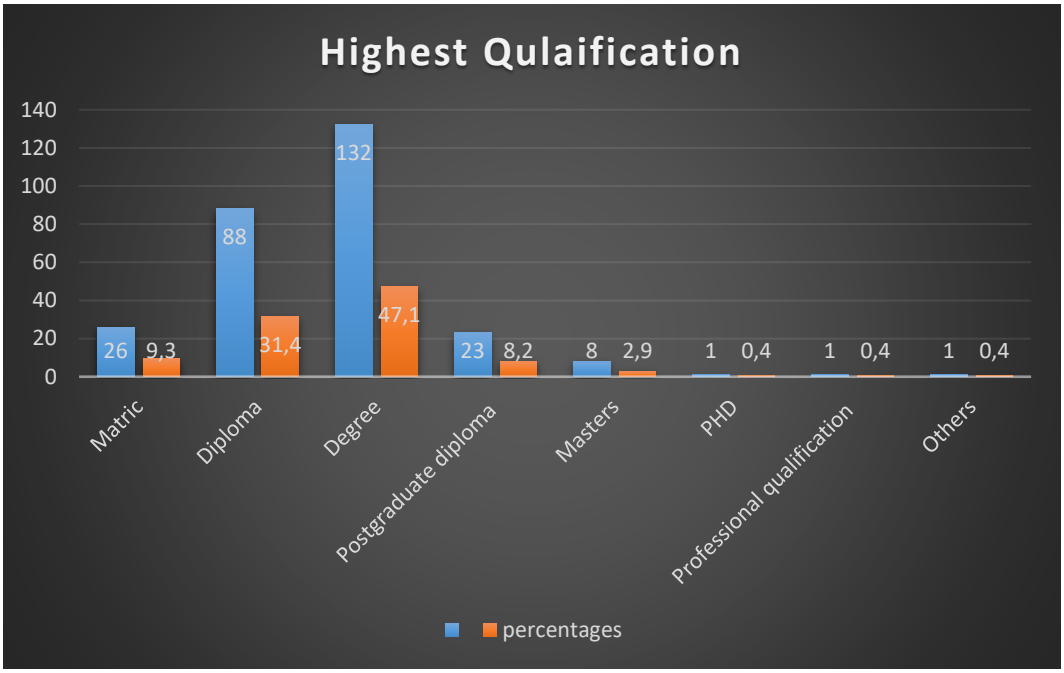

Figure 5.3: Highest qualification distribution

Source: Author's own compilation

5.3.4 The employment period of respondents

The results in Figure 5.4 below show that 42.9 percent (120) of the surveyed respondents have been employed in their organisation for less than two years. The results also show that n=119 (42.5%) have been employed between 2-5 years; 26 (9.3%) respondents have been employed between 6-10 years; 11 (3.9%) have been employed between 11-15 years; and two respondents (0.7%) have been employed between 16-20 years, and 20 years and more.

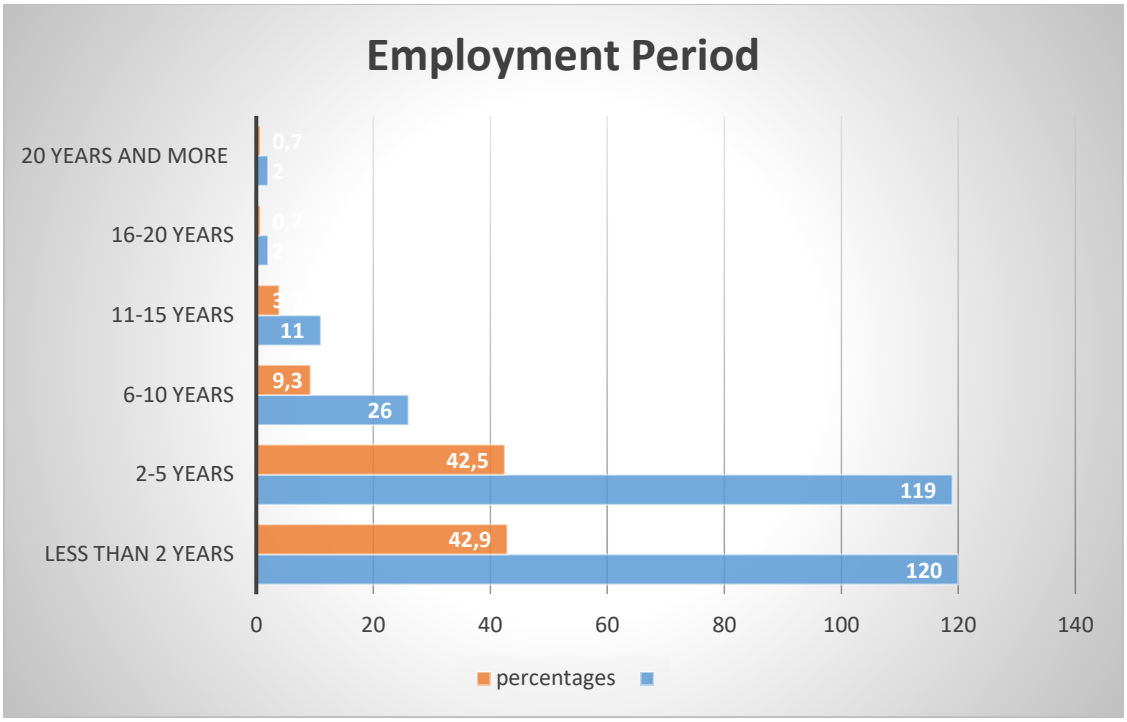

Figure 5.4: Employment period in the organisation

Source: Author's own compilation

5.3.5 Race distribution

Regarding the race distribution of the respondents, the highest percentage is the black (African) race at 86.6% (n=234) in the rail industry. The black race is then followed by white race with 8.2% (23); third is 5.4% (n=15) which is to Indian race; second last, 2.9% (n=8), is mixed (Coloured) race; and last which was other had no respondents. The results are shown in Figure 5.5 below.

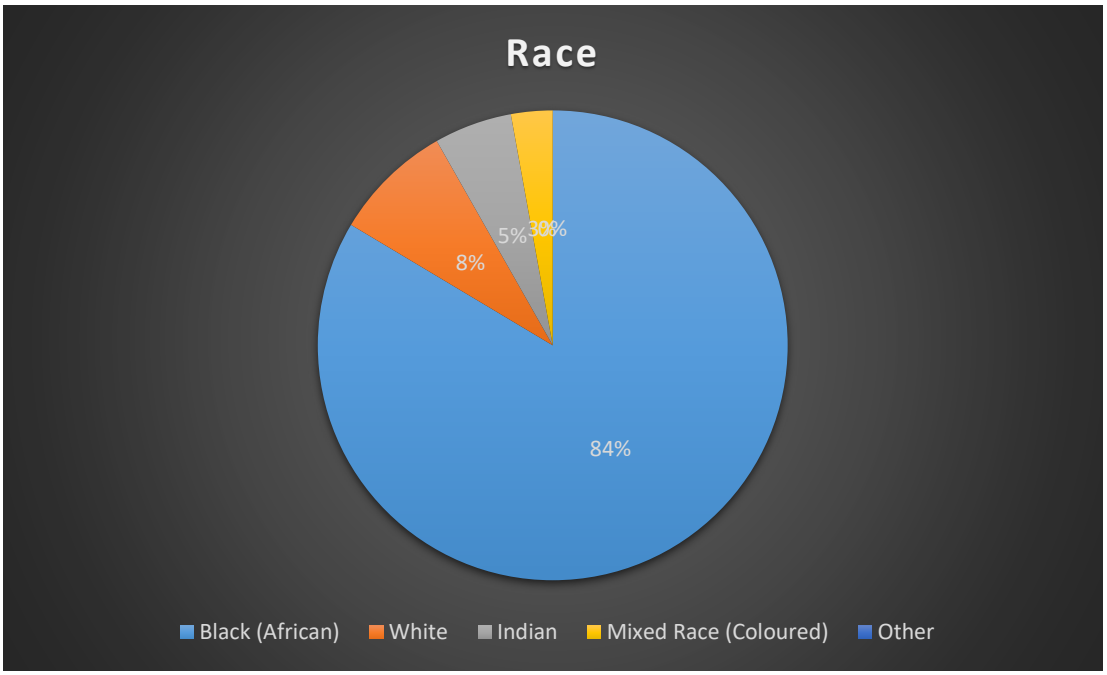

Figure 5.5: Racial distribution of the respondents

Source: Author's own compilation

5.4 DESCRPITIVE STATISTICS FOR CONSTRUCTS

This study tested relationships between five constructs with its dimensions, namely supply chain integration with its dimensions: Internal integration, supplier integration and customer integration. The second construct is supply chain resilience and lastly supply chain performance with its dimensions: Tangible dimension and intangible dimension. The study used descriptive statistics to explore the respondents' perceptions of the constructs. It was essential to establish the respondents' perceptions of these constructs to obtain a clear indication of their degree of affirmation (1-strongly disagree, 2-disagree, 3- neutral, 4- agree, 5 – strongly agree).

Statistics such as the minimum and maximum values, mean score, standard deviation, skewness and kurtosis were considered. Minimum and maximum values represent the degree of strongly disagree or strongly agree as provided on the Likert scale. The standard deviation was applied to determine how dispersed the data values were. Skewness and kurtosis were applied to establish the normality of data distribution.

Skewness is the level of asymmetry from data distribution (Bono, Arnau, Alarcon, & Blanca, 2019:03). The distribution of data can either be positive or negative. Positive skew means the data results are larger and bring the average up. Negative skew means the results are smaller than the median, therefore they bring results down (Jain, 2018:05).

Kurtosis measures the combined weight of tails relative to the rest of the distribution (Chen, & Xia, 2019: 06). Skewness close to 0 and kurtosis close to 3 is favourable (Jain, 2018:4). Bono, Arnau, Alarcon and Blanca (2019:02) highlighted that skewness and kurtosis are both indicators of how balanced the data set is against the median; however, it does not offer anything more than that.

Table 5.3: Descriptive statistics for internal integration

Item	Description Valid: (N=280)	Minimum	Maximum	Mean	Standard deviation	Skewness	Kurtosis statistics
II1	In our firm, there is data integration among internal functions.	1	5	**2.90**	1.188	.266	-.868
II2	In our firm, there is real-time inventory management.	1	5	3.08	1.060	.141	-.657
II3	In our firm, there is real-time access to logistics – related information.	1	5	3.05	1.101	.169	-.710
II4	In our firm, there is data integration in operation processes.	1	5	3.07	1.022	.092	-.498
II5	In our firm, there are regular information exchange amongst cross-functional teams.	2	5	3.11	1.048	.090	-.636
II6	In our firm, there is online interaction between operations and sales functions.	1	5	3.08	1.122	.190	-.724
Overall scale				3.05	1.09	0.43	-.682

Source: Author's own compilation

Table 5.3 shows the six items that were tested in the rail industry. The average mean value and standard deviation of ($\bar{x}$=3.04: SD ± 1.181) show that respondents were neutral with the measurement instruments. The highest mean value was obtained from II5 (in our firm, there is online interaction between operations and sales functions and the mean was ($\bar{x}$=3.11: SD ±1.048)). This shows the degree to which internal integration can influence a firm positively or negatively. The lowest mean value was obtained from II1 (in our firm, there is data integration among internal functions. With the mean value of ($\bar{x}$=2.90) and standard deviation of SD ± 1.188). Average values for skewness and kurtosis were .158 and -.682. The skewness to the right means that the majority of responses were aligned towards the agreement (right side) of measurement items.

II2 measured if there is real time inventory management in supply chain integration and shows a mean of ($\bar{x}$=3.08: SD ±1.060). II3 (in our firm, there is real time access to logistics related information) has a mean and standard deviation of ($\bar{x}$=3.05: SD ±1.101). II4 shows mean and standard deviation of ($\bar{x}$=3.07: SD ±1.022), with the item (in our firm, there is data integration in operations processes). II6 (in our firm, there is online interaction between operations and sales functions with ($\bar{x}$=3.08: SD ±1.122).

This shows how important supply chain integration is in every organisation – internal functions need to communicate with each other, systems needs to be in place, and inventory management needs to be in place and accurate. Poor internal integration will automatically lead to poor firm performance (Topolsek & Orthaber, 2011:05).

Table 5.4: Descriptive statistics for supplier integration

Item	Description Valid: (N=280)	Minimum	Maximum	Mean	Standard deviation	Skewness	Kurtosis statistics
SI1	In our firm, there is information exchange with suppliers through the internet or web-based technologies.	1	5	3.09	1.097	.110	-.740
SI2	Our firm has managed to establish strategic partnerships with suppliers.	1	5	3.10	1.073	.150	-.722

Item	Description Valid: (N=280)	Minimum	Maximum	Mean	Standard deviation	Skewness	Kurtosis statistics
SI3	Our firm's suppliers participate in the planning stage of our operations.	1	3	**3.15**	2.106	10.265	-.145
SI4	Our firm's suppliers participate in the process of procurement and production.	1	5	3	1.145	.072	-.849
SI5	Our firm has established a quick ordering system.	2	5	**2.95**	1.025	0.60	-.470
SI6	In our firm, there is stable procurement through networks (e.g. EDI).	1	5	2.99	1.044	.110	-.500
Overall scale				3.04	1.25	1.99	-0.571

Source: Author's own compilation

Table 5.4 shows six measurements that were tested in the rail industry with a mean value of and standard deviation of ($\bar{x}$=3.04: SD ± 1.24). SI3 has the highest mean value of ($\bar{x}$=3.15: SD ± 2.106) measured by (our firm's suppliers participate in the planning stage of our operations. This shows that suppliers are interested in the planning stage of firm operations so they can form a long-term relationship with companies in the rail industry. The lowest mean value is ($\bar{x}$=2.99: SD ± 1.044) measured by (in our firm, there is stable procurement through networks, e.g. EDI). This shows that there still need to improve networks in the railway industry. SI1 (in our firm there is information exchange with suppliers through the internet or web-based technologies) has a mean value of ($\bar{x}$=3.09: SD ± 1.097). SI2 (our firm has managed to establish strategic partnerships with suppliers) has a mean of ($\bar{x}$=3.10: SD ± 1.073). SI5 has a mean of ($\bar{x}$=3.00: SD ± 1.145) represented by this item (our firm has established a quick ordering system.

Table 5.5: Descriptive statistics for customer integration

Item	Description Valid: (N=280)	Minimum	Maximum	Mean	Standard deviation	Skewness	Kurtosis statistics
CI1	Our firm has implemented integrated demand forecasting.	1	7	5.98	1.089	-1.646	-.326
CI2	Our firm has implemented online order taking.	1	7	**6.18**	0.977	-1.836	-.676
CI3	The ordering process used in our firm are fast.	1	7	6.00	0.964	-1.495	-.545
CI4	Our firm has effective customer profiling system.	1	7	5.93	1.188	-1.413	-.588
CI5	Our firm has an effective after-sales service support system.	2	7	**5.92**	1.067	-1.264	-.737
CI6	Our firm follows up with customers for feedback.	1	7	5.95	1.245	-1.544	-.608
Overall scale				5.99	1.088	-1.533	-0.58

Source: Author's own compilation

Table 5.5 represents six measurement instruments that were tested in the rail industry with a mean value and standard deviation of ($\bar{x}$=3.14 : SD ± 1.09). Item CI6 has the highest mean value of ($\bar{x}$=3.30: SD ± 1.118) with this item (our firm follows up with customers for feedback), which proves that companies in rail are about satisfying their customers. The lowest mean value is ($\bar{x}$=3.03: SD ± 1.035) CI1 (our firm has implemented integrated demand forecasting). This shows that there needs to more improvements when it comes to integrated demand forecasting in the rail industry. CI3 (the ordering processes used in our firm are fast) has a mean value of ($\bar{x}$=3.06: SD ± 1.069). CI2 (our firm has implemented online order taking) has a mean of ($\bar{x}$=3.05: SD ± 1.161). CI4 has a mean value of ($\bar{x}$=3.17: SD ± 1.062) with this measurement item (our firm has an effective customer profiling system. CI5 (our firm has an effective after sales service support) has a mean value of ($\bar{x}$=3.26: SD ± 1.146).

Table 5.6: Descriptive statistics for supply chain resilience

Item	Description Valid: (N=280)	Minimum	Maximum	Mean	Standard deviation	Skewness	Kurtosis statistics
SR1	Our firm is capable to anticipate and overcome disruptions in the supply chain network.	1	5	**3**	1.142	.029	-.804
SR2	We have the ability to quickly react to interruptions by reconfiguring resources and establish to usual operations.	1	5	3.09	1.040	.058	-.417
SR3	Operations would be able to continue after the occurrence of disruptions.	1	5	3.21	1.047	.067	-.606
SR4	We would still be able to meet customer demand.	1	5	**3.23**	1.054	.005	-.663
SR5	Performance does not diverge significantly from goals.	1	5	3.19	1.033	.066	-.474
SR6	Our firm can maintain a high situational awareness at all times.	1	5	3.22	1.057	.025	-.475
Overall scale				3.16	1.06	0.042	-.573

Source: Author's own compilation

Table 5.6 shows six measurement instruments that were tested in the rail industry. The average mean value and standard deviation are ($\bar{x}$=3.15 : SD ± 1.06). The highest mean value is SR4 (we would still be able to meet customer demand) with a mean of ($\bar{x}$=3.23: SD ± 1.054). This shows that even in disruptions within the firm, the firm will still meet the demand of the customer. The lowest mean value is ($\bar{x}$=3.00: SD ± 1.142) with the measurement instrument SR1 (our firm is capable to anticipate and overcome disruptions in the supply chain network). This shows there still needs to be some improvements in the rail industry. SR02 (we have the ability to quickly react to interruption by configuring resources and establish to usual operations) has the mean value of ($\bar{x}$=3.09: SD ± 1.040). SR03 (operations would be able to continue after the occurrence of

disruptions) has a mean value of ($\bar{x}$=3.23: SD ± 1.054). SR05 has a mean value of ($\bar{x}$=3.19: SD ± 1.057) with this measurement instrument (performance does not diverge significantly from set goals). SR06 (our firm can maintain a high situational awareness at all times) has a mean of ($\bar{x}$=3.22: SD ± 1.033).

Table 5.7: Descriptive statistics for tangible dimension

Item	Description Valid: (N=280)	Minimum	Maximum	Mean	Standard deviation	Skewness	Kurtosis statistics
TD1	Our firm manages its supply chain costs effectively.	1	5	**3.13**	1.136	.107	-.808
TD2	Our firm manages its profit effectively.	1	5	**3.25**	1.078	-.071	-.637
TD3	Our firm manages cash turnover effectively.	1	5	3.13	1.046	-.184	-.325
TD4	Our firm manages returns on sales effectively.	1	5	3.23	1.060	-.086	-.447
Overall scale				3.19	1.08	-0.06	-.554

Source: Author's own compilation

Table 5.7 represents four measurement instruments that were tested in the rail industry. The average mean value of ($\bar{x}$=3.185) is followed by a standard deviation of (SD ± 1.08). The measurement instrument ID2 (our firm manages its profit effectively) has the highest mean of ($\bar{x}$=3.25: SD ±1.136). This shows that companies in the rail industry do manage their profits effectively. The lowest mean value was obtained from TD1, and TD3 has the same mean value as TD1 (our firm manages its supply chain costs effectively) with a mean value being ($\bar{x}$=3.13: SD ±1.136), which shows that failure to manage costs effectively can lead to serious financial implications (Beck, Bente & Schilling, 2013:10). TD3 (our firm manages cash turn over effectively) has a mean value of ($\bar{x}$=3.13: SD ±1.046). Measurement instrument TD4 (our firm manages cash returns on sales effectively) has a mean value of ($\bar{x}$=3.23: SD ±1.060).

Table 5.8: Descriptive statistics for intangible dimension

Item	Description Valid: (N=280)	Minimum	Maximum	Mean	Standard deviation	Skewness	Kurtosis statistics
ID1	Our firm utilises its capacity effectively.	1	5	**3.23**	1.147	-.156	-.748
ID2	Our firm manages inventory turnover effectively.	1	5	3.24	1.048	-.070	-.410
ID3	Our firm has sufficient material availability.	1	5	**3.32**	1.093	-.184	-.602
ID4	Our customers are satisfied.	1	5	3.24	1.108	-.063	-.637
ID5	Our firm manages lead times effectively.	2	5	3.27	1.121	-.190	-.648
ID6	Our firm manages deadlines for products or services effectively.	1	5	3.26	1.120	-.282	-.567
Overall scale				3.26	1.106	-.158	-3.612

Source: Author's own compilation

Table 5.8 represents six items that were tested in the rail industry. The average mean value and standard deviation are ($\bar{x}$=3.26 : SD ± 1.106). The lowest mean value is ID1 (our firm utilises its capacity effectively) with a mean of ($\bar{x}$=3.23: SD ± 1.147). The highest mean value is ID5 (our firm manages lead times effectively) with a mean of ($\bar{x}$=3.27: SD ± 1.121). This highlights that procurement departments in the rail industry do manage their lead times effectively. Measurement instrument ID2 (our firm manages inventory turnover effectively) has a mean value of ($\bar{x}$=3.24: SD ± 1.048). Items ID2 and ID4 have the same mean value of ($\bar{x}$=3.24: SD ± 1.108) with the measurement instrument (our customers are satisfied). Measurement instrument DD6 (our firm manages deadlines for products or services effectively) has a mean value of ($\bar{x}$=3.26: SD ± 1.120).

5.5 EXPLORATORY FACTOR ANALYSIS

Exploratory factor analysis (EFA) is a statistical technique that is used to limit data to a smaller set of summary variables. The EFA identifies the structure of the relationship between the variable and respondent (Yin, 2014:04). The main goal of EFA is to analyse relationships between practices and usually decisions are made by researchers. EFA can be described as one of the data reduction techniques (Maxwell & Weaver, 2014:06). In order to determine the factor structure of the collected data, EFA was performed in this study. However, before the use of EFA, tests were done to verify the suitability of the use of EFA for the data that was gathered for the study.

As part of this preliminary analysis the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity were used. The KMO shows the proportion of variance that is explained by variables that are measured in a study (Chan & Idris, 2017:3). The Bartlett's test is a statistic used to assess the equality of variance in different samples (Maxwell & Weaver, 2014:10). The KMO value should be greater than 0.5 for a satisfactory factor analysis to proceed and Bartlett's test of sphericity should be significant if EFA is suitable for use for the data that has been collected (Hadia, Adullaha & Sentosaa, 2016::3).

The results for the KMO and Bartlett's tests are shown in Table 5.9

Table 5.9: KMO and Bartlett's test of sphericity

CONSTRUCTS	KMO MEASURE	BARTLETT'S TEST		
		Approximate Chi-Square	Degrees of freedom	Significance level
II	.911	1017.997	15	.000
SI	.851	608.016	15	.000
CI	.874	836.657	15	.000
SCR	.900	979.340	15	.000
TD	.811	555.431	6	.000
ID	.906	1070.569	15	.000
II= Internal Integration; SI=Supplier Integration; CI=Customer Integration; SCR= Supply Chain Resilience; TD=Tangible Dimension; ID=Intangible Dimension.				

Source: Compiled by author

The Bartlett's test for all the constructs was significant ($p< 0.01$) and the KMO value for all contracts in Figure 5.9 was above the 0.5 minimum threshold. Therefore, the results proved that there is a strong relationship among variables and justified that the use of factor analysis in this study was factorable.

In this study, the EFA was performed using principal component analysis. Principal component analysis refers to a reduction method that is used to reduce the dimensionality of large data sets. Principal component analysis does this by transforming a large set of variables into a smaller one which contains most of the information in the large set (Holand, 2019:10). And the EFA was also performed using Varimax rotation which refers to a method used to simplify the expression of a sub-space in a few major items (Lee, 2018:40).

In performing EFA, four criteria were considered. The first was to retain only items with factor loadings greater than 0.5. Factor loadings refer to a data reduction method which explains correlations between observed variables using a smaller number of factors (Izquierdo, Olea & Abad, 2014:04). Factor loadings are important because they allow researchers to investigate concepts that are not easily measured directly by taking a large number of variables into a few interpretable underlying factors (Izquierdo *et al*, 2014:06). The second criterion was to retain all those factors with eigenvalues greater than 1, because they explain significant variance and indicate criticality of the underlying factor component. Measures of variance explained by each factor are called eigenvalues (Munir, 2015:15). Eigenvalues are important because they make it easier for a researcher to maintain a relationship between two variables (Munir, 2015:17).

The third criterion was to use the scree plot to assess the number of factors that should be retained. A scree plot is a line plot of eigenvalues of factors in an analysis (Ledesma, Mora & Macbeth, 2015:05). It determines the numbers of factors to retain in an exploratory factor analysis (Ledesma et al., 2015:5).

The fourth criterion used was to consider only items with communalities greater than 0.5. Communalities are variances accounted for statistic reflecting of how much variance is reproduced by the latent constructs (Samuels, 2017:6). Communality factors that are greater than 0.2 account for a significant amount of the variance and signify their criticality in the construct of the study. (Child, 2006:05) (Yong & Pearce, 2013:10).

The next sections show the results of the EFA procedure performed on the supply chain integration, internal integration, supplier integration, customer integration, supply chain resilience, and supply chain performance scales respectively.

5.5.1 Determination of underlying factors for the internal integration scale

Upon applying the EFA procedure to the internal integration scale, none of the items demonstrated cross-loadings, hence none of them were discarded during the factor analysis. The factor extraction procedure produced a single-factor structure. Table 5.10 presents the factor solution results for the internal integration construct.

Table 5.10: Unidimensional factor structure for the internal integration scale

Item	Description	Communalities	Factor loadings
II1	In our firm, there is data integration among internal functions.	.676	.822
II2	In our firm, there is real – time inventory management.	.763	.874
II3	In our firm, there is real-time access to logistics- related information.	.702	.838
II4	In our firm, there is data integration in operations processes.	.751	.867
II5	In our firm, there are regular information exchanges amongst cross-functional teams.	.661	.813
II6	In our firm, there is online interaction between operations and sales functions.	.590	.768
Eigenvalue			**4.144**
Percentage of Variance			**69.067**

Source: Compiled by author

As indicated in Table 5.10, both communalities and factor loadings of each items were greater than the 0.2 and 0.5 cut off values. The II factor that consisted of six items had an eigenvalue of 4.144 with a percentage of 69.067.

The scree plot in Figure 5.6 supports values in Table 5.10.

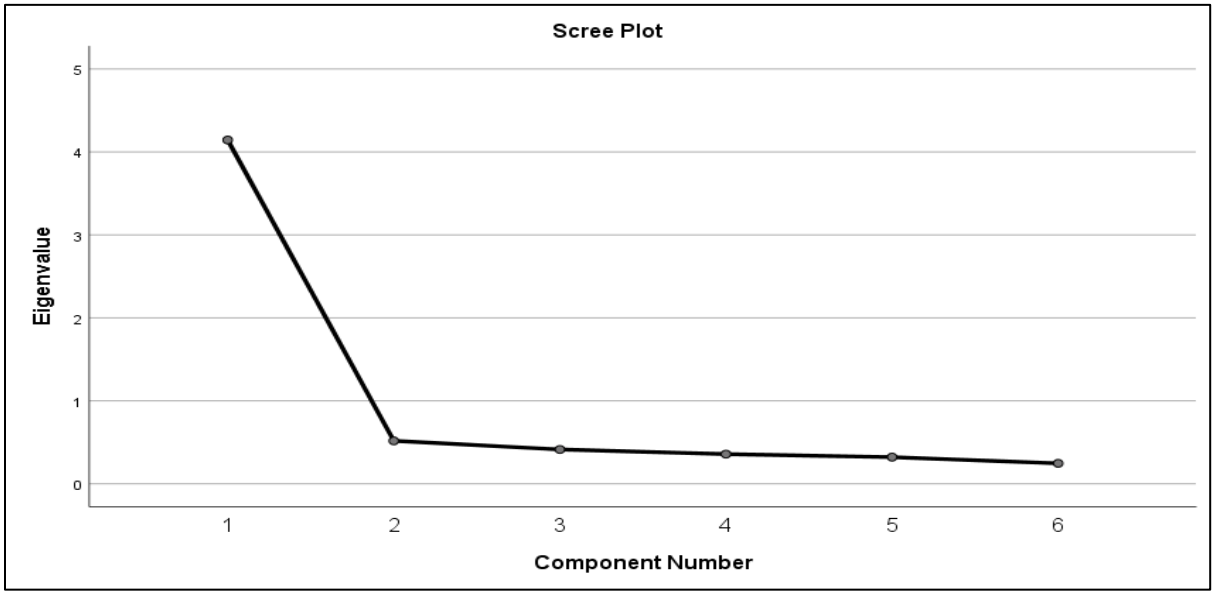

Figure 5.6: Scree plot for the internal integration scale

Source: Compiled by author

5.5.2 Determination of underlying factors for the supplier integration scale

The results of the application of the EFA procedure to the supplier integration scale are shown in Table 5.11.

Table 5.11: Unidimensional factor structure for the supplier integration scale

Item	Description	Communalities	Factor loadings
SI1	In our firm, there is information exchange with suppliers through the internet or web – based technologies.	.633	.795
SI2	Our firm has managed to establish strategic partnerships with suppliers.	.647	.804
SI3	Our firm s suppliers participate in the planning stage of our operations.	.259	.509
SI4	Our firm s suppliers participate in the process of procurement and production.	.574	.758
SI5	Our firm has established a quick ordering system.	.586	.765

SI6	In our firm, there is stable procurement through networks (e.g. EDI).	.636	.797
Eigenvalue			**3.334**
Percentage of Variance			**55.565**

Source: Compiled by author

One supplier integration factor with six items, an eigenvalue of 3.334 and a percentage of variance explained of 55.565 % was extracted from the ST scale. All items achieved communalities greater than the recommended minimum of 0.2 and factor loadings higher than the suggested minimum value of 0.5. Hence no item was discarded from the scale.

The results above are further supported by the scree plot presented in Figure 5.7.

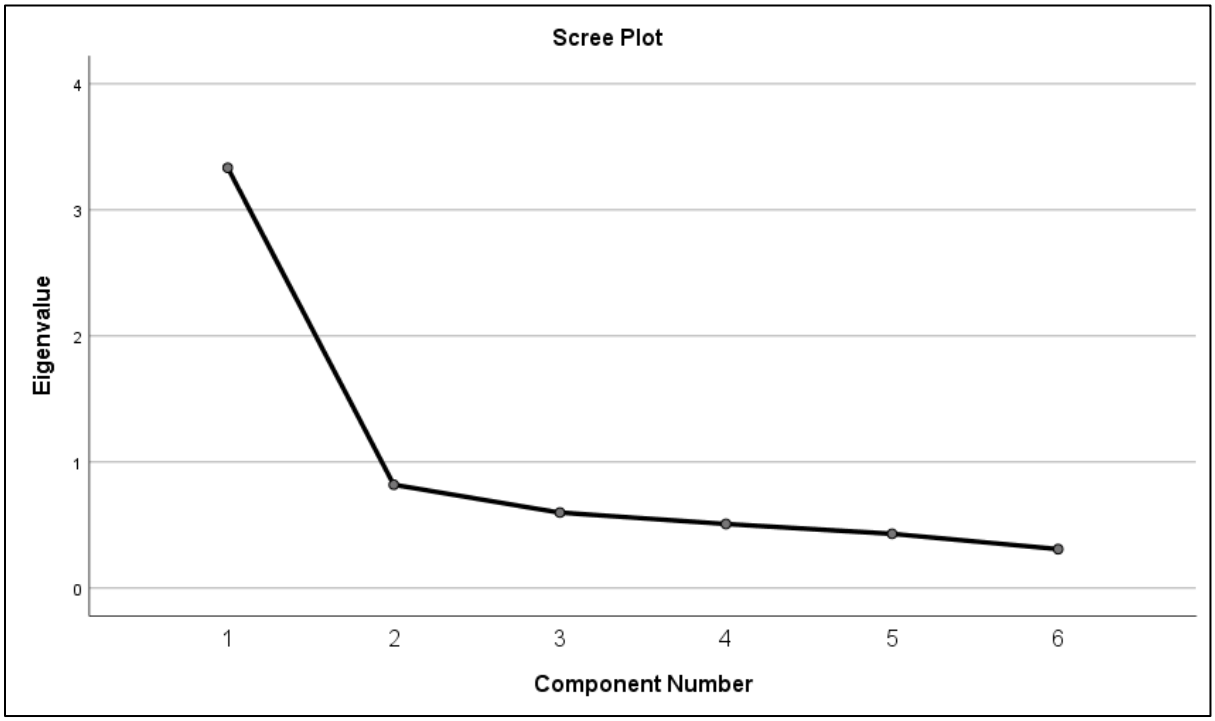

Figure 5.7: Scree plot for supplier integration values

Source: Compiled by author

5.5.3 Determination of underlying factors for the customer integration scale

The results of the application of the EFA procedure to the customer integration scale are shown in Table 5.12.

Table 5.12: Unidimensional factor structure for the customer integration scale

Item	Description	Communalities	Factor loadings
CI1	Our firm has implemented integrated demand forecasting.	.626	.791
CI2	Our firm has implemented online order taking.	.625	.791
CI3	The ordering processes used in our firm are fast.	.596	.772
CI4	Our firm has an effective customer profiling system.	.730	.854
CI5	Our firm has an effective after – sales service support.	.661	.813
CI6	Our firm follows up with customers for feedback.	.552	.743
Eigenvalue			**3.790**
Percentage of Variance			**63.173**

Source: Compiled by author

The factor consisted of six items, had an eigenvalue of 3.790 and contributed to 63.173% of the variance. All communalities were greater than 0.2 and all items had factor loadings greater than 0.5.

The scree plot of customer integration values are indicated in Figure 5.8.

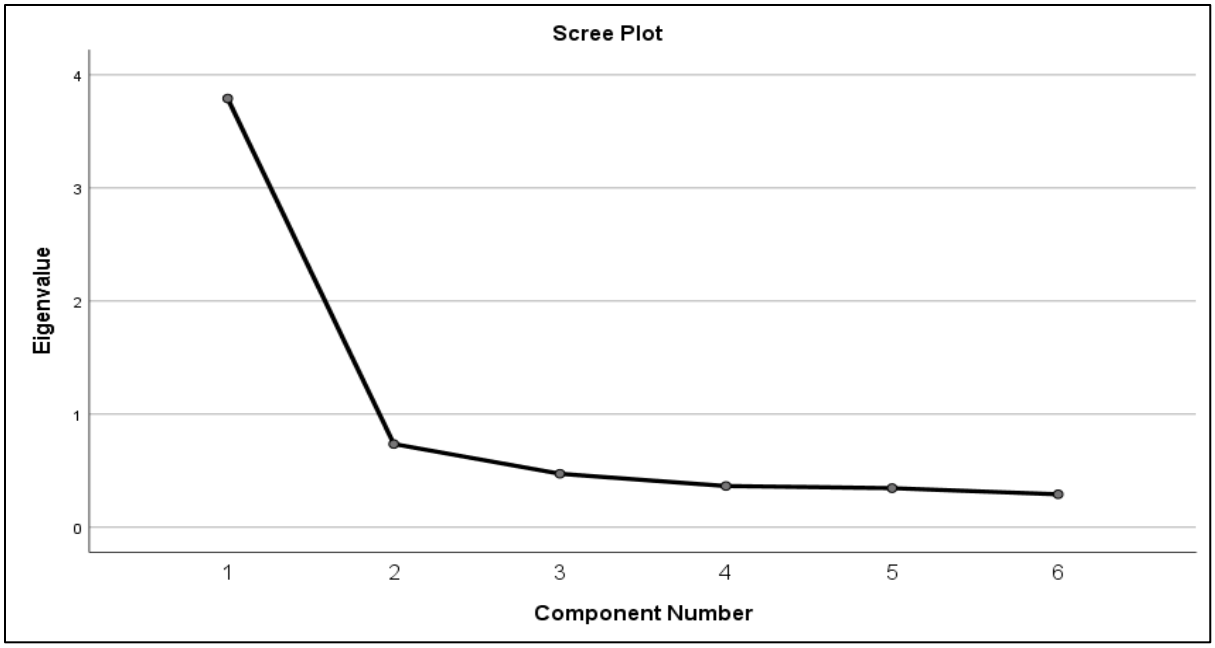

Figure 5.8: Scree plot of customer integration values

Source: Compiled by author

5.5.4 Determination of underlying factors for the supply chain resilience scale

The EFA was similarly conducted for the supply chain resilience scale. All six items met the 0.5 minimum threshold. The results of the EFA for the supply chain resilience scale are shown in Table 5.13.

Table 5.13: Unidimensional factor structure for the SCR scale

Item	Description	Communalities	Factor loadings
SCR1	Our firm is capable to anticipate and overcome disruptions in the supply chain network.	.657	.811
SCR2	We have the ability to quickly react to interruption by reconfiguring resources and establish to usual operations.	.678	.823
SCR3	Operations would be able to continue after the occurrence of disruptions.	.689	.830
SCR4	We would still be able to meet customer demand.	.728	.853

SCR5	Performance does not diverge significantly from set goals.	.696	.834
SCR6	Our firm can maintain a high situational awareness at all times.	.647	.805
Eigenvalue			**4.095**
Percentage of Variance			**68.248**

Source: Compiled by author

As indicated in Table 5.13, the factor consisted of six items, had an eigenvalue of 4.095 and a percentage of variance explained of 68.248%. All communalities and factor loadings for all items were higher than the recommended cut-off values of 0.2 and 0.5, respectively.

Support for the factor structure above is presented in the scree plot in Figure 5.9.

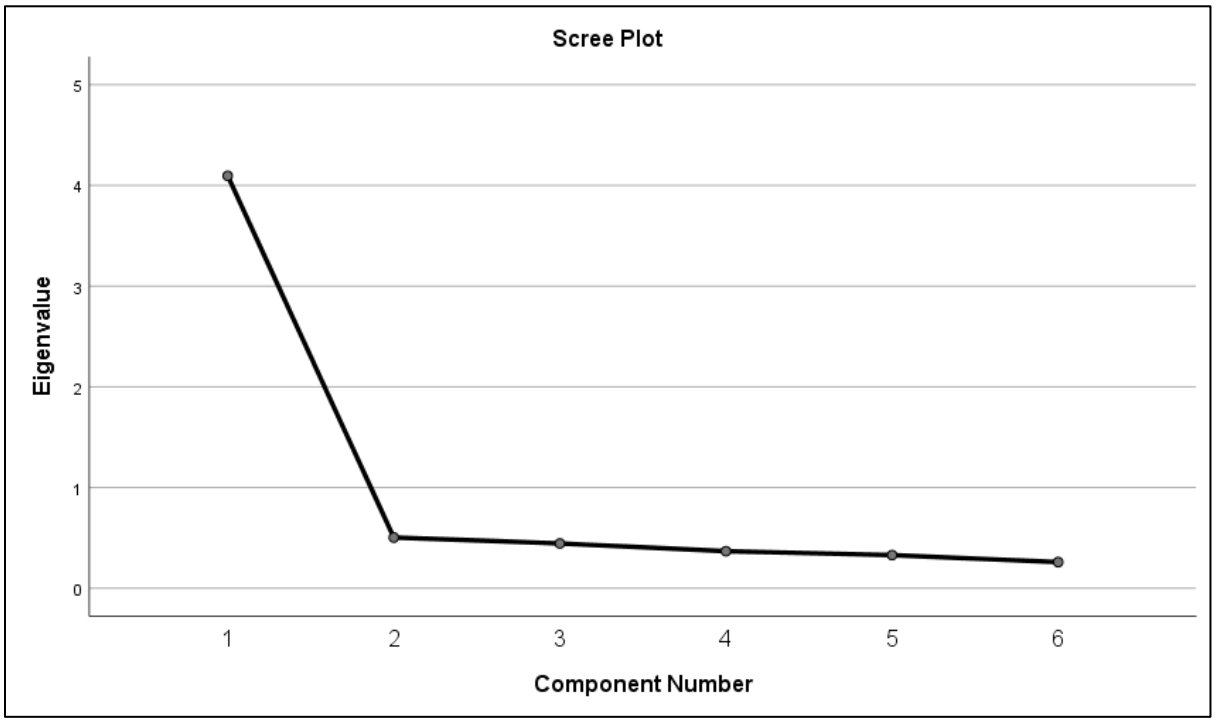

Figure 5.9: Scree plot for supply chain resilience values

Source: Compiled by author

5.5.5 Determination of underlying factors for the tangible dimension scale

The factor structure for the tangible dimension scale is presented in Table 5.14.

Table 5.14: Unidimensional factor structure for the tangible dimension scale

Item	Description	Communalities	Factor loadings
TD1	Our firm manages its supply chain costs effectively.	.600	.774
TD2	Our firm manages its profits effectively.	.803	.896
TD3	Our firm manages cash turnover effectively.	.731	.855
TD4	Our firm manages returns on sales effectively.	.738	.859
Eigenvalue			**2.871**
Percentage of Variance			**71.766**

Source: Compiled by author

In Table 5.14, the factor consisted of four items and had an eigenvalue of 2.871 and a percentage of variance of 71.766%. Expected minimum values for communalities and factor loadings were met in all items. The scree plot in Figure 5.10 further supports this factor structure.

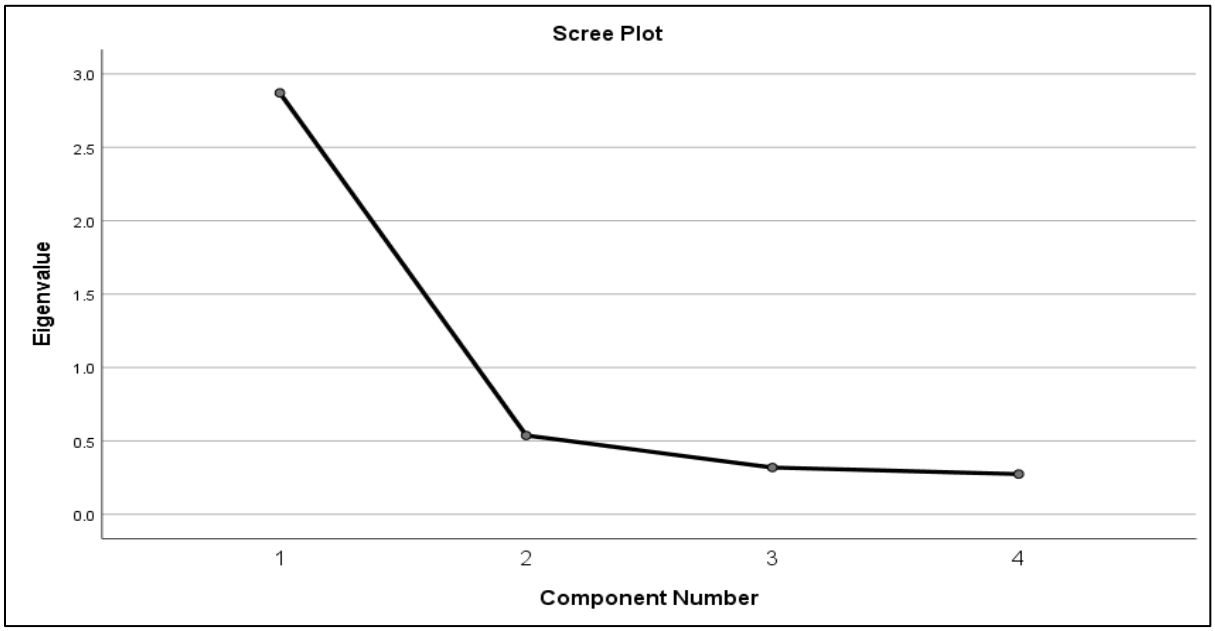

Figure 5.10: Scree plot for tangible dimension values

Source: Compiled by author

5.5.6 Determination of underlying factors for the tangible dimension scale

The EFA was similarly conducted for the intangible dimension construct. None of the items was removed from the construct's entire set of items either due to cross-loadings or loading lower than the 0.5 minimum threshold. Results of the factor solution of the respective construct are presented in Table 5.15

Table 5.15: Unidimensional factor structure for the intangible dimension scale

Item	Description	Communalities	Factor loadings
ID1	Our firm utilizes its capacity effectively.	.618	.786
ID2	Our Firm manages its inventory value effectively.	.650	.806
ID3	Our firm has sufficient material availability.	.721	.849
ID4	Our customers are satisfied.	.718	.847
ID5	Our firm manages lead times effectively.	.757	.870
ID6	Our firm manages deadlines for products or services effectively.	.744	.862
Eigenvalue			**4.208**
Percentage of Variance			**70.125**

Source: Author

As revealed in Table 5.15, the factor consisted of six items, had an eigenvalue of 4.208 and contributed 70.125% of the total variance.

The scree plot developed in the EFA for the intangible dimension is presented in Figure 5.11

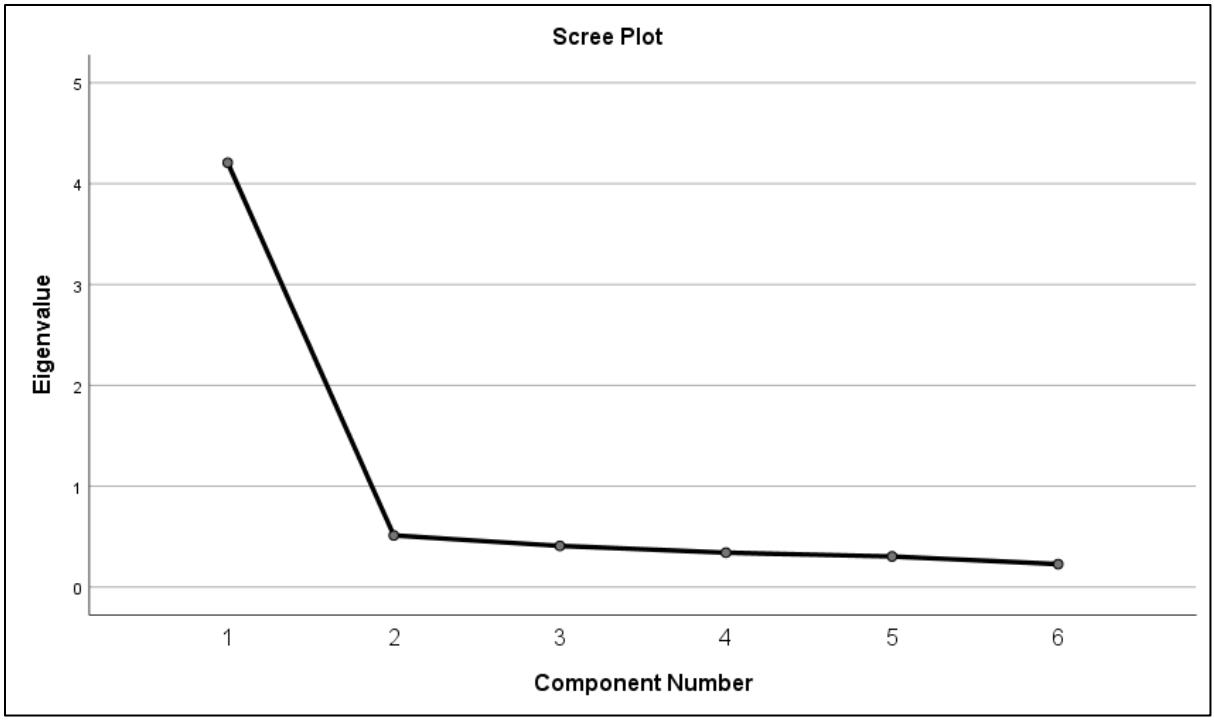

Figure 5.11: Scree plot for the intangible dimension scale

Source: Compiled by author

5.6 INFERENTIAL STATISTICS

Specific questions need to be answered prior to a research study, and researchers perform inferential statistics in order to satisfy the questions (Kern, 2013:03). Inferential statistics removes data from a sample and make inferences about the larger population from which the sample was drawn. Inferential statistics makes conclusions from a sample and generalises them to a population (Kern, 2013:10). Data that was gathered in this study was analysed using inferential statistics. Structural equation modelling (SEM) which aims to test relationships between research constructs was used to analyse the inferential statistics of this study. The SEM procedure is composed of two techniques, namely the confirmatory factor analysis and the path analysis techniques (Pearl & Mckenzie, 2018:6), which were conducted sequentially.

5.7 RESULTS OF THE CONFIRMATORY FACTOR ANALYSIS

Confirmatory factor analysis (CFA) can be used to verify the factor structure of observed variables. The hypothesis can also be tested using the CFA – this is to test the relationship between the

observed variables and their underlying latent constructs (Prudon, 2015:05). This section of the study provides results of the CFA, which was designed to assess the psychometric properties of the measurements scales that were used. These properties consist of reliability, validity, and model fit. The results of the analysis are presented in Table 5.16.

After determining the factor structure of the data set using the EFA, the confirmatory factor analysis model is the next step. The factor structure, how the constructs relate and group, based on inter- correlations were explored using the EFA. The CFA process confirms the factor structure that was extracted from EFA. Table 5.16 and Figure 5.12 provide this analysis in detail.

Figure 5.12 is a diagrammatic depiction of the CFA model. Latent constructs are signified by the oval shape while observed constructs are represented by the rectangular shapes. Adjacent to the observed variables are measurement errors, which are also represented by circular shapes. The bi-directional arrows denote the relationship between the latent constructs.

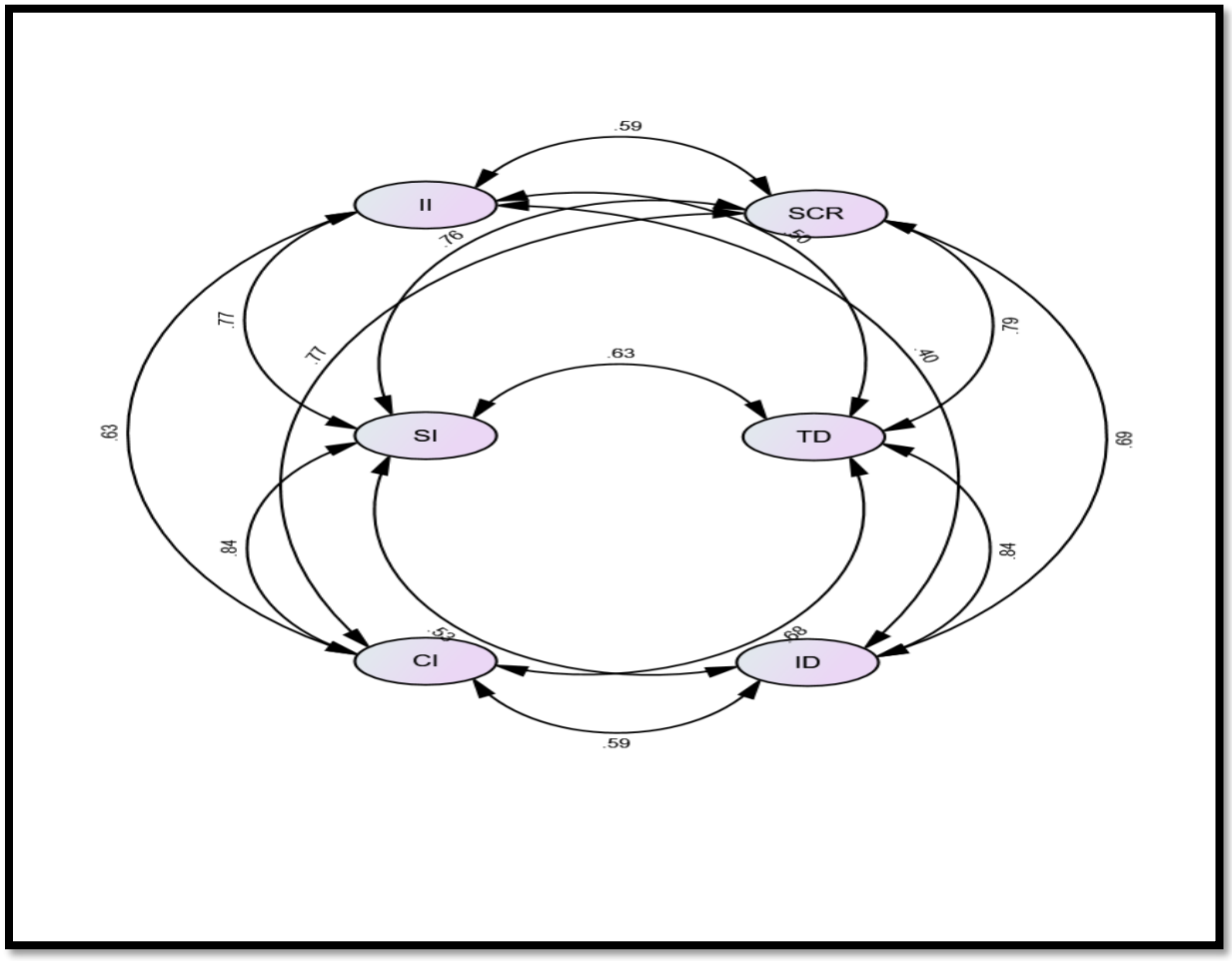

Figure 0.12: Confirmatory factor analysis model

Source: Author's own compilation

Figure 5.12 provides standardised estimates and factor correlations. An adequate model fit for a five-factor model are indicated above because most factor loadings were above 0.6, therefore they show a strong relationship amongst each other (Verdugo, Guille, Arias, Vicente, & Badia, 2015:6).

5.7.1 Reliability

Reliability measures consistency, precision and trustworthiness of a research study (Zohrabi, 2013:07). Three methods were used to test the reliability of this study, namely Cronbach's alpha test (Cronbach α), composite reliability test (CR) and AVE. These results are reported in Table 5.16.

Table 0.16: Accuracy analysis statistics

Research constructs		Descriptive statistics		Cronbach's test		C.R.	AVE	Factor loading
		Mean	SD	Item-total	α Value			
Internal Integration	**II-1**	3.048	1.090	.736	.909	.967	.937	.780
	II-2			.806				.849
	II-3			.758				.805
	II-4			.795				.838
	II-5			.726				.764
	II-6			.671				.726
Supplier Integration	**SI-1**	3.046	1.248	.618	.783	.918	.797	.729
	SI-2			.650				.764
	SI-3			.383				.405
	SI-4			.608				.698
	SI-5			.608				.699
	SI-6			.647				.765
Customer Integration	**CI-1**	5.993	1.088	.691	.882	.962	.896	.748
	CI-2			.868				.731
	CI-3			.664				.708
	CI-4			.772				.809

Research constructs		Descriptive statistics		Cronbach's test		C.R.	AVE	Factor loading
		Mean	SD	Item-total	α Value			
	CI-5			.717				.777
	CI-6			.631				.713
Supply Chain Resilience	**SCR-1**	3.156	1.062	.723	.906	.975	.942	.773
	SCR-2			.739				.787
	SCR-3			.748				.797
	SCR-4			.776				.816
	SCR-5			.750				.783
	SCR-6			.716				.765
Tangible Dimension	**TD-1**	3.185	3.525	.623	.866	.972	.933	.731
	TD-2			.795				.855
	TD-3			.725				.774
	TD-4			.732				.813
Intangible Dimension	**ID-1**	3.26	1.106	.696	.914	.979	.941	.749
	ID-2			.721				.776
	ID-3			.775				.808
	ID-4			.771				.803
	ID-5			.801				.841
	ID-6			.789				.836

II= internal integration**; SI=** supplier integration**; CI=** customer integration**; SCR=** supply chain reseilence **; TD=** tangible dimension**; ID**= intangible dimension.
C.R= Composite Reliability**; AVE=** Average Variance Reliability.

Source: Author's own compilation

5.7.2 Cronbach's alpha test

All six constructs in this study were measured for reliability using the Cronbach s alpha coefficient. The results are shown in Table 5.16, showing all constructs achieved a Cronbach alpha of above

the recommended threshold which is 0.7. All the constructs are within 0.909 and 0.914. (with II=0.909; SI= 0.783; CI= 0.882; SCR= 0.906; TD= 0.866; ID= 0.914).

With the item total correlation all values are above 0.3 (II; SI; CI; SCR; TD; ID). However, if a study has an item total correlation that is below 0.3 it simply means that the items in the study do not correlate within the scale and the items are not measuring the same item measured by other items (Metsamuuronen, 2016:5).

The above shows that all constructs in this study are reliable because their values are above the recommended thresholds for both Cronbach alpha and item total correlation.

5.7.3 Composite reliability

The composite reliability (CR) index test was used to evaluate the internal reliability of each construct. The formula for composite reliability is provided below (Bacon, Sauer, & Young, 1995:10):

(CR): $CR\eta = (\Sigma\lambda yi)\ 2 / [(\Sigma\lambda yi)\ 2 + (\Sigma\varepsilon i)]$

Composite reliability = (square of the summation of the factor loadings) / {(square of the summation of the factor loadings) + (summation of error variances)}.

Table 5.17 shows the calculation of composite reliability of the research constructs and the factor loadings in Table 5.16 were used to calculate the CR.

Table 5.17: Composite reliability calculation

Composite reliability (CR) of internal integration (II)
$(\Sigma\lambda y_i)^2 = (0.780+0.849+0.805+0.838+0.764+0.726)^2 = 22.67$
$\Sigma\varepsilon_i = (1-0.780)^2 + (1-0.849)^2 + (1-0.805)^2 + (1-0.838)^2 + (1-0.764)^2 + (1-0.726)^2 = 0.266$
$CR\eta = 22.67 / (22.67 + 0.266) = 0.976$
CR= 0.967

Composite reliability (CR) of supplier integration (SI)

($(\Sigma\lambda y_i)^2$= (0.729+0.764+0.405+0.698+0.699+0.765) $^{2 =}$ 16.48

$\Sigma\varepsilon_i$= (1-0.729) ^{2} + (1-0.764) ^{2} + (1-0.405) ^{2} + (1-0.698) ^{2} +(1-0.699) ^{2} +(1-0.765)^2 = 0.720

CRη= 16.48/ (16.48+ 0.720) = 0.918

CR= 0.918

Composite reliability (CR) of customer integration (CI)

$\Sigma\lambda y_i)^2$= (0.748+0.731+0.708+0.809+0.777+0.713) $^{2 =}$ 20.124

$\Sigma\varepsilon_i$= (1-0.748) ^{2} + (1-0.731) ^{2} + (1-0.708) ^{2} + (1-0.809) ^{2} +(1-0.777) ^{2} +(1-0.713)^2 = 0.389

CRη= 20.124/ (20.124+ 0.389) =

CR= 0.962

Composite reliability (CR) of supply chain resilience (SCR)

($\Sigma\lambda y_i)^2$= (0.773+0.787+0.797+0.816+0.783+0.765) $^{2 =}$ 22.28

$\Sigma\varepsilon_i$= (1-0.773) ^{2} + (1-0.787) ^{2} + (1-0.797) ^{2} + (1-0.816) ^{2} +(1-0.783) ^{2} +(1-0.765^2) = 0.274

CRη= 22.28 / (22.28+ 0.274) = 0.975

CR= 0.975

Composite reliability (CR) of tangible dimension (TD)

$\Sigma\lambda y_i)^2$= (0.731+0.855+0.405+0.774+0.813) $^{2 =}$ 12.80

$\Sigma\varepsilon_i$= (1-0.731) ^{2} + (1-0.855) ^{2} + (1-0.774) ^{2} + (1-0.813) ^{2} = 0.179

CRη= 12.80/ (12.80+ 0.179) = 0.972

CR= 0.972

Composite reliability (CR) of intangible dimension (ID)

($\Sigma\lambda y_i)^2$= (0.749+0.776+0.808+0.803+0.841+0.836) $^{2 =}$ 23.16

$\Sigma\varepsilon_i$= (1-0.749) ^{2} + (1-0.776) ^{2} + (1-0.808) ^{2} + (1-0.803) ^{2} +(1-0.841) ^{2} +(1-0.836)^2 = 0.241

CRη= 22.67 / (22.67+ 0.241) = 0.979

CR= 0.979

Table 5.17 provided the composite reliability values for all the constructs: internal integration = 0.967; supplier integration = 0.918; customer integration = 0.962; supply chain resilience = 0.975; tangible dimension = 0.972; intangible dimension 0.979. All the constructs were above the 0.7 which proves that the constructs are reliable (Bacon, Sauer, & Young, 1995:10).

5.7.4 Average variance extracted

Average variance extracted (AVE) is the amount of variance that a construct has in relation to the amount of variance due to the measurement error (Jayasinghe- Mudalige, Udugama & Ikram, 2012:14).

Ahmad, Zulkurnain, and Khairushalimi (2016:04) provided the formulae below:

$V\eta = \Sigma\lambda yi2 / (\Sigma\lambda yi2 + \Sigma\varepsilon i)$

AVE = {(summation of the squared of factor loadings) / {(summation of the squared of factor loadings) + (summation of error variances)}.

Table 5.18 shows the calculation of the average variance of the research constructs and the factor loadings in Table 5.16 were used to calculate the average variance.

Table 5.18: Average variance extracted calculation

Average variance extracted (AVE) of internal integration (II) $\Sigma\lambda y_i^2 = (0.780^2 + 0.849^2 + 0.805^2 + 0.838^2 + 0.764^2 + 0.726^2) = 3.83$ $\Sigma\varepsilon_i = (1-0.780)^2 + (1-0.849)^2 + (1-0.805)^2 + (1-0.838)^2 + (1-0.764)^2 + (1-0.726)^2 = 0.266$ $V\eta = 3.84 / (3.83+0.266) =$ **0.937** **AVE =0.937**
Average variance extracted (AVE) of supplier integration (SI) $\Sigma\lambda y_i^2 = (0.729^2 + 0.764^2 + 0.405^2 + 0.698^2 + 0.699^2 + 0.765^2) = 2.84$ $\Sigma\varepsilon_i = (1-0.729)^2 + (1-0.764)^2 + (1-0.405)^2 + (1-0.698)^2 + (1-0.699)^2 + (1-0.765)^2 = 0.720$ $V\eta = 2.84 / (2.84+0.720) =$ **0.797**

AVE =0.797

Average variance extracted (AVE) of customer integration (CI)

$\Sigma\lambda y_i^2 = (0.748^2 + 0.731^2 + 0.708^2 + 0.809^2 + 0.777^2 + 0.713^2) = 3.36$

$\Sigma\varepsilon_i = (1-0.748)^2 + (1-0.731)^2 + (1-0.708)^2 + (1-0.809)^2 + (1-0.777)^2 + (1-0.713)^2 = 0.389$

$V\eta = 3.36 / (3.36+0.389) = 0.896$

AVE =0.896

Average variance extracted (AVE) of supply chain resilience (SCR)

$\Sigma\lambda y_i^2 = (0.773^2 + 0.787^2 + 0.797^2 + 0.816^2 + 0.783^2 + 0.765^2 = 3.71$

$\Sigma\varepsilon_i = (1-0.773)^2 + (1-0.787)^2 + (1-0.797)^2 + (1-0.816)^2 + (1-0.783)^2 + (1-0.765)^2 = 0.227$

$V\eta = 3.71/ (3.71+0.227) = 0.942$

AVE =0.942

Average variance extracted (AVE) of tangible dimension (TD)

$\Sigma\lambda y_i^2 = (0.731^2 + 0.855^2 + 0.774^2 + 0.813^2) = 2.52$

$\Sigma\varepsilon_i = (1-0.731)^2 + (1-0.855)^2 + (1-0.774)^2 + (1-0.813)^2 = 0.179$

$V\eta = 2.52/ (2.52+0.179) = 0.933$

=

AVE =0.933

Average variance extracted (AVE) of intangible dimension (ID)

$\Sigma\lambda y_i^2 = (0.749^2 + 0.776^2 + 0.808^2 + 0.803^2 + 0.841^2 + 0.836^2) = 3.86$

$\Sigma\varepsilon_i = (1-0.749)^2 + (1-0.776)^2 + (1-0.808)^2 + (1-0.803)^2 + (1-0.841)^2 + (1-0.836)^2 = 0.241$

$V\eta = 3.86 / (3.86+0.241) = 0.941$

AVE =0.941

Table 5.18 provided the average variance values for all the constructs: internal integration = 0.937; supplier integration = 0.797; customer integration = 0.896; supply chain resilience = 0.942;

tangible dimension = 0.933; intangible dimension 0.941. All the constructs were above the 0.5 which proves that the constructs are reliable (Ahmad et al., 2016:4).

5.7.4 Construct validity

Construct validity can also be referred as validity evidence. In simple terms it is the degree to which the test measures what it claims to measure. Construct validity has two indicators which are convergent and discriminant validity which were both explored in this study (Kahveci & Kahveci, 2016:6).

5.7.5 Convergent validity

Convergent validity is a subtype of construct validity. However, convergent validity refers to the degree to which two measures of constructs that in theory should be related are in fact related (Brown, 2010:08). In simple terms, measurements should highly correlate with other measurement items that measure the same latent variable.

In this study, factor loadings extracted in the CFA were used to determine the convergent validity (Table 5.16). The results show that all factor loadings were above the minimum threshold of 0.5 with the exception of supplier integration which was 0.405. Therefore, the results show that convergent validity existed in this study because convergent validity measured what it intended to measure (Thoma, Cook, Mcgrew & Dalin, 2018:10).

5.7.6 Discriminant validity

There are measurement items that are not supposed to be related to discriminant validity checks if the measurements items are unrelated (Wang, Clay, & French, 2015:11). This was further assessed by determining whether the value score of AVE is higher than the threshold of 0.5 (Thoma et al., 2018:9).

Table 5.19: Correlations between constructs

Construct correlation

Research construct	Internal integration (II)	Supplier integration (SI)	Customer integration (CI)	Supply chain resilience (SCR)	Tangible dimension (ID)	Intangible dimension (ID)
Internal integration (II)	**1.000**	.767	.638	.594	.496	.401
Supplier integration (SI)	.767	**1.000**	.835	.759	.560	.531
Customer integration (CI)	.638	.835	**1.000**	.772	.682	.588
Supply chain resilience (SCR)	.594	.759	.772	**1.000**	.790	.687
Tangible dimension (TD)	.496	.560	.682	.790	**1.000**	.838
Intangible dimension (ID)	.401	.531	.588	.687	.838	**1.000**
***Correlation is significant at the 0.001 level (3-tailed).						

Source: Author's own compilation

Table 5.19 shows correlations that were computed during CFA to assess discriminant validity. It is shown that there are positive correlations across the individual paired constructs which were found to be below the cut-off value of 1; therefore, the presence of discriminant validity is confirmed in the scale items. Recommended guidelines for convergent, construct and discriminant validity were all met in the study.

5.8 MODEL FIT ASSESSMENTS

Model fit analysis can be viewed as a statistical model in research that describes the relationship between response variables and predictor variables (Hussain, Fangwei, Sidiqi, Ali, & Shabbir, 2018:10). However, before assessing the fitness of a research model, a relationship with certain indicators (indices) of fitness are required. The following indicators are required: chi-square value over degrees of freedom (χ^2/df); goodness-of-fit index (GFI); comparative fit index (CFI); incremental fit index; Tucker-Lewis index (TLI); the normed fit index (NFI); relative fit index

(RIF); root mean square residual (RMR); and root mean square error of approximation (RMSEA) (Hooper, Coughlan, & Mullen, 2008:03).

The acceptability of the model fit was established by the chi-square value over the degree of freedom ($\chi 2/df$), of which the value should be not more than 3 (Recker, 2014:10). Values of GFI, CFI, IFI, and TLI must be superior or equal to 0.90 and the RMSEA value must be equal to or below 0.08 (Hussain, Fangwei, Sidiqi, Ali, & Shabbir, 2018:11).
Table 5.20 shows the model fit results for confirmatory factor analysis.

Table 5.20: Model fit results for confirmatory factor analysis

Model fit indices	**Accepted threshold values**	**Sources**	**Results obtained**
$\chi 2/df$	Between 1 to 3 [$\leq$ 3.0]	Barrett (2006:05)	1.860
RMSEA	Equal to or below 0.08 [$\leq$ 0.08]	Maccallum, Brown and Sugawara (1996:05)	0.056
CFI	Equal to or greater than 0.90 [$\geq$ 0.9]	Christopher and Drasgow (2010:05)	0.930
IFI	Equal to or greater than 0.90 [$\geq$ 0.9]	Christopher and Drasgow (2010:05)	0.931
TLI	Equal to or greater than 0.90 [$\geq$0.9]	Christopher and Drasgow (2010:05)	0.924
NFI	Equal to or greater than 0.90 [$\geq$0.9]	Hu and Bentler (1999:05) (Lysons & Farrington 2012:586)	0.862
RFI	Equal to or greater than 0.90 [$\geq$0.9]	Christopher and Drasgow (2010:05)	0.849

Source: Author's own compilation

As shown in Table 5.20, the results show the model fit for confirmatory factor analysis. The chi-square value over degrees of freedom ($\chi 2/df$) is 1.86 which falls within the <5 threshold suggested

by Barrett (2006:05). The RMSEA should be equal to or below 0.08 [≤ 0.08] and the RMSEA of this study is 0.05 which falls within the thresholds (Maccallum *et al,* 1996:05). Furthermore, other indices such as CFI, IFI, TLI, NFI and RFI their thresholds should be equal to or greater than 0.90 [≥ 0.9] (Christopher & Drasgow, 2010:05). The following thresholds were obtained in this study: CFI=0.93, IFI=0.931, TLI=0.924, NFI=0.862 and RFI=0.849. Although the NFI and RFI did not meet the standard threshold, they were close to the required cut-off limit of 0.9.

The model fit results for the structural model are reported in Table 5.21.

Table 5.21: Model fit results for the structural model

Model fit indices	**Accepted threshold values**	**Sources**	**Results obtained**
$\chi 2$/df	Between 1 to 3 [≤ 3.0]	Barrett (2006:05)	2.719
RMSEA	Equal to or below 0.08 [≤ 0.08]	Maccallum, Brown and Sugawara (1996:05) Lysons & Farrington 2012:586)	0.080
CFI	Equal to or greater than 0.90 [≥ 0.9]	Christopher and Drasgow (2010:05)	0.900
IFI	Equal to or greater than 0.90 [≥ 0.9]	Christopher and Drasgow (2010:05)	0.900
TLI	Equal to or greater than 0.90 [≥0.9]	Christopher and Drasgow (2010:05)	0.849
NFI	Equal to or greater than 0.90 [≥0.9]	Hu and Bentler (1999:05)	0.796
RFI	Equal to or greater than 0.90 [≥0.9]	Christopher and Drasgow (2010:05)	0.780

Source: Author's own compilation

Table 5.21 indicates the model fit results for path analysis. As indicated on the table above, the chi-square value over the degree of freedom is 2.719 and according to Barrett (2006:05) it should

be between 1 to 3 [≤ 3.0]. The CFI, IFI, TLI, NFI, and RIF which should all be equal to or above 0.9 and RMSEA which should be equal to or below 0.08 were included in this study (Maccallum *et al*, 1996:05). The following values were obtained: RMSEA=0.08, CFI=0.90, IFI=0.90, TLI=0.849, NFI=0.796, and RFI=0.780. The TLI, NFI and RFI did not meet the required threshold, but most indices met the expected thresholds.

5.9 HYPOTHESES TESTING RESULTS

In this study, the hypothesised relationships were tested using path analysis. Path analysis refers to a statistical analysis technique which is usually used to evaluate relationships between variables (Sulistyo & Pulungan, 2018:10). After the modification of the full conceptual model, results were obtained from it, and a detailed analysis was conducted thereafter. The results of the hypotheses tests are illustrated in Figure 5.13.

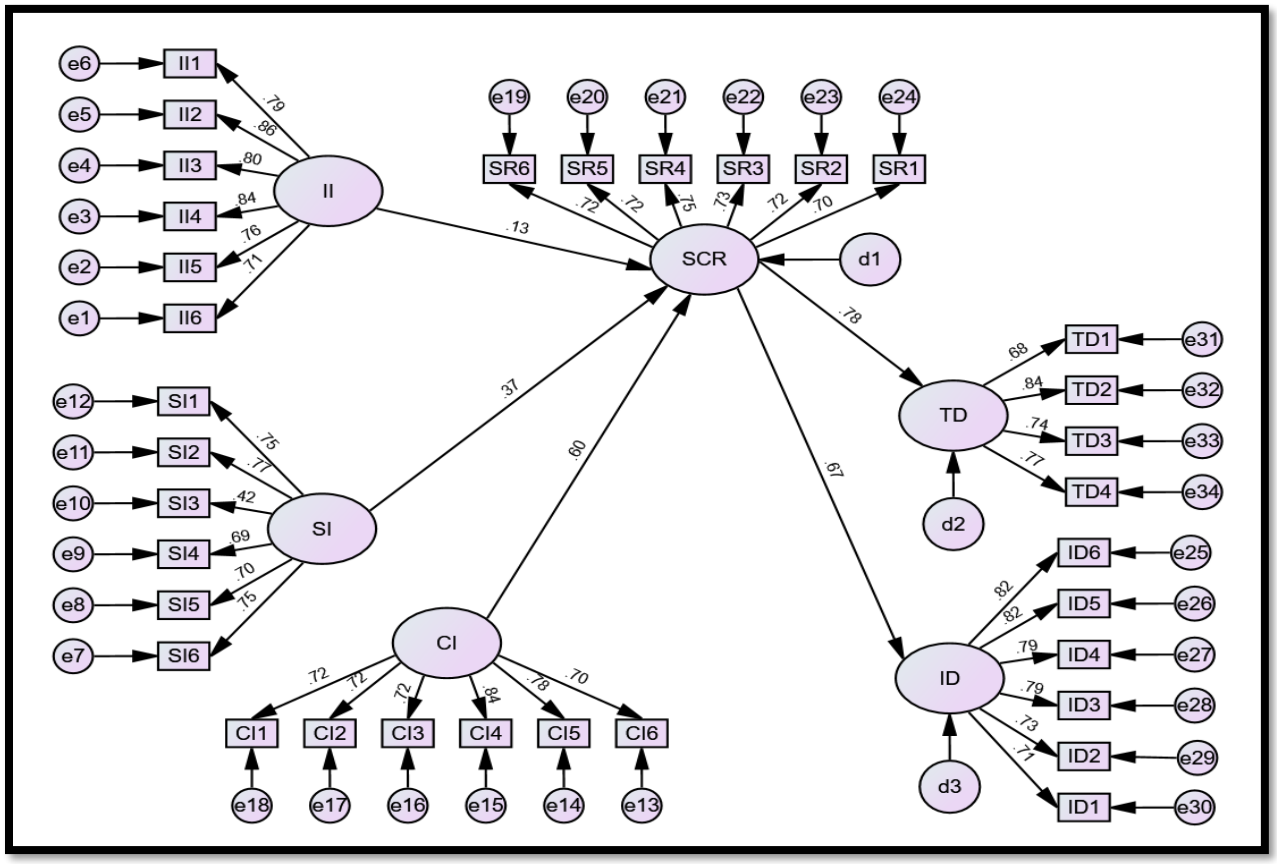

Figure 5.13: Structural model from path analysis

The structural path model in Figure 5.13 shows the latent variables (II, SI, CI, IS, SCR, TD, ID), and their associated observed variables and error terms. The unidirectional arrows between the latent constructs are the structural paths that were tested in this study and the figures attached are the path coefficients. For example, the path coefficient between II and SCR is 0.13. The highest path coefficient is between supply chain resilience and the tangible dimension of SCP ($\beta = 0.78$). The factor loadings are the figures indicated in the arrows between the latent and observed variables.

Table 5.22: Results of structural equation model analysis

Structural paths	Hypothesis	Path coefficient	Outcome
Internal integration → Supply chain resilience	H_1	.132***	**Supported and Significant**
Supplier integration → Supplier chain resilience	H_2	.369***	**Supported and Significant**
Customer integration → Supply chain resilience	H_3	.596***	**Supported and Significant**
Supply chain resilience → Tangible dimension	H_4	.781***	**Supported and Significant**
Supply chain resilience → Intangible dimension	H_5	.673***	**Supported and Significant**
Structural model fits: χ^2/df=2.719; IFI=0.90; CFI= 0.90; NFI=0.796; TLI= 0.849; RMSEA=0.08			
significance level <0.001***			

As presented in Table 5.22, all coefficients for the hypothesises paths were significant at a level of p<0.01. The table also shows that all five hypotheses (H_1, H_2, H_3, H_4 and H_5) were accepted.

A discussion of the results of the hypotheses tests is presented in the next section.

5.9.1 Discussion of the hypotheses tests results

In a bid to address the empirical objectives, this section discusses the results of the hypotheses tests. The study utilised the two main criteria under structural equation modelling to validate and confirm each hypothesis. The first criterion included checking the path coefficients which are represented by a beta (β). For a hypothesis to be supported and deemed significant, the path

coefficient must be either negative or positive. The second criterion constitutes the significance of the relationship, which comprises three levels which are represented by stars also known as p-values. The levels of significance include values with at least three stars (***), which represent p-values less than 0.001, two stars (**) which represent p-values less than 0.05, and one star (*) which denotes a p-value less than 0.1.

5.9.2 Results for Hypothesis 1

H_1: Internal integration positively and significantly influences supply chain resilience.

As shown in Table 5.22, there is a significant positive relationship between internal integration and supply chain integration. This result was provided through structural equation modelling. The relationship between supply chain integration and supply chain resilience shows a path coefficient of (β = 0.132; $p < 0.001$). The results suggest that internal integration in the rail industry leads to supply chain resilience. Also, internal integration within firms in the rail industry can improve the resilience of the supply chain.

This research study shows that internal integration is a powerful tool to achieve positive supply chain resilience in an organisation. This result also suggests that internal integration is a significant predictor of supply chain resilience. Likewise, Piprani, Mohesar and Jaafar (2020:5) also place emphasis on the importance of integrating business processes and point to supply chain integration as a key driver for enhancing a firm's performance.

A few suggestions derived from this research study are that through internal integration firms can ehanance manufacturing flexbility, quality, agility and delivery performance. Better coordination and collaboration between their departments can also be achieved. The study also supports that integration is important as it enables firms to be better and more prepared to face any unforeseen changes well in advance (Sessu, Sjahruddin & Santoso, 2020:4).

H2: Supplier integration positively and significantly influences supply chain resilience.

Table 5.22 shows the results of testing the relationship between supplier integration and supply chain resilience. The results reveal that the relationship between the two constructs is positive and

significiant (β = 0.369; p < 0.001). This result implies that supplier integration leads to an improvement in the resilience of the rail supply chain, and that this resilience is determined by the extent of integration with suppliers in that industry. Similar results were obtained in studies by Hohenstein, Feisel, Hartmann and Giunipero (2015:22) as well as Piprani *et al. (*2020:05) who suggest that companies should adopt the strategy of supplier integration because such actions enable them to achieve a sustainable competitive advantage, and results boost both the resilience and performance of a supply chain. The results of the study have two implications. Firstly, supplier integration is highly recommended in firms in the rail industry. Second, the results prove that supplier integration leads to suppy chain resilience, which in turn improves the performance of the rail supply chain.

H3: Customer integration positively and significantly influences suppy chain resilience.

Customer integration and suppy chain resilience were closely observed in this research study and showed a significant and postitive relationship, achieving a path coffiecient of (β = 0.596; p < 0.001). These results denote that the resilience of the rail industry is bound to improve through integration with customers. The results further imply that the the resilience of the rail industry is based on the degree to which the industry manages to integrate with its customers. A previous study by Huo (2012:09) found similar results, suggesting that customer integration in firms is important because knowledge about the customer provides an opportunity to make righful decisions that will benefit the firm and that will lead to a positive resilience. In South Africa, for example, Gibela manufactures locomotives and wagons from scratch to replace the old Metrorail equipment. These are then delivered to PRASA, whose customers would vandalise the trains because PRASA never considered integrating with their customers. In 2021, Gibela introduced a new depot in Cape Town where it integrated with most of its customers, which helped to lessen the vandalism.

The outcome of this hypothesis is adapted into practice in two ways. First, the results suggest that where customer integration is applied firms stand a better chance of detecting potential risks and threats. The empirical evidence of this research study supports the integration of customers in firms. The second suggestion from this research study is that firms can penetrate the customers' firms and market and understand their products. This will help in reducing the need for rework and scraps which are often caused by misunderstanding customers' needs (Sessu *et al.*, 2020:5).

H4: Supply chain resilience positively and significantly influences the intangible dimension of supply chain performance.

The result of testing the relationship between supply chain resilience and the tangible dimension showed a postive and significant path coefficient of (β = 0.781; p < 0.001). The result implies that a more resilient rail supply chain is bound to provide superior intangible performance. The results are consistent with a previous study by Pettit, Croxton and Fiksel (2013:9), where resilience was linked to intangible performance. The results of the current study empahsise that firms should invest more in their environment, spaces, and buildings were employees perform their duties. The better the available facilities the higher the performance of the rail supply chain.

Few suggestions can be adopted from this empirical study. First, firms in the rail industry should cultivate/develop more resilient supply chain networks, as this boosts their capabilities to absorb disruptions, and to speedily recover and return to normal conditions when faced with disruptions. It is evident from literature that the more time a firm takes to react to any turbulence, the greater the damage (Wieland & Wallenburg, 2013:09). Secondly firms should prioritise upgrading and optimising intangible aspects of their performance, such as costs, profits and cash and this is driven in part by the ability of these firms to expedite resilient networks.

H5: Supply chain resilience positively and significantly influences the tangible dimension of supply chain performance.

Supply chain resilience and the intangible dimesion of supply chain performance were found to have a positive impact on each other. The results showed a path coefficinet of of (β = 0.673; p < 0.001). This result indicates that higher supply chain resilience stimulates superior performance of the rail supply chain in South Africa. The results of the present study are supported by a previous study by Piprani et al., (2020:5) where similar results were obtained. The study suggests that firms in the rail industry should try and miminise risks and potential threats in a bid to enhance supply chain resilience as this leads to enhanced supply chain performance. It is evident that supply chain resilience has a great impact on intangible aspects of performance, namely customer needs, product quality, inventory turnover and material availability in the rail industry. This provides firms with good reasons for striving to improve supply chain resilience (Ambulkar & Blackhurst, 2015:16).

5.10 CONCLUSION

Chapter 5 provided information on the actual analysis of the collected data. Subjects addressed in this chapter include the descriptive analysis of the results, inferential statistics of the collected data where CFA was used to establish the reliability and validity of the data and path analysis was used to assess the relationship between the variables. Descriptive analysis weighed up the demographic profile of the respondents and their organisations. It also explored the mean scores and standard deviation of the constructs to show the averages of the responses to the constructs. The descriptive analysis also showed the skewness and kurtosis to highlight the distribution of data. The results of the mean scores indicated that most of the responses leaned towards the agree side of the scale. After the descriptive statistics, the collected data was subjected to the EFA procedure to test the factor structure. All scales were unidimensional. Lastly, the CFA procedure was applied to test for scale accuracy and path analysis was applied to test the hypotheses. The results of the study validated all suggested relationships. Three were unsupported. The next chapter focuses on the conclusions and recommendations of the study.

CHAPTER 6: CONCLUSIONS, RECOMMENDATIONS, LIMITATIONS AND IMPLICATIONS FOR FURTHER RESEARCH

6.1 CHAPTER OVERVIEW

This chapter is the final chapter of the study. The aim of this chapter is to conclude and give comments on practical and theoretical implications of the results. A review of the dissertation chapters is provided. Conclusive remarks based on theoretical and empirical objectives are provided. Limitations that the researcher of the study experienced are also discussed, and recommendations are provided in detail to assist future researchers.

6.2 A REVIEW OF DISSERATION CHAPTERS

The first chapter of this dissertation provided the overview of the study. It focused on the main goal of the study and provided a structure of the dissertation chapters. The second chapter was a review of the literature on the rail industry in South Africa. The topics that were discussed included the development of the rail industry, its composition, and the legislative framework. Further focus of this chapter was on the contributions of the rail industry, its challenges as well as previous research in SCM within the rail industry. The third chapter was a review of the literature on the research constructs (supply chain integration, internal integration, customer integration, supplier integration, supply chain resilience, tangible dimension, intangible dimension, and supply chain performance) and the formulation of the hypotheses. Topics discussed included the definitions of the constructs, factors determining them and the outcomes. The fourth chapter outlined in detail the research methodology used in this study. Topics such as research paradigm, approach, strategy and design were defined. Other topics presented in the chapter included the sampling design, procedures for data collection, data analysis techniques, reliability and validity, and the ethical considerations. Chapter five focused on the data analysis, presentation and interpretation of the research results. The chapter provided a report on the application of data analysis techniques such as demographic data, descriptive statistics of the research constructs, EFA and SEM. Interpretations of the presented results were provided, supported by relevant literature. This final chapter, Chapter 6, provides the conclusions on theoretical and empirical objectives along with recommendations for each construct. Contributions of this study are highlighted; limitations are pointed out and implications for future research are discussed.

6.3 CONCLUSIONS BASED ON THERORETICAL OBJECTIVES

As indicated in Chapter 1 of this dissertation, the following objectives were set for the study:

- **i.** To review the literature on the rail industry in South Africa;
- **ii.** To conduct a literature review on supply chain integration and its sub-dimensions, namely internal, supplier and customer integration;
- **iii.** To analyse the literature on supply chain resilience;
- **iv.** To explore literature on supply chain performance and its sub-dimensions, namely the tangible and intangible dimensions;
- **v.** To review literature on stakeholder theory.

6.3.1 To review the literature on the rail industry in South Africa

The first theoretical objective of the study was addressed in Chapter 2 of this dissertation, which presented the background of the rail industry in detail. This chapter outlined the growth of the rail industry and how it developed from the 20th century until today. The composition of the rail industry was also discussed in detail and showed that organisations such as PASSENGER RAIL ANGENCY OF SOUTH AFRICA, TRANSNET, METRORAIL, GIBELA, and ALSTOM UBUNYE are the main players. The legislative frameworks through which the rail industry in South Africa is governed were discussed. The literature identified the Rail Safety regulator Act of 2002, National Land Transport Act (No.5 of 2009) and the National Land Transportation Transition Act (No.22 of 2000. There are further regulatory tools that ensure the rail industry delivers its mandate. These include the safety management system, rail safety permits, occurrence reporting and investigation, standard regulations and guidelines, conducts of inspection and audits, development of regulations, safety standards and regulatory prescripts, support and promoted occupational health and safety and issues notices of non- compliance. The economic contribution of the rail industry was also presented, outlining how the rail industry affects or impacts the South African society. The economic contribution of the rail industry was also presented, outlining how the rail industry affects or impacts the South African society. The study found that the industry contributes to South Africa in positive ways such as employment creation, facilitating the transportation of people and goods, providing skills development to the youth, promoting and upskilling employees and contributing to productivity and lastly, challenges affecting the rail

industry were also discussed. The study found that maintenance of rail lines, decline in fleet availability, vandalism of infrastructure, train scheduling and problems in operating long-distance services were the major challenges impacting on the operations of the industry.

6.3.2. To conduct a literature review on supply chain integration and its sub-dimensions, namely, internal, supplier and customer integration

The second theoretical objective of the study was addressed in Chapter 3 of the dissertation, in which the literature on the research constructs was reviewed. The literature defined supply chain integration as the strategic collaboration with supply chain partners, and management of processes in order to achieve effective and efficient flow of products and services by providing value to customers. The factors determining supply chain integration were also discussed. It was found that such factors include commitment, trust, collaborative communication, dependence and interdependence, long-term relationships, management control and integration policies. The literature further presented the importance of supply chain integration in firms. It emerged that the activity is essential because it promotes flexibility, waste elimination, improved financial performance and profit, and the ability to respond to changing demands of the customer. The types of supply chain integration were also discussed, namely internal integration, supplier integration and customer integration. Internal integration was described as practices of merging together and developing internal resources and information to generate shared knowledge that goes beyond the boundaries of individual factors. The literature also described supplier integration as the degree to which a manufacturer cooperates with its key suppliers to fulfil its customers' requirements by shaping inter-organisational structures, strategies, and practices into collaborative processes. Customer integration was described as the active integration of the customer in the provision of goods and services (Leyer & Moormann, 2012 :07).

6.3.3. To analyse the literature on supply chain resilience

The third theoretical objective was addressed in Chapter 3 of the dissertation. Works by various authors were consulted in order to fully understand the concept of supply chain resilience. The literature defined supply chain resilience as the ability of a system to return to its original state or move to a desirable state after being disturbed. It was further described as the adaption capability to prepare for unexpected events, respond to interruptions and recover from them. It was found that supply chain visibility, information sharing, supply chain agility, collaboration among players

and the structure of the supply chain were the major factors determining supply chain resilience. The chapter further explored the benefits of supply chain resilience, of which outcomes such as competitive advantage, availability, and flexibility were found to be relevant. These benefits make it important for firms to consider placing emphasis on developing resilient supply chains in order to succeed in their activities.

6.3.4 To explore literature on supply chain performance and its sub-dimensions, namely the tangible and intangible dimensions

The fourth theoretical objective was addressed in Chapter 3 of this dissertation. The literature defined supply chain performance as the ability of a supply chain to respond to customers' needs, minimise production and inventory costs while delivering at the right time and the right quantity. It emerged that supply chain performance is important because it leads to numerous desirable outcomes such as competitive advantage and sustainable growth, reduction of risks, improved product and material flow, seamless information flows and enhanced financial flows. From the literature, it emerged that supply chain performance is an outcome of factors such as determining the environment of the firm, information technology adoption, relationship with suppliers and customers, quality and process strategy. Further, the importance or benefits of supply chain performance emerged: The literature identified two subcomponents of supply chain performance, namely the intangible and tangible dimensions. Intangible supply chain performance refers to those outcomes of supply chain performance that do not exist in physical form. Examples include liquidity, profit, sales, costs, location and firm reputation. Tangible supply chain performance includes those physical aspects such as inventory, equipment, materials, buildings and other infrastructure, and employees, customers and suppliers.

6.3.5 To review literature on stakeholder theory

The fifth theoretical objective of the study was also achieved in Chapter 3 of this dissertation. The current study was based on the stakeholder theory. The literature indicated that the stakeholder theory places emphasis on the relationships between a firm and its various internal stakeholders. These stakeholders include employees, management, government, surrounding communities, suppliers, competitors and communities of practice, among others. The theory suggests that a firm can only flourish if it manages to develop and maintain meaningful and harmonious relationships with its stakeholders. It was also highlighted that this theory is important because it introduces

value creation for a firm through its stakeholders. It recognises that firm success hinges on, among other things, the contribution by a firm's strategic constituencies, thereby bringing it closer to a realistic economic optimum. The stakeholder theory was also selected because the present study focused on supply chain integration and alliances with various stakeholders such as different departments in an organisation, and external suppliers and customers.

6.4 CONCLUSIONS BASED ON EMPIRICAL OBJECTIVES

The following empirical objectives were set for the study:

1. To examine the degree of supply chain integration in the South African rail industry;
2. To examine the level of supply chain resilience in the South African rail industry;
3. To assess the performance of the South African rail supply chain;
4. To analyse the influence of supply chain integration on supply chain resilience in the South African rail industry;
5. To determine the influence of supply chain resilience on supply chain performance in the South African rail industry.

6.4.1 Conclusions on the degree of supply chain integration in the South African rail industry

The first empirical objective was intended to test for the degree of supply chain integration in the South African rail industry. Since supply chain integration is categorised into three subgroups, namely internal integration, supplier integration and customer integration, it is necessary to provide conclusions on the levels of each one of them in the South African rail industry.

6.4.1.1 Degree of internal integration

Internal integration was the first element of supply chain integration and was tested using six items. Responses showed that all the respondents were neutral. The first item measured the degree of data integration among internal functions and had a mean value of 2.90, which implies that respondents in the rail industry were not sure if there is data integration among internal functions. The second item measured if there is real-time inventory management and scored a mean value of 3.08 which shows that the respondents were again neutral, suggesting that there is no real time inventory management in the rail industry. The third item measured real time access to related logistics

information and again, the respondents were neutral. The next item focused on integration among operations processes, information exchange among cross-functional teams and if there is online interaction between operations and sales functions. Responses to all of the above showed that the respondents were neutral. The study therefore concludes that there is no evidence of internal integration in the railway industry, an area that requires attention in order to meet customer demand.

6.4.1.2 Degree of supplier integration

Supplier integration was measured using six items. Answers from four of the respondents were natural, and two respondent totally disagreed with the questions. The first question had a mean value of 3.09, which tested if there is information exchange with suppliers through the internet or web-based technologies. The next items scored a mean value of 3.10 (our firm has managed to establish strategic partnerships with suppliers), and 3.00 (our firm's suppliers participate in the process of procurement and production). Other items' mean scores were 2.95 (Our firm has established a quick ordering system) and 2.99 (in our firm there is stable procurement through networks), respectively. The study therefore concludes that there is no evidence of supplier integration in the rail industry. It is therefore necessary to implement improvements in this area to ensure that firms in the rail industry are able to integrate their activities with their suppliers.

6.4.1.3 Degree of customer integration

Customer integration was the last element of supply chain integration. The respondents responded affirmatively to all six questions asked in this element. According to the respondents, there is integrated demand forecasting in the rail industry and this item had a mean value of 5.98. There is also satisfactory online order taking, indicated by a mean value of 6.18, fast ordering processes (6.00), effective customer profiling (5.93), and effective after sales support system (5.92), and there are follow-ups with customers' feedback (5.95). The study therefore concludes that there is satisfactory integration between firms in the rail industry and their customers. Rail industries have fast ordering systems, demand forecasting that is integrated, and effective follow-ups with customer feedback are made to ensure that customers are satisfied.

6.4.2. Conclusions on the level of supply chain resilience in the South African rail industry

Table 5.4.4 in Chapter 5 indicates that supply chain resilience had an overall scale mean value of 3.16. This is mainly because respondents were neutral in responding to the items used to measure supply chain resilience. The items included the capability of the rail industry firms to anticipate disruptions and overcoming them, the ability to quickly react to interruptions, the ability of rail firm operations to continue after the occurrence of disruptions, the potential of firms' performance to diverge from goals set, and maintenance of a high situational awareness at all times. The study thus concludes that there is a lack of evidence of the strength of resilience in the rail industry.

6.4.3. Conclusions on the performance of the South African rail supply chain

The third empirical objective was intended to test for the performance of the South African rail industry supply chain. In the EFA, two dimensions of supply chain performance were identified, which are the tangible and intangible sub-scales. It is essential to draw conclusions on the levels of each one of these two dimensions of supply chain performance in the context of the South African rail industry.

6.4.3.1. Supply chain performance based on the tangible dimension

The first dimension of supply chain performance is the tangible dimension which had an overall mean value of 3.19. This dimension was assessed using four measurement items. The first item (our firm manages its supply chain costs effectively) had a mean value of 3.13, the second (our firm manages its profit effectively) attained a mean score of 3.25, the third (our firm manages cash turnover effectively) had a mean value of 3.13 and the fourth, measuring returns on sales effectively, achieved a mean score of 3.23. The study therefore concludes that there was no evidence of the actual level of tangible SCP performance in the rail industry.

6.4.3.2 Supply chain performance based on the intangible dimension

The second dimension of supply chain performance is the intangible dimension. In this study six measurement items were used to assess this dimension and these showed that all respondents were neutral. The first item which checked if firms in the rail industry utilise their capacity effectively had a mean value of (3.23), indicating that respondents were not sure. The second item verified whether companies manage inventory turnover effectively (3.24). The next item assessed if there is sufficient material availability and attained a mean value of 3.32. Other items included

satisfaction of customers (3.24), management of lead times (3.27), and management of product deadlines (3.26). The study concludes that there was a lack of evidence of the level of intangible supply chain performance in the rail industry.

6.4.4. Conclusions on the influence of supply chain integration on supply chain resilience in the South African rail industry

The first hypothesis (H_1) sought to investigate the influence of internal integration on supply chain resilience in the South African rail sector. The results show that there is a positive and significant relationship between internal integration and supply chain resilience (β = 0.132). This result suggests that internal integration plays a vital role in organisations operating in the rail industry. Therefore, if organisations in the rail industry integrate their internal systems, they stand a better chance of increasing their supply chain resilience which leads to positive outcomes in the reaching of milestones.

The second hypothesis (H_2) focused on the relationship between supplier integration and supply chain resilience. The results were positive and significant (β = 0.369), which emphasises the importance of supplier integration in a firm. Organisations should therefore integrate with their suppliers and develop in order to enhance the resilience of the rail supply chain in South Africa.

The third hypothesis (H_3) investigated the influence of customer integration on supply chain resilience, and the results were positive and significant (β = 0.596). These results suggest the importance of customer integration in an organisation as a means to achieve supply chain resilience. Thus, organisations operating in the rail sector should direct attention to their customer needs by integrating with them in certain processes where customer inputs are essential. This integration with customers has the effect of contributing positively to the resilience of the rail supply chain.

6.4.5. Conclusions on the influence of supply chain resilience on supply chain performance in the South African rail industry

With regards to the fourth hypothesis (H_4), which focused on the relationship between supply chain resilience and tangible supply chain performance, the results were positive and significant (β = 0.781). Based on this result, it is concluded that supply chain resilience plays an important role in

stimulating the tangible attributes of supply chain performance, such as costs, profits, sales and cash turnover in the rail industry.

The final hypothesis (H_5) focused on supply chain resilience and intangible supply chain performance, and the results were positive and significant (β = 0.673). The study, therefore, concludes that supply chain resilience has an effect of enhancing the intangible aspects of supply chain performance, such as capacity utilisation, inventory turnover, material availability and customer satisfaction in the rail industry.

6.5. RECOMMENDATIONS

This section provides recommendations on how the rail industry in South Africa can benefit from the various constructs considered in this study. These constructs are supply chain integration (and its three sub-components), supply chain resilience and supply chain performance (and their two sub-components).

6.5.1. Recommendations on supply chain integration

Since the study considered three dimensions of supply chain integration, recommendations are hereby provided on each of these constructs. These are internal integration, supplier integration and customer integration.

6.5.1.1 Recommendations on internal integration

To improve internal integration in the rail industry, the following recommendations are put forward:

- Supply chain professionals and the rest of employees should receive training which focuses on the importance of synergistic collaborations between different departments and divisions within each rail firm. Several workshops can be held periodically and can be facilitated either by internal experts or external consultants. Important topics such as Principles of Production and Inventory Management and Customer Excellence Training can be covered in the training workshops. Such training can help with important skills and knowledge on how to avoid the silo mentality, how to approach personnel in other departments and the selection of technologies that facilitate such collaborations.

- Improvement of internal communication is recommended. Communication throughout departments is essential in the rail industry because it allows employees to understand information more accurately and quickly. Communication can be shared electronically, verbally and by writing. For example, information can be disseminated electronically through emails and the social media. Verbally, it can be shared through monthly, weekly or daily meetings. Also, billboards visible to all people can be used. Such types of communication will enable employees in railway companies to be more flexible and quickly adjust to situations and deliver accordingly.
- Specific sets of goals and key performance indicators (KPIs) can be selected. Through the setting of goals and KPIs, employees will have to perform and meet their key performance indicators. This can be implemented through line managers in the organisation, who can set objectives with their employees and these can be reviewed monthly or quarterly. Interventions can be made where employees fail to meet their KPIs, and rewards can be issued where they surpass their KPIs. This will help the companies in the railway meet its goals and objectives.
- Automation of systems should be considered. Companies in the railway sector should consider system automations to improve internal integration. Through the automation of systems, the time taken to complete tasks can be reduced significantly. Employees can be provided with excessive Global System Integrator training through global external service providers. This will enable employees to focus on more important tasks.
- Nurture constructive organisational cultures. Companies in the rail industry should develop constructive organisational cultures that promote positive energy among employees. Stickers or decoration trophies that bear the firm's values and beliefs can be placed at strategic positions within the firm's premises to remind employees of their firm's core values. These values can be repeated verbally in meetings to ensure that all people share the same values and are working towards the same goal. A positive organisational culture leads to positive outcomes such that all departments will be integrated.

6.5.1.2 Recommendations on supplier integration

To improve supplier integration in the rail industry, the following recommendations are suggested:

- Supplier development is one of the strategies that companies can use to increase supplier integration. It helps to boost performance in a firm as well as to drive continued growth, which drives innovation by helping suppliers to work together and develop unique solutions. Supplier development creates stronger long-term relationships with suppliers, which can be beneficial to the firm because quality products/service with better prices will be provided. It leads to competitive advantages through educating and mentoring suppliers, which can help companies to partner with suppliers that understand their business from pricing to quality requirements. This strategy can be executed by having supplier development forums, internal or external meetings with suppliers where the supplier development team in the firm engages with its suppliers on how to help them perform at their best.
- Technology adoption can also help companies to improve supplier integration in the rail industry. This strategy can be executed by investments in supplier management software that makes it easy to keep track of information about the firm's suppliers in one place. Purchase order management software can also be used, which can be used to create, process and track purchase orders, which enhances transparency between the firm and its suppliers. This will help companies to have accurate visibility of supplier's deliveries and activities will be planned accordingly. Technology adoption also saves costs and time.
- Risk management in supplier selection also helps improve supplier integration in a firm. This strategy can be executed by checking for supplier references, for example their previous work, their ability to manage crises, their working experience, and their financial status. This is very important because a chain is only as strong as its weakest link, and failure by the supplier to perform can have devastating effects on the buying firm. Risk management in supplier selection also helps minimise interruptions in the business.
- Rail firms should invest in supplier relationship management processes. It is essential for a firm to have employees who are responsible for supplier relationship management. This strategy can be implemented by having documents in place that will help the team through the management and administration of suppliers. For example, this can be done through flowcharts, policy documents and agreements and documents that cover all points regarding the supplier and the business. This helps the business because a special bond with the supplier is created and improves supplier integration.

6.5.1.3 Recommendations on customer integration

To improve customer integration in the rail industry, the following methods can be implemented:

- Sales and customer relationship management systems should be improved. This is one of the ways that helps to improve customer integration in a firm, so the firm can turn marketing leads into sales. It is also vital to integrate customer feedback data into customer relationship management. Customer relationship management provides milestones with records and revenue numbers while customer experience provides data for those customer decisions. This can be done through following up with the customer after sales, and distribution of customer experience surveys. This helps the firm see how the behaviour of the customer changes as improvements are made based on the customer's feedback.
- Employee engagement software. It is very important for companies to treat its employees well as they strive to satisfy customers, since employees are the ones that deal with customers. This can be done by gathering data that measures job satisfaction, employee engagement and motivation. This will help the firm with increased productivity for a better customer experience. Happy employees always want the firm to meet its goals and objectives, thereby improving customer integration in a firm.
- Mapping the journey of the customer is vital in a firm because customers interact with companies through different channels from stores to websites. This can be done by having a well-designed online website where the firm interacts with its customers. This will enable the firm to map a continuous customer journey, predict customer behaviour and help them personalise the experience everyone goes through. In this way, customer integration and loyalty are built.
- Firms must equip their employees with customer excellence training, so that they can provide proper service to customers. If companies invest in their employees, they are simply investing in their customers which will lead to positive customer integration. They can execute this strategy by providing training through internal or external service providers. Customer relationship forums and a KPI that relates to customer satisfaction should be created that should be met. By doing this, the customer integration process will be improved.

- Data integration should also be considered. As customers engage with products and service firms, they must integrate data to better service their needs. This can be done by email campaigns, customer surveys and promotional social events. This will benefit the firm because the more focused a campaign becomes, the more connected customers feel, apart from being part of the brand. This will improve customer integration within the firm, hence the failure to integrate with customers suggests that sales will be low, and the firm will be doomed from stage one.

6.5.2 Recommendations on supply chain resilience

To improve supply chain resilience in the rail industry, the following recommendations should be addressed:

- Companies that can balance flexibility and resiliency tend to have a healthy supply chain. Flexibility can be through being flexible in operations, for example being able to change suppliers/supplier options and potentially lowering costs using standard products instead of customised ones. Resiliency allows firms to recover from disruptions in a supply chain, for example by ensuring buffer stock to avoid supplier disappointments with deliveries and ensuring that all fast-moving items have reorder points and can be replenished automatically by systems put in place. This will help companies improve their supply chain resilience in the rail industry.
- Multisource can also be applied. It is important for companies in the rail industry to introduce multisourcing strategies if they want to improve their supply chain resilience in their businesses. These strategies can be implemented by ensuring that companies do not apply a single-based sourcing strategy. They must have more than one supplier that can provide the same product because this will work in favour of the business – if one supplier cannot supply, the other supplier can perform the duty. Multisourcing is vital because it creates competition between suppliers which helps suppliers perform at their best and all this will lead to a positive supply chain resilience.
- Increased redundancy, such as increasing inventory and utilising less capacity: this is one of the most powerful tools that can be used to improve supply chain resilience in a firm. The more suppliers the firm has, the more options it has. This helps the operation to continue because even if the distribution of products has to be shut down the firm will have

options as mentioned above (multisourcing and redundancy works hand in hand). The more suppliers a firm has, the greater resilience in the supply chain of the firm. This is important because redundancy allows the firm to have additional inventory to cover delays or shortages.

- Enhanced flexibility. Flexible processes can help a firm overcome the negative impact of disruptions and respond positively. Companies can enhance flexibility by standardising and automating workflows and processes. This includes, for example, standardising plants, warehouse designs and documenting processes. Adoption of a plug and play approach is beneficial – whereby a system highlights ways to speed up processes that are critical and ensures resources are where they are needed.
- Clear communication is important in improving supply chain resilience in the rail industry. Without clear communication suppliers cannot deliver what is expected. Companies can implement this strategy by ensuring that their suppliers are very well informed of what is expected of them to deliver. This is important because it will save time and the supply chain will be flexible, leading to a positive supply chain resilience.

6.5.3 Recommendations on supply chain performance

To improve supply chain performance in the rail industry, the following recommendations should be seriously considered:

- Increasing the visibility of the rail supply chain. Supply chain visibility allows the firm to monitor the progress of their product from the suppliers to the firm. It can be promoted by suppliers being able to check the firm's inventory so they can understand the firm better. It can also be attained by planning ahead to fulfil future demand through consumption-based planning and future material forecasting. This helps the firm because when suppliers, colleagues and customers have the power of visibility they can utilise that, communicate and plan for the future.
- Inventory optimisation and cost reduction – no firm wants to only incur costs, they also want to reduce the costs as it is important for companies to investigate cost reduction and optimisation of inventory. This strategy is achieved by doing stock on hand analysis through systems that would identify slow moving items and items that are just in the warehouse but have not moved for about a year. They can sell the items to other rail

companies and do better by forecasting and demand planning before placement of purchase requisitions and procuring of items. This will help companies improve their supply chain performance.

- Technology adoption – companies should identify areas where technology can be implemented to improve and streamline processes. This strategy saves time and allows employees to focus on more important tasks. For example, with the annual stock count, companies can introduce barcoding systems instead of counting C-Parts (screws) one by one. This is important because with appropriate technology in place, reporting of data will be more accessible and more accurate.
- Contract management – the management of contracts should be handled by supply chain departments in a firm. Potential savings are negotiated during procurement processes. For example, if a firm overstocks, the supply chain will be at fault and if it understocks the supply chain department is still at fault. It is important then that they manage the contracts because it will allow supply chain leaders to leverage spend where there is a greater opportunity to reduce costs and mitigate risks.
- Supply chain council set up – without leaders in place the supply chain of a firm may lack a clear vision of efficiency and functionality. It is important for this to be in place because it allows the firm's supply chain to align with the overall strategy of the firm and this will lead to positive supply chain performance. This strategy can be implemented by cross-functional communication and by demonstration of the value of an organised supply chain.

6.6 CONTRIBUTIONS OF THE STUDY

This section of the chapter deals with the theoretical and practical contributions of the study.

6.6.1 Theoretical contributions

Theoretically, this study contributes new knowledge to the existing literature in the South African rail industry. The study also directs supply chain management research to the rail industry, which is an important economic sector and where there are many emerging issues that require empirical attention. It also provides information on the current state of the supply chain integration, supply chain resilience and supply chain performance in the rail industry in Gauteng Province from the

perspective of professionals employed in the sector. The study further generates new information on the relationship between supply chain integration, supply chain resilience and supply chain performance in the rail industry of South Africa. The study also provides information about the importance of the three forms of integration, namely supplier, customer and internal integration in rail companies. Also, the study confirms the usefulness of the supply chain performance framework considered in this study, which categorises supply chain performance into tangible and intangible dimensions. This framework can this be applied with confidence in various sectors of the economy. The study is among the first studies to investigate this connection in South Africa. The study provides a unique conceptual model of the relationship between the constructs used in this study, which enables future researchers to apply this knowledge in their studies. This study is very important for future researchers because it provides new knowledge of supply chain integration, resilience and performance in the rail industry of South Africa.

6.6.2 Practical contributions

The results provided in this study are important to professionals in the rail industry. The study shows that if rail industries improve supply chain integration there will be benefits to the firm in the form of enhanced resilience and performance of the supply chain. This makes it important for supply chain professionals to take note and implement their integration strategies effectively so that they can improve their supply chain resilience, and supply chain performance. The study informs supply chain professionals to realise and embrace the importance of supply chain integration in its three forms to stimulate the resilience and performance in the rail supply chain. Specifically, more emphasis should be placed on customer integration which has the highest effect on supply chain resilience. The study is also a problem-solving framework for supply chain performance problems in the rail supply chain in that it confirms the efficacy of supply chain integration in enhancing the effectiveness of the rail supply chain.

This study also suggests that if supply chain professionals apply some of these strategies in their companies there is a greater chance of resilience in the firm, because where there is integration among departments there is greater resilience which leads to positive supply chain performance. Also, waste could be eliminated by ensuring that data is integrated across operations, which is an important way to ensure that the supply chain is sustainable and successful in the long term. In terms of profitability, the study suggests that integrating the rail supply chain leads to greater

profitability and financial success of the firm. The same view can be applied to other intangible aspects of supply chain performance. Hence, supply chain professionals in the rail industry can use the study as a diagnostic framework for the solving of various challenges facing the rail supply chain in South Africa.

6.7 LIMITATIONS AND IMPLICATIONS FOR FURTHER RESEARCH

The current study provided useful information on the relationship between supply chain integration, supply chain resilience and supply chain performance in the South African rail industry. However, there were limitations that should be noted. The first limitation was that the sample was drawn from Gauteng Province only, excluding other provinces in the country where the rail industry is active. Caution should therefore be exercised in generalising the results of the study to other environments. Additionally, the sample was collected using non-probability sampling, which subjected the study to sampling bias. The third limitation is that the study only used the quantitative method in which questionnaires were adapted from other studies that were originally intended for other purposes. Limited explanations and the lack of monitoring during the completion of the questionnaire was a major limitation. It would have been better if the researcher had time and been able to guide the respondents throughout the questionnaire. And sadly, the emergence of the Covid-19 pandemic that occurred in 2020 and that caused an economic shut down disrupted the data collection process and the researcher's access to face-to-face contact sessions with the study leader (supervisor).

For future research, an expansion of the same study to other provinces in South Africa could provide more information. The use of probability sampling techniques in future may also lead to more sustainable results. An expansion of the scope of the study to different provinces of the study could provide information on the value of supply chain integration to both businesses and academics. Future researchers should try exploring the mixed method approach which will help obtain more realistic and reliable data that would help. Since the study only focused on rail, future research could be directed to the integration of various modes of transportation.

6.8 CHAPTER SUMMARY

This chapter served as the final chapter of the study. The overview of the study, conclusions based on theoretical and empirical objectives of the study were highlighted in this chapter.

Recommendations on how to improve internal integration, supplier integration, customer integration, supply chain resilience and supply chain performance were discussed. Supply chain professionals in the rail industries may apply these recommendations to improve supply chain integration, supply chain resilience and supply chain performance in their firms. The study also reveals significant positive relationships between supply chain integration, supply chain resilience and supply chain performance in the rail industry. Furthermore, limitations and implications for future research were discussed in the chapter. Implications or suggestions for future research will help future researchers on how to conduct similar studies in a better way. This chapter further indicates that the study has made both practical and theoretical contributions to companies operating in the railway industry.

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APPENDIX 1

RESEARCH QUESTIONNAIRE

Date: 5 February 2019

Dear Respondent,

I am a postgraduate student at the Vaal University of Technology studying towards a Magister Technologiae: Logistics Management. The title of my research project is **Supply Chain Integration, Resilience and Performance in the South African Railway Industry.**

You are invited to participate in this research study by completing the attached survey questionnaire. This questionnaire consists of four sections. Before you complete the enclosed questionnaire I wish to confirm that:

- Your participation in this study is voluntary and you are free to withdraw at any time.
- Your anonymity will be maintained and no comments will be ascribed to you by name in any written document or verbal presentation. Nor will any data be used from the questionnaire that might identify you to a third party. Please do not write your name anywhere on the questionnaire.
- On completion of the research a copy of the completed research report will be made available to you upon request.
- Completion of the questionnaire will take approximately 15 minutes.

If you have any query concerning the nature of this research or unclear about any question please feel free to contact me at mailakgothatso@gmail.com or 0787006409.

Your response and time is greatly appreciated. Thank you!
Yours sincerely,

Zodwa Maila

Section A –Demographic Characteristics

1 Occupational Area

Area of occupation	Please tick	Area of occupation	Please tick
Transportation		Supplier relations	
Warehousing		Operations/ manufacturing	
Demand management		Workshop	
Stock/Inventory Management		Customer Services	
Disposal Control		Other (please indicate)	
Procurement			
Technical/ Quality			

2 Indicate your Gender (Please tick)

Male		Female	

3 Indicate your age group (please tick)

18 to 25 years		36 to 40 years	
26 to 30 years		41 to 50 years	
31 to 35 years		Above 50 years	

4 Indicate your level of education (please tick)

Matric		Diploma	
Degree		Postgraduate diploma	
Masters		PhD	
Professional Qualification		Other (please indicate)	

5 How long have you been working for this organisation? (Please tick)

Less than 2 years		11 to 15 years	
2 to 5 years		16 to 20 years	
6 to 10 years		Above 20 years	

6. Please indicate your race (please tick)

Black (African)	
White	
Indian	
Mixed race (Coloured)	
Other (please specify)	

Section B –SUPPLY CHAIN INTEGRATION

This study considers three forms of supply chain integration, which are internal, supplier and customer integration. Please indicate the extent to which you agree or disagree by ticking the corresponding number between 1 (Strongly disagree) and 5 (Strongly agree). A rating of (3) points towards a neutral view of the statement. (Five-point scale: 1 – strongly disagree; 2 – disagree; 3 – neutral; 4 – agree; 5 – strongly agree).

INTERNAL INTEGRATION		1	2	3	4	5
II1	In our firm, there is data integration among internal functions.	1	2	3	4	5
II2	In our firm, there is real-time inventory management.	1	2	3	4	5
II3	In our firm, there is real-time access to logistics-related information.	1	2	3	4	5
II4	In our firm, there is data integration in operations processes.	1	2	3	4	5
II5	In our firm, there are regular information exchanges amongst cross-functional teams	1	2	3	4	5
II6	In our firm, there is online interaction between operations and sales functions.	1	2	3	4	5
SUPPLIER INTEGRATION		1	2	3	4	5
SI1	In our firm, there is information exchange with suppliers through the internet or web-based technologies.	1	2	3	4	5
SI2	Our firm has managed to establish strategic partnerships with suppliers.	1	2	3	4	5
SI3	Our firm's suppliers participate in the planning stage of our operations	1	2	3	4	5

SI4	Our firm's suppliers participate in the process of procurement and production.	1	2	3	4	5
SI5	Our firm has established a quick ordering system.	1	2	3	4	5
SI6	In our firm, there is stable procurement through networks (e.g. EDI).	1	2	3	4	5
CUSTOMER INTEGRATION		1	2	3	4	5
CI1	Our firm has implemented integrated demand forecasting.	1	2	3	4	5
CI2	Our firm has implemented online order taking.	1	2	3	4	5
CI3	The ordering processes used in our firm are fast.	1	2	3	4	5
CI4	Our firm has an effective customer profiling system	1	2	3	4	5
CI5	Our firm has an effective after-sales service support system	1	2	3	4	5
CI6	Our firm follows up with customers for feedback.	1	2	3	4	5

Section C –SUPPLY CHAIN RESILIENCE

Please indicate the extent to which you agree or disagree by ticking the corresponding number between 1 (Strongly disagree) and 5 (Strongly agree) to indicate the level of resilience of your firm's supply chain. A rating of (3) points towards a neutral view of the statement. (Five-point scale: 1 – strongly disagree; 2 – disagree; 3 – neutral; 4 – agree; 5 – strongly agree).

SUPPLY CHAIN RESILENCE		**1**	**2**	**3**	**4**	**5**
SR1	Our firm is capable to anticipate and overcome disruptions in the supply chain network.	1	2	3	4	5
SR2	We have the ability to quickly react to interruption by reconfiguring resources and establish to usual operations.	1	2	3	4	5
SR3	Operations would be able to continue after the occurrence of disruptions.	1	2	3	4	5
SR4	We would still be able to meet customer demand.	1	2	3	4	5
SR5	Performance does not diverge significantly from set goals.	1	2	3	4	5
SCR6	Our firm can maintain a high situational awareness at all times	1	2	3	4	5

Section D –SUPPLY CHAIN PERFORMANCE

This study considers two forms of supply chain performance, which are the tangible and intangible dimensions. Please indicate the extent to which you agree or disagree by ticking the corresponding number between 1 (Strongly disagree) and 5 (Strongly agree) to indicate the level of performance of your firm's supply chain. A rating of (3) points towards a neutral view of the statement. (Five-point scale: 1 – strongly disagree; 2 – disagree; 3 – neutral; 4 – agree; 5 – strongly agree).

TANGIBLE DIMENSION		1	2	3	4	5
TD1	Our firm manages its supply chain costs effectively.	1	2	3	4	5
TD2	Our firm manages its profit effectively.	1	2	3	4	5
TD3	Our firm manages cash turnover effectively.	1	2	3	4	5
TD4	Our firm manages returns on sales effectively.	1	2	3	4	5
INTANGIBLE DIMENSION		1	2	3	4	5
ID1	Our firm utilises its capacity effectively.	1	2	3	4	5
ID2	Our firm inventory turnover effectively.	1	2	3	4	5
ID3	Our firm has sufficient material availability.	1	2	3	4	5
ID4	Our customers are satisfied.	1	2	3	4	5
ID5	Our firm manages lead times effectively.	1	2	3	4	5
ID6	Our firm manages deadlines for products or services effectively.	1	2	3	4	5

Thank you for taking your time to complete this questionnaire. Your views are much appreciated

APPENDIX 2

DECLARATION BY LANGUAGE EDITOR

JEANNE ENSLIN
FREELANCE LANGUAGE PRACTITIONER

Editing certificate

TO WHOM IT MAY CONCERN

I, Jeanne Enslin, acknowledge that I did the language editing of **Zodwa Maila's** dissertation submitted for the requirements for the degree of Master of Technology (Logistics Management) – at the Vaal University of Technology.

The title of the dissertation is:

SUPPLY CHAIN INTEGRATION, RESILIENCE AND PERFORMANCE IN THE SOUTH AFRICAN RAIL INDUSTRY.

All corrections or changes are evident in the version in track changes and with several comments for the student's attention. **This editing certificate is subject to the student checking and dealing with input that requires her attention**.
The quality of the final document, in terms of language, formatting and references remains the student's responsibility.

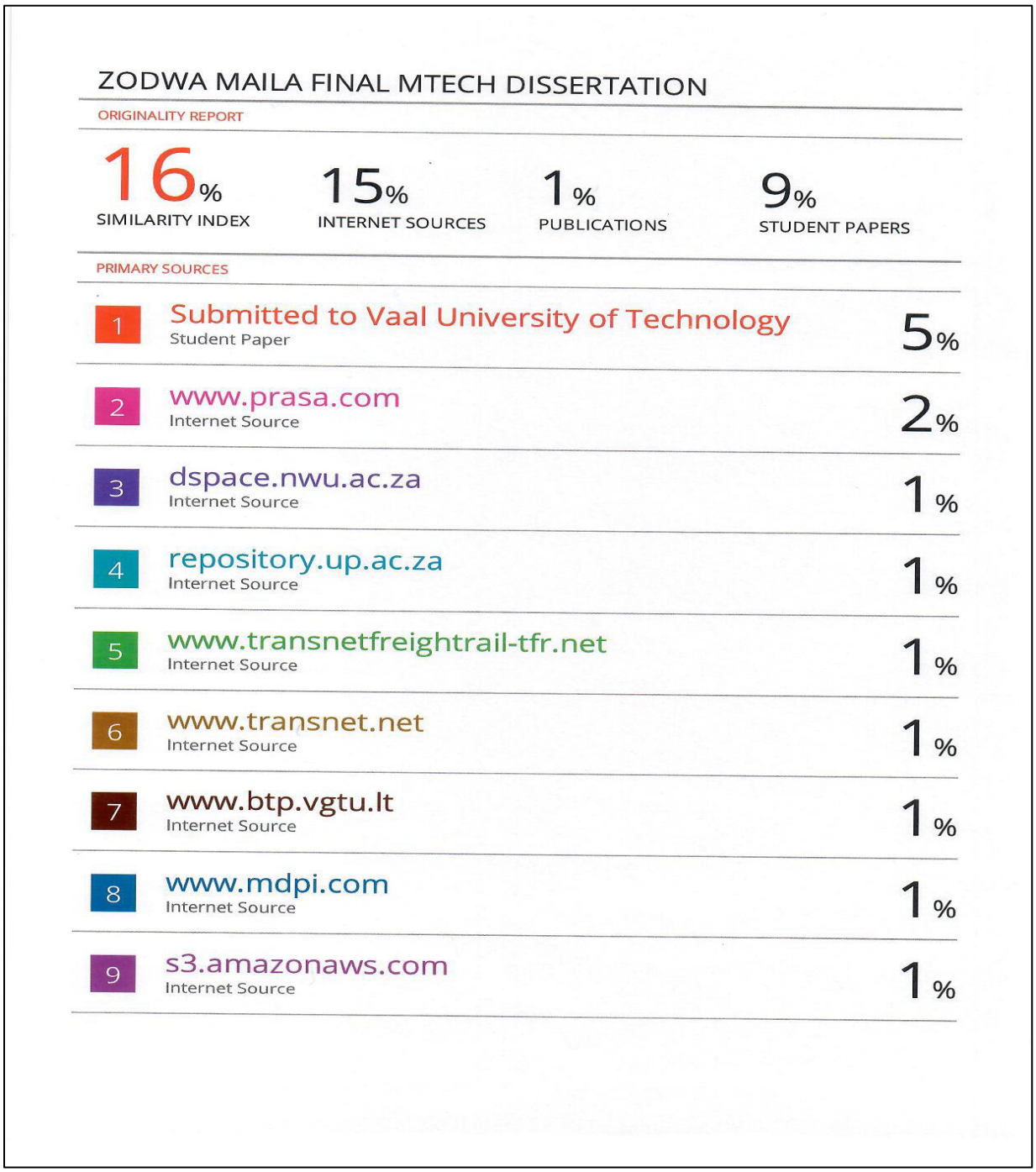
Jeanne Enslin
Language editor
+27 82-6961224

26 April 2020.

BA English and History (University of Stellenbosch)
Senior Teaching Diploma (University of Stellenbosch)
Honours in Translation Studies, cum laude (Unisa)
Post-graduate diploma in editing, cum laude (University of Stellenbosch)

APPENDIX 3

TURNITIN REPORT



ZODWA MAILA FINAL MTECH DISSERTATION

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