ENHANCERS FOR SUPPLY CHAIN RESILIENCE IN MANUFACTURING FIRMS IN KENYA

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Enhancers for Supply Chain Resilience in manufacturing Firms in Kenya

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

Signature……. Date ……..

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This thesis has been submitted for examination with our approval as University supervisors.

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DEDICATION

This thesis is dedicated to my beloved wife Helen and my children Abigail, Nemuel Jr. and Shantel for their support.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

CAS	Complex adaptive system
CFA	Confirmatory component analysis
CFA	Confirmatory factor analysis
CFI	Comparative fit index
EFA	Explanatory factor analysis
GDP	Gross Domestic Product
GFI	goodness-of-fit index
GOK	Government of Kenya
KAM	Kenya association of manufacturers
KMO	Kaiser-Meyer –Olkin
KNBS	Kenya National Bureau of Statistics
MIT	Massachusetts institute of technology
NFI	Normative fit index
PCA	Principal component analysis
RMSEA	Root-mean-square of approximation
ROK	Republic of Kenya,
SCM	Supply chain management

SCM	Supply chain management
SCR	Supply chain risk
SCRES	Supply chain resilience
SCRM	Supply chain risk management
SCV	Supply chain vulnerability
SEM	Structural equation modeling
STC	Strategic choice
VIF	Variance inflation factor

DEFINITION OF OPERATIONAL TERMS

Operational flexibility: Is the ability of an enterprise to adapt to changing requirements of its environment and stakeholders with minimum time and effort. Flexibility practices can enhance supply chain resilience such as order fulfillment flexibility, flexible sourcing and supply base, flexible production capacity, flexible transportation and flexible labour arrangements. It, therefore, ensures that changes caused by the risk event can be absorbed by supply chain through effective responses (Benjamin, Mark, Jerry & Marta, 2015).

Manufacturing firms: Are organizations which produce physical tangible through processing raw materials, assembling products parts and repairing of manufactured products (Agus, 2000).

Production efficiency: Is the capability to produce outputs with minimum resource requirements. This is done to reduce all cost drivers while meeting customer demands. For example, consistently producing the most from labour and equipment, waste elimination, production variability reduction and failure prevention (Pettit, Fiksel, & Croxton, 2010).

Supply chain re-engineering: Is the fundamental rethinking and radical redesign of supply chain processes to achieve dramatic improvements in critical temporary measures of performance such as cost, quality or service. Therefore, is an act of conceptualization, design, implementation and

operational of supply chains through supply chain knowledge understanding and supply strategy (Naim, Lalwani, Fortuin, Schmidt, Taylor, & Aronsson, 2000).

Supply chain resilience: Is the supply chain's ability to be prepared for unexpected risk events, responding and recovering quickly to potential disruptions to return to its original situation or grow by moving to a new, more desirable state in order to increase customer service, market share and financial performance (Giunipero, Nils-Ole & Edda, 2015).

Supply chain vulnerability: Is an exposure to serious disturbance, arising from risks within the supply chain as well as risks external to the supply chain. Therefore, is the susceptibility of supply chain to the likelihood and consequences of disruption (Svensson, 2002).

Strategic sourcing: It is a proactive measure of searching potential suppliers and appraising them in areas such as quality management practices, long term quality output, supplier´s strength, process capabilities, management practices, cost reduction at the same time as increasing profit, design and development capabilities (Chiang, Hillmer & Suresh, 2012).

Risk awareness: Is making supply chain risk assessment a formal part of decision making process at every level. This is done through sharing a common understanding of risks that could occur within their operations (Christopher & Peck, 2004).

Vulnerabilities: Are fundamental factors that make an enterprise susceptible to disruptions. Examples are: turbulence, deliberate threats, resource limits, sensitivity and supplier/customer disruptions (Pettit, Fiksel & Croxton, 2010).

ABSTRACT

Supply chain resilience is a relatively new area in supply chain research in Kenya and it focuses on the firms' ability to absorb disruptions. Supply chain resilience can enable manufacturing firms to overcome disruptions and continually transform them to meet the changing needs and expectations of its customers, shareholders and other stakeholders. Thus, the general objective of this study was to investigate enhancers for supply chain resilience in manufacturing firms in Kenya. The study adopted cross-sectional survey design using both quantitative and qualitative approaches. The target population was 613 manufacturing firms in Nairobi and its surroundings (in a radius of 30 km), who were members of Kenya Association of Manufacturers (KAM) in 2015. The study used stratified random sampling to pick a sample size of 62 manufacturing firms which was proportionate to the population representing 14 industrial sectors in manufacturing firms. Data was collected using questionnaire. Descriptive statistics was used aided by Statistical Packages for Social Sciences version 24 to compute percentages of respondents' answers. Also, analysis was conducted using a two stage process consisting of confirmatory measurement model and confirmatory structural model. The study found out that strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness were significant predictor supply chain resilience in manufacturing firms with supply chain re-engineering being the most significant predictor among the four. Likewise, the study found out that manufacturing firms' in Kenya lacked risk awareness as key criteria for selecting suppliers, trade-off between efficiency and redundancy stock. The study recommends that it would be appropriate for management of manufacturing firms to adopt and embrace strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness as a proactive way of creating resilience in manufacturing firms. Equally, the study recommends that manufacturing firms should share resources with their supply partners in a form of leveraging capabilities, resources and assets. Similarly, manufacturing firms should conduct mapping tools to identify bottlenecks and critical path in supply chain and risk awareness as key criteria for selecting suppliers, trade-off between efficiency and

redundancy stock. The study demonstrates that there is need for management to be proactive in developing resilience. Mitigation processes are essential to supply chain resilience, irrespective of the type of organization. Also, the study has highlighted the benefits of using proactive actions by focusing on key issues to create the resilience capability within the companies or along their supply chains to overcome critical disruptions as well as daily outages. This study recommends that a similar research can be conducted from multiple informants groups to come up with a variety of outcomes by creating discussion among supply chain managers with different skill, experience and motivation. Also, a similar research can be conducted using longitudinal so as the research to identify the evolution of resilient strategies across number of years.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Supply chain disruptions can be very severe to the productivity of manufacturing firms. This complicates working business environment and hence calling for lean and flexible global operations in any manufacturing firms. Skipper and Hanna (2009); Scholten and Fynes (2014) asserted that the growing complexity of managing global supply chains and meeting exacerbating customer requirements has made organizations more aware of their operational and economic vulnerability to threats from the macro environment. Supply chain resilience can help to reduce and overcome exposure to risks through developing strategies that enable the supply chain to recover to its original functional state following a disruption (Juttner & Maklan, 2011). Therefore, manufacturing firms can use supply chain resilience to prevent and overcome disruptions in case it occurs.

Resilience is defined as a process of mitigating disruptions that might occur and cause losses in the organizations. Fiksel (2006); Scholten and Fynes (2014) define resilience as capacity of a system to survive, adapt and grow in the face of turbulent change. Business systems face technological change, financial risk, political turbulence and mounting regulatory pressures; industrial growth does not proceed smoothly. The traditional tool to manage uncertainty is risk management, which is especially challenging when threats are unpredictable. Deliberate threats such as theft or terrorism can even adapt to new security measures. At the same time, corporations are accepting broader responsibility for the social and environmental impacts of their supply chains. The entire enterprise has a role to play in creating and maintaining supply chain resilience (Pettit, Fiksel, & Croxton, 2010).

A resilient supply chain has the capacity to overcome disruptions and continually transform itself to meet the changing needs and expectations of its customers, shareholders and other stakeholders. Supply chain resilience encompasses the ability to prepare for unforeseen disruptions and to respond and recover from them faster than competitors do (Jüttner & Maklan, 2011; Chopra & Sodhi, 2014). All firms rely on their suppliers to maintain smooth operations and their customers for continued revenue. Therefore, a resilient firm is truly only as resilient as its supply chain (Welch & Welch 2007).

1.1.1 Global Perspective of Supply Chain Resilience

Previously, resilience was not a well-known concept in the business' world, and to some extent, its meaning is still limited to a minority of researchers and practitioners within the supply chain management field. This concept has emerged from a fusion of disciplinary concepts and ideas which began in material science to describe the capacity of a material to bounce back to its original shape after any deformation (Sheffi, 2005). Because of its wide application to different subjects, such as ecology, psychology, economy, social and organizational approaches, resilience has become a multidimensional and multidisciplinary phenomenon in the last 40 years (Ponomarov & Holcomb, 2009).

In the business environment, the first wide-spread study on supply chain resilience began in the United Kingdom, following transportation disruptions from fuel protests in 2000 and the outbreak of the Foot and Mouth Disease in early 2001. The study explored the UK's industrial knowledge base about supply chain vulnerabilities and found that: supply chain vulnerability is an important business issue, little research exists into supply chain vulnerability, awareness of the subject is poor and a methodology is needed for managing supply chain vulnerability (Cranfield University, 2003; Pettit *et al*., 2010).

Christopher and Peck (2004) developed an initial framework for a resilient supply chain. They asserted that supply chain resilience can be created through four key principles: resilience can be built into a system in advance of a disruption (re-engineering), a high level of collaboration is required to identify and manage risks, agility is essential to react quickly to unforeseen events and the culture of risk management is a necessity. Characteristics such as agility, availability, efficiency, flexibility, redundancy, velocity and visibility were treated as secondary factors.

In parallel to the Cranfield studies (2003), researchers at the Massachusetts Institute of Technology (MIT) analyzed many case studies of supply chain disruptions with a focus on identifying vulnerability characteristics and management responses such as flexibility, redundancy, security and collaboration (Sheffi, 2005). It is critical to note that disruptions can also bring unexpected opportunities for success, as shown by three examples from Sheffi's work (2005). First, the Los Angles Metro link transit system increased its ridership by 20-fold immediately following the January 1994 Northridge earthquake. Second, FedEx seized opportunity in the aftermath of a strike at UPS in 1997 by filling unmet demand. Third, Dell took advantage of the West Coast port lockout in 2002 to spur demand for LCD monitors that they could ship economically via air freight, displacing bulkier CRTs. Such disruptions can offer an opportunity to impress customers and win their loyalty and successful recovery and adaptation to new market forces can lead to competitive advantage (Pettit *et al*., 2010). As a result of these featured events, managers concerned about further threats were forced to think of alternative ways to develop strategies for preventing and coping with different types of disruptions. At this point in time, researchers have seen this topic as a great opportunity to explore business continuity and competitive advantage.

In today's inter-connected world, most organizations recognize the potential risk of experiencing a supply chain disruption. This can be caused by, for example, a workforce strike, extreme weather conditions or a truck breaking down (Blackhurst, Dunn & Craighead, 2011). Such disruption can be related to any unplanned and unanticipated event that impacts the normal flow of goods, material and/or services (Craighead, Blackhurst, Rungtusanatham & Handfield, 2007). The vulnerability of supply chains to disruptions is evidenced by major events in the past; for example, the earthquake in Japan in 2012 not only impacted the Japanese and Asian economies, but led to shortages in the automobile and technology industry supply chains in Europe (Scholten, Scott, & Fynes, 2014).

The apparent ability of some supply chains to recover from inevitable and unexpected supply chain disruptions more effectively than others for example, the Nokia and Ericsson case triggered a debate about supply chain resilience (Juttner & Maklan, 2011). Supply chain resilience is based on the underlying assumption that not all risks can be prevented. Resilience is a proactive and holistic approach to managing supply chain risks enhancing traditional risk management strategies (i.e. risk assessment, vulnerability analysis, continuity planning): as it does not require risk identification and quantification, supply chain resilience can deal with unforeseeable disruptions and events (Pettit *et al*., 2010). The concept refers to an organization's capacity to survive, adapt and grow when confronted with change and uncertainty (Knemeyer, Zinn & Eroglu, 2009) and has been defined in supply chain terms as "the adaptive capability of the supply chain to prepare for unexpected events, respond to disruption and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structures and function" (Ponomarov & Holcomb, 2009; Giunipero *et al*., 2015). It can be thought of in terms of "shock absorption" between stages of the supply chain (Sheffi & Rice, 2005).

1.1.2 State of Supply Chain Resilience in Kenya

Kenya's economic growth remains vulnerable to external shocks, especially developments in the global economy, regional stability and security, and weather-related supply shocks. On the domestic front, political stability and national cohesion are essential for improved business confidence and policy predictability. Kenyan authorities should develop mechanisms to respond flexibly to macroeconomic risks and shocks (Republic of Kenya, 2013). For example, in the Kenyan context oil and gas supply chains, many of the security threats identified are attacks perpetrated while oil and gas are transported by sea (for example sea piracy, hijacking), in pipelines (for example theft, sabotage and vandalism) or while it is being extracted from platforms or stored in facilities. For instance, the entire offshore areas of Yemen and Somalia extending to Oman and Kenya have been frequently associated with endemic piracy. Attacks on ships increased by 10 per cent in 2010, mostly by Somali based pirates (Luciani, 2011). This has increased vulnerability of Kenya's supply chain in various sectors.

The Kenya manufacturing sector grew by 3.1 per cent in 2012 compared to 3.4 per cent in 2011. The weak performance is attributed to high costs of production, stiff competition from imported goods, high costs of credit, drought incidences during the first quarter of 2012, and uncertainties due to the 2013 general elections. The influx of counterfeits and volatility in international oil prices also affected the performance of the sector (ROK, 2013). The slow performance is also attributed by contraction in food, beverage and tobacco, leather and footwear, electrical and electronics, rubber product and energy, paper and paper products sectors. The growth of manufacturing sector was negatively affected by soaring cost of fuel and weak Kenyan Shilling which lowered the demand for manufactured products. In addition droughts experienced in 2010 resulted to reduced availability of raw materials (Kenya Association of Manufacturers, 2012). These unforeseen disruptions are indication that the Kenya manufacturing firms suffers from lack of supply chain resilience.

Kenya has faced supply chain disruptions since the year 2007. Guyo, Kangongo, Bowen and Ragui (2013) in their study of "supply chain disruption in the Kenya floriculture industry" found that the most significant factors contributing to supply chain disruption in the floriculture industry in Kenya are natural disasters, logistics process design, labor union actions and finally production function mechanics. To address supply chain disruptions, the study recommended that implementation of comprehensive business continuity plans to mitigate against the supply chain effects of natural disasters, development of logistical process redundancies, formulation of creative policies to contain labor unions agitations and investment in research to develop resilient and scalable production function mechanics. This study failed to address on how supply chain resilience can be achieved in Kenya floriculture industry.

Also, the performance of the agriculture sector in Kenya was adversely affected at the beginning of 2012 when a severe frost dealt a blow to tea production, while the delay in the onset of long rains led to suppressed agricultural activities (GOK, 2009). Agriculture functions have been devolved under the Constitution of Kenya 2010. The county governments can leverage public-private partnerships (PPPs) to enhance agricultural production and productivity. Potential areas for application of PPPs include cold chain infrastructure; use of ICT in collecting, processing and disseminating information; development of cottage industries; and skills development (GOK, 2009; ROK, 2013). Despite the fact that agricultural functions have been devolved there are no much changes that can be witnessed in agricultural sector. In steady agricultural sector has worsened (ROK, 2013).

Likewise, the Kenya National Bureau of Statistics (KNBS, 2013) Economic Survey, the total tourist arrivals for 2012 were 1,780,768, which was a decline of 0.3 per cent over the 2011 figure of 1,785,382. Estimated receipts from tourism in 2012 stood at KSh 96.02 billion, a 1.92 per cent drop from the KSh 97.90 billion realized in 2011. This decline is attributed to the pre-election anxieties in the market, rising cost of flying into Kenya, decreasing passenger numbers, high taxes and negative publicity spread in the international media about dismal security along the Kenyan coast.

Kenya economic report (2013) recommended that the government needs to implement strategies to accelerate growth of the sector, including full operationalization of the Tourism Act 2011, increased investment in infrastructure, improved security, implementation of Vision 2030 flagship projects such as development of resort cities, and continued diversification of source markets. Kenya's economic growth sectors need to remain stable and be able to deal with all external shocks, especially developments in the global economy, regional stability and security, and weather-related supply shocks, political stability and national cohesion are essential for improved business confidence and policy predictability. But these recommendations by Tourism Act of 2011 has not been fully implemented and do not offer solutions to supply chain disruptions.

Kenya's Vision 2030 political pillar aims to realize a democratic political system that is issue-based, and adherence to the rule of law applicable to a modern, market-based economy. This will enhance Kenya's global competitiveness and promote economic development (ROK, 2013). Good governance is essential in strengthening democracy, promoting effective policy implementation and application of rule of law. Good governance promotes accountability, transparency, efficiency, and rule of law in public institutions at all levels. In addition, it allows for sound and efficient management of human, natural, economic, and financial resources for equitable and sustainable development (ROK, 2013; Government of Kenya, 2013). This political pillar is yet to be achieved but businesses have a responsibility of adopting and surviving in hash political environment. Thus the businesses need to address disruptions that affect supply chains in order for them to thrive. In general, the environment in which business

operates is very dynamic and complexity of managing both global and local supply chains. Similarly, all sectors in Kenya starting from tourism, agriculture and manufacturing sectors had been affected greatly by an inherent risk of unexpected disturbances and that had caused financial losses. But this study focused on manufacturing sector because this sector is expected to account about 20 percent of Gross Domestic Product and nevertheless the sector had been performing poorly at 10 percent for the last one decade (KAM, 2015).

1.1.3 The Kenya Manufacturing Sector

The manufacturing sector in Kenya constitutes 70 per cent of the industrial sector contribution to Gross Domestic Product (GDP), with building, construction, mining and quarrying cumulatively contributing the remaining 30 per cent (KAM, 2015). Kenya Vision 2030 identified the manufacturing sector as one of the key drivers for realizing a sustained annual GDP growth of 10 per cent. The manufacturing sector has high, yet untapped potential to contribute to employment and GDP growth. For example, compared to the agriculture sector, which is greatly limited by land size, the manufacturing sector has high potential in employment creation and poverty alleviation since it is less affected by land size (Bigsten, Kimuyu & Sodderbom, 2010; ROK, 2013). The contribution of the manufacturing sector to GDP has continued to stagnate at about 10 per cent, with contribution to wage employment on a declining trend. The first Medium Term Plan (MTP) 2008-2012 targets for realizing Vision 2030 remain largely unachieved in terms of contribution of the sector to GDP and implementation of flagship projects. Vision 2030 envisages a robust, diversified and competitive manufacturing sector capable of accelerating employment and economic growth.

Manufacturing sector in Kenya is important and it makes a substantial contribution to the country's economic development. It has the potential to generate foreign exchange earnings through exports and diversify the country's economy. This sector has grown over time both in terms of its contribution to the country's gross domestic product and employment. It is the third leading sectors contributing to Gross Domestic Product (GDP) in Kenya (ROK, 2013). According to Kenya Vision 2030, the manufacturing

sector is expected to play a key role in the growth of the Kenyan economy. The medium term plan of 2008 - 2012, overall goal of the sector was to increase its contribution to the Gross Domestic Product (GDP) by at least 10% per annum. The sector is expected to register a growth of 10% in the planned period to be driven largely by local, regional and global markets (KAM, 2012).

The sector comprises about 3,700 manufacturing units and divided into several broad sub-sectors. Most manufacturing firms are family-owned and operated. The sector is mainly agro-based and characterized by relatively low value addition, export volumes, employment and capacity utilization partly due to weak linkages to other sectors. The bulk of Kenya's manufactured goods (95%) are basic products such as food, beverages, building materials and basic chemicals. Only 5% of manufactured items, such as pharmaceuticals, are in skill-intensive activities. The intermediate and capital goods industries are also relatively underdeveloped, implying that Kenya's manufacturing sector is highly import dependent (KAM, 2012). Locally manufactured goods comprise 25% of Kenya's exports against a share of Kenyan products in the regional market of only 7% of the US $12 billion regional market (World Bank, 2011). This is an indication that there is a large potential to improve Kenya's competitiveness in the region by replacing external suppliers gradually (KAM, 2012).

However, the manufacturing sector contribution to GDP worsened from 9.6 per cent in 2011 to 9.2 per cent in 2012, while the growth rate deteriorated from 3.4 per cent in 2011 to 3.1 per cent in 2012. These adverse changes are attributed to high costs of production, stiff competition from imported goods, highs costs of credit, drought incidences during the first quarter of 2012, and uncertainties due to the 2013 general elections (KNBS, 2013).

Influx of counterfeits and volatility in international oil prices continued to affect the performance of the sector. In 2012, the sector's growth continued improving across the three subsequent quarters compared to the first quarter. The food sub-sector recorded a decline of 0.3 per cent during 2012. Sub-sectors that recorded impressive growth performance in 2012 include motor vehicles (16.9%), beverages and tobacco (3.8%), rubber and plastic products (7.0%), paper and paper products (11.9%), electrical equipment (8.6%) and textiles (10.0%) (KNBS, 2013). The fluctuations in quarterly growth patterns could be attributed to weather changes and agricultural seasonality, since the sector is heavily reliant on agro-based processing. Successive decline in growth rates during the second and third quarters of 2009 was attributed to prolonged drought, which resulted to decline in the food and beverages sub-sector production.

1.2 Statement of the Problem

The Government of Kenya considers manufacturing firms in particular a key pillar of its growth strategy. According to the Kenya Vision 2030 (Government of Kenya, 2007) the manufacturing sector is one of the pillars of economic development. The sector is expected to play a key role in the growth of the Kenyan economy by contributing 20 percent of Gross Domestic Product (GDP) (KAM, 2015). The manufacturing sector is currently employing 280,300 people directly, which represents 13 percent of total employment and additional of 1.6 million or 20 percent people employed in the informal side of the industry (KAM, 2015).

However, the manufacturing sector in Kenya is facing supply chain vulnerability ranging from technological change, financial risk, political turbulence and mounting regulatory pressures, workforce strike, terrorism, drought incidences and influx of counterfeits (KNBS, 2013; Transparency International, 2013). For example, in 2013 locally, 75 per cent of manufacturing firms experienced at least one disruption, of which 21 per cent suffered more than Ksh 500 million in costs for a single incident (Business Continuity Institute, 2013).Likewise, Transparency International (2013) asserts that developing countries are more vulnerable to particular supply chain threats such as

political turmoil, including rebel activities and post-election violence, bribery, corruption and other unethical business practices.

A study by Benjamin, Mark, Jerry and Marta (2015) found out that majority of the studies on supply chain resilience have been carried out in developed countries. Perhaps, the cultural and economic differences that exist between developed and developing economies suggest that perceptions and responses to threats may differ between these contexts. However, the study pointed out that supply chain resilience is an issue in developing countries and recommended a study to be carried out.

Also, a study by Guyo, Kangongo, Bowen and Ragui (2013) in the floriculture industry in Kenya noted that disruptions in the floriculture industry are caused by natural disasters, logistics process design, labor union actions and production function mechanics. But the study failed to develop a guiding framework on how manufacturing firms should build robust supply chain resilience. Hence, this study sought to investigate enhancers for supply chain resilience in manufacturing firms in Kenya.

1.3 Objectives of the Study

1.3.1 General Objective of the Study

The study sought to investigate enhancers for supply chain resilience in manufacturing firms in Kenya.

1.3.2 Specific Objectives

1. To determine the influence of strategic sourcing on supply chain resilience in manufacturing firms in Kenya.
2. To examine the influence of supply chain re-engineering on supply chain resilience in manufacturing firms in Kenya.
3. To establish the influence of operational flexibility on supply chain resilience in manufacturing firms in Kenya.

4. To analyze the influence of risk awareness on supply chain resilience in manufacturing firms in Kenya.

1.4 Hypothesis

$H0_1$: Strategic sourcing has positive significant influence on supply chain resilience in manufacturing firms in Kenya.

$H0_2$: Supply chain re-engineering has positive significant influence on supply chain resilience in manufacturing firms in Kenya.

$H0_3$: Operational flexibility has positive significant influence on supply chain resilience in manufacturing firms in Kenya.

$H0_4$: Risk awareness has positive significant influence on supply chain resilience in manufacturing firms in Kenya.

1.5 Significance of the Study

1.5.1 Manufacturing Firms

The study would help procurement managers in manufacturing firms for better orchestrating the flow of goods and information along the supply chains to cope with supply disruptions for example risks. This study has highlighted the benefits of using proactive actions by focusing on key issues to create the resilience capability within the companies or along their supply chains to overcome critical disruptions as well as daily outages. In particular, the study has demonstrated the need for management to be proactive in developing resilience. Mitigation processes are essential to supply chain resilience, irrespective of the type of organization.

The study has translated theory into practical guidance which would guide managers for manufacturing firms to be able to apply and create awareness of specific resilience approaches that develop the adaptive capabilities to prepare for, respond to and recover

from a disruption. This would allow management to direct and prioritize resources accordingly and reduce the vulnerability of the supply chain for unforeseeable events.

1.5.2 Academicians and Researchers

The study adds knowledge in the supply chain resilience strategy literature with regard to organizational issues and from a scientific view point; this study contribute to the on-going research on supply chain disruption management. Literature review reveals that this area of research is underexplored especially in developing countries, despite some researchers have already pointed out its importance. Most of these studies have been conducted in developed countries. Hence, this study would provide a point of reference to the local scholars who would like pursue in the area of supply chain resilience.

1.5.3 Government and Policy Makers

This study has offered descriptive insights into how the interaction between manufacturing firms and government/regulatory bodies takes place through collaboration to improve the opportunities for manufacturing firms to highlight current pitfalls in regulations, harmonization of quality standards and security threats like terrorism. This would enable the government to reap 20% of GDP from manufacturing firms in order to achieve Kenya Vision 2030.

1.5.4 Shareholders

The shareholders would find the study findings useful in evaluating the managerial strategies and the extent to which supply chain resilience can be achieved in manufacturing firms to maximize profit margins.

1.6 Scope of the Study

The study focused on enhancers for supply chain resilience in manufacturing firms, with specific reference to the Kenya manufacturing firms. Supply chain resilience would enable manufacturing firms to overcome disruptions and continually transform them to meet the changing needs and expectations of its customers, shareholders and other stakeholders. The enhancers for supply chain resilience included: strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness. This study was supported by Benjamin *et al*., (2015) pointed out that supply chain resilience is an issue in developing countries and a study was required to be carried out in future. The study only investigated manufacturing firms, which were only located in Nairobi and its surrounding area (30 kilometres of radius). Most of the manufacturing firms were located in Nairobi region. Based on the available data, more than 80% of manufacturing firms were located in the Nairobi and its surrounding area (KAM, 2015).

Also, the study focused manufacturing firms because the Kenya Government identifies manufacturing firms as a key sector in the economy, through Vision 2030. The Vision aims to transform Kenya into a newly industrialized middle economy, globally competitive middle income country providing high quality of life to its citizens by the year 2030. In many emerging economies, industry is the key driver of the economy (KAM, 2015).

1.7 Limitations of the Study

The study had some limitations. The first limitation was securing the valuable time of supply chain managers to respond to the questionnaires was a big challenge, therefore the researcher allowed the respondent adequate time to respond to the questionnaires, encouraged the supply chain managers on the benefits and significance of the study and ensured that follow ups were made. The second limitation was negative reception of the researcher by some managers due to the subject of the research made it difficult for the researcher from collecting data in some offices. To address this, the researcher made sure that management is in support such as the Chief Executive Officers and Human Resource Managers of the outcome of the research to be able to make supply chain managers in giving information for research purposes. The third limitation is that the study respondents' were adamant to fill the questionnaire because of fear that the information might be revealed to their competitors. But these fears were encountered by assuring the respondents that the information was to be used for academic purpose with the assistance of letter of authority to collect the data from the University.

CHAPTR TWO

LITERATURE REVIEW

2.1 Introduction

This study is an investigation of enhancers of supply chain resilience in manufacturing firms in Kenya. The literature review covers theories of system, contingency, strategic choice and complex adaptive. The study also examined the empirical studies showing relevant scholarly work on various aspects of interest and gaps related to this study. The study has outlined the conceptual framework that was used in the study. This chapter also contains the discussion of the independent variable (strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness) and summary.

2.2 Theoretical Framework

A theory is a set of interrelated constructs (concepts), definitions and propositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting phenomena (Camp, 2010). Cooper and Schindler (2008) view a theory as a set of systematic interrelated concepts, definitions, and propositions that are advanced to explain and predict phenomena (facts). In this section, four theories of supply chain resilience had been discussed and how they interact with supply chain management.

2.2.1 Systems Theory

Systems theory is an intuitive and widely applicable in supply chain management. For example, supply chains are composed of nodes that are interconnected to form networks by the physical flow of materials and these networks should be managed properly to ensure smooth flow of materials from suppliers into the manufacturing plant and eventually distribution of finished products to the consumers. Therefore, manufacturing firms can be viewed as open systems that are influenced by and interact with the external environment (Bertalanffy, 1951; Katz & Kahn 1978).

Because of open systems, manufacturing firms rely on a steady flow of inputs that originate and are extracted from the environment to sustain their operations. Hence, manufacturing firms cannot operate in isolation of environmental inputs. Through the environment, manufacturing firms are able to draw its inputs in order to process them into finished goods and services (Frankel, Bolumole, Eltantawy, Paulraj & Gundlach, 2008; Skipper, Craighead, Byrd & Rainer, 2008).

As open systems, the necessary inputs from the environment will vary depending on the industry and a firm's position in the supply network. In a manufacturing industry, for example, raw materials may be considered inputs upstream, whereas semi-finished products may be considered inputs farther downstream. Ideally, inputs flow from the environment to the focal firm as scheduled and in a desired quantity and quality thus contributing to self-maintenance. This ideal state of the system is altered when unexpected events (i.e., disruptions) interrupt the normal flow of goods (Svensson, 2000; Hendricks & Singhal, 2003; Kleindorfer & Saad, 2005). These disruptions, which the researcher defines as unexpected deviation from the norm and their negative consequences, manifest themselves in various forms. Disruptions, for example, can be anything from a truck breaking down or a supplier's workforce going on strike, to extreme weather conditions that result in power outages or transportation issues, fire outbreak, terrorism activities. The impact of disruptions on a system varies depending on the level of resiliency within the supply chain (Blackhurst *et al*., 2011).

The resiliency of a supply chain and the recovery time from a disruption should be inversely related. In other words, as the resiliency of a supply chain increases the total recovery time decreases. A supply chain's resiliency lies on a continuum and thus a supply network can be classified as being more or less resilient. A vulnerable (i.e., less resilient) supply chain's operation is volatile because it does not possess the capabilities to continue operating when disruptions occur (Sheffi & Rice 2005; Blackhurst *et al*., 2011). Therefore, the supply chain is vulnerable to disruptive events. Conversely, resilient supply chains have the ability to absorb or avoid disruptions entirely. Certain supply design characteristics may impact supply resiliency.

In addition, the application of this theory is that all supply chain members are required to understand the network structure in which they are operating to be aligned in the event of a disruption occurring. This was also acknowledged within the supply chain disruption literature (Christopher & Peck, 2004; Ponis & Koronis, 2012; Ponomarov & Holcomb, 2009). Mapping the supply network involves understanding who owns what, as well as key measures that are currently in place. Such maps can then direct management attention and enable the prioritization of planning as processes and structures to absorb risks are already in place when the risk event occurs (Wieland & Wallenburg, 2012). Through an increase of supply chain re-engineering, manufacturing firms in Kenya would be able to create smooth flow of materials from upstream to downstream.

To be resilient, manufacturing firms in Kenya are required to develop appropriate management policies and actions that assess risk continuously and coordinate the efforts of their supply network. Supply chain partners must share a common understandings and awareness of the risks that could occur within their operations. This would enhance smooth flow of materials and information from upstream and downstream in manufacturing firms. Therefore, leading companies provide training to employees, suppliers and customers about security and supply network risks alliance (Blackhurst *et al*., 2011; Rice & Caniato, 2003). Kathryn *et al*., (2014) suggest that the combination of low interactive complexity and high tight coupling leads to the fewest number of

disruptions occurring downstream and a significantly different proportion of disruptions from more complex orders. Therefore by reducing interactive complexity, manufacturing firms in Kenya can reduce the number of interactions between steps in a process, thereby decreasing the likelihood of risk activities within their plants affecting production downstream.

2.2.2 Contingency Theory

This theory postulates that there is no one universally applicable set of management principles by which to manage organizations under all conditions. Organizations are individually different, face different situations (contingency variables), and require different ways of managing. Wren (2005) observes that contingency theory is a class of behavioural theory that claims that there is no best way to organize a corporation, to lead a company, or to make decisions. Instead, the optimal course of action is contingent upon the internal and external situation. Several contingency approaches were developed concurrently in the late 1960s. The authors of these theories argued that Marx Weber's bureaucracy and Fredrick Taylor's scientific management theories had failed as they neglected environmental influences and that there is not one best way to manage an enterprise (Azjen, 2005). Thus, contingency variables include organization size, technology, environmental uncertainty, individual differences and many others.These variables influences and shape the individual behaviour in a certain situation while managing manufacturing firms.

Contingency theory is about the need to achieve fit between what the enterprise is and wants to become (its strategy, culture, goals, technology, staff and external environment) and what it does; how it is structured and the processes, procedures and practices it puts into effect (Purcell, Kinnie, Hutchinson, Rayton & Swart, 2007). Thus, organizations are required to formulate different strategies in order to achieve their objectives. This is because a single strategy may not be appropriate due to the environmental influences. Rue and Byars (2004) argue that the contingency theory is an extension of humanistic theories where classical theories assumed universal view in managing enterprises; that is, whatever worked for one enterprise could work for another.

The contingency theory states that there is no universal principle to be found in the management of enterprises but one learns about management by experiencing a large number of case problem situations and determines what will work for every situation (Wren, 2005). This is true because different manufacturing firms have different unique challenge from one another. For example, a manufacturing firm may be experiencing shortage of materials and another one may be experiencing go slow or boycotts of workers. The approach to solve these challenges may be quite different.

This theory is important to the manufacturing firms because it requires mangers to adopt different managerial skills in order to create SCRES in manufacturing firms. For example supply chain disruptions exhibit both internal (e.g., a fire at a major manufacturing plant) and external risks (e.g., economic shocks). Not managing these risks can deteriorate operational and financial performance (Hendricks & Singhal, 2003 and 2005; Giunipero & Eltantawy, 2004). Managers in the manufacturing firms should implement predefined contingency plans to provide a quick responsewith appropriate mitigation measures that enable them to recover fast by minimizing the negative disruption consequences.

Likewise, mangers should enhance flexibility through higher supply chain visibility from effective communication and information sharing in real-time among supply chain partners (such as demand and inventory levels) in order to detect risk events early and trigger response processes to disruptions with improved speed. Chopra and Sodhi (2014) recommend managers to segment (based on volume, product variety and demand uncertainty) and regionalize supply chains to reduce costs and increase responsiveness for de-risking the supply chain.

Also, the manufacturing firms could apply the SCRES elements to benchmark proactive and reactive SCRES strategies. Additionally, measuring SCRES is a crucial managerial insight that supports a firm's knowledge and understanding of handling unexpected risk events. It also helps firms to evaluate their disruption management, even in terms of failure (Melnyk *et al*, 2014).

Thus strategic contingency theory emphasizes the importance of managers in the manufacturing firms to use strategies that are appropriate to the circumstances of the organization, including the culture, operational processes and external environment. Management strategies have to take account of the particular needs of the organization (Schuler & Jackson, 1987 & Dyer, 2005).

2.2.3 Strategic Choice Theory

Strategic choice theory (SCT) was developed and advanced by Child in 1972. According to this theory, the goal of the organizations is to achieve high performance standards and increase the efficiency to the limits of economic constraints. Kenya manufacturing firms need to consider contextual factors as very important if firms are to perform well. For instance, mangers that make sound decisions for their organizations and adopt modern technology to analysis risks, they are likely to become more resilient.

Strategic decisions in organizations have significant effects on organizational outcomes. This was also concurred by Child (1972), in his seminal article on the role of strategic choice, provided a theoretical framework for this theory. Strategic choice theory, according to Child's perspective is less concerned with the functional operation of the organization and has more to do with the governance structure and political actions in organizations. Therefore, managers should establish structural reforms, manipulate environmental features, and choose relevant performance standards in achieving organizational goals. According to the SCT, managers play an important role in achieving organizational outcomes through their decision making or leading the changes in organizations (Child, 1972; Ketchen & Hult, 2007). This strategic decision making functions at three levels: Top tier or long term planning, middle tier or functional level, and bottom tier at the individual level (Kochan, Katz & McKersie, 1986). Strategic choice theory views managers as proactive agents who are down-stream decision-makers and mainly focus on directing major decisions and change processes in organizations. Change or what Child (1972) calls "variation in organizational structure," is caused by three contextual factors: environmental conditions, technology, and size.

This theory is useful in this study because managers play an important role in achieving organizational outcomes through their decisions making. Therefore, managers in the manufacturing firms should foster continuous commitment to communication and collaboration at different levels across, within, and between organizations, involving staff from different departments, supply chain members and organizational levels in strategic planning and establish risk awareness via training and education, if they are to take the first steps to becoming more resilient (Scholten *et al*., 2014). Also, managers of the manufacturing firms should be able to develop a good relationship with suppliers, and be able to make informed decisions. Strategic sourcing can help the supply chain design (or supply chain configuration or even re-engineering) to reduce complexity and enhance the alignment of the flows throughout the supply chain (Carla *et al*., 2014).

Lastly, managers in the manufacturing firms should develop product flexibility as a strategy that can help firms in critical situations; however, it should be combined to the

other general points, such as sourcing strategic and inventory. Technology, particularly information technology (IT), is also an important issue which is considered by The World Economic Forum (2013) as one of the ways to create supply chain resilience. Moreover, managers in the manufacturing firms should be more aware of the current situation of the market risks, the environment (political) and the company's operation to make decisions less likely to lead to disruptions. Bearing this in mind, by managing and controlling those intra and inter-organizational issues, which have proven to be closely linked to resilient enablers, it is possible to achieve supply chain resilience.

2.2.4 Complex Adaptive System

Complexity adaptive system (CAS) consists of an interconnected network of multiple agents that respond adaptively to changes in both the environment and the system of agents within it. For instance, manufacturing firms in Kenya operates in a volatile environment which changes frequently due to disruptions and yet they need to adopt and survive within the same environment. Thus, the environment in which manufacturing firms in Kenya operates contain both chaos and order, complex non-linear systems strive to be neither overly stable nor unstable (Wycisk, McKelvey & Hülsmann, 2008). Holland (1995); Choi, Dooley and Rungtusanatham (2001) defined a CAS as a kind of system that, over a period of time, emerges into a coherent form through the aforementioned properties of adaptation and self-organization. In a CAS, adaptation implies that the system's agents or elements are responsive, flexible, reactive and often proactive in dealing with the inputs of other agents or elements that affect it. Hence, manufacturing firms need to be proactive, flexible, re-design their structures and make strategic decisions.

The agents that constitute a CAS are guided by order-generating rules, also known as schemas (McCarthy 2003; Pathak *et al*. 2007; Hasgall, 2013), which determine how the CAS responds during the adaptation process. The CAS environment is rugged and dynamic; and CAS agents must adapt to maintain fit with the environment in a timely manner. During the adaptation process, new changes in the CAS and its environment may arise through a process of coevolution, which makes it necessary to learn, thereby making appropriate modifications to schemas to increase fitness. But, equally, a CAS acts on and modifies its environment, and entities within the environment learn from the system's responses.

Also, CAS is influenced by inconsistent relationship between the cause and effect of CAS events. In case of the occurrence of a disruption, it may yield disproportionately negative or positive results. Urry (2005) refers inconsistent relationship between the cause and effect of CAS events as non-linearity. For example, non-linerality may be influenced by the number and type of connections and interactions between the CAS agents. The degree of connectivity may also influence the extent to which the CAS agents act autonomously such that the higher the connectivity, the lower the agents' autonomy, and vice versa (Pathak *et al*. 2007). Non-linearity in a CAS also produces self-organization and emergence. Self-organization and emergence in a CAS can cause changes, including the development of new structures, patterns and properties.

These changes may also be facilitated by the feature of scalability, which implies that different entities at different levels of a CAS have the same concerns; for example, reducing costs, increasing delivery speed and adaptation (Surana *et al*. 2005). As such, individual agents strive to achieve their goals by addressing their concerns, but end up causing the emergence of similar collective patterns at the wider system level.

Supply chain looks like a CAS, since it mirrors the main features of a CAS. For example, a system is resilient to the extent that it can adapt to threats in its environment without violating its integrity as a system. Often, this involves modifying its environment (e.g. selecting and educating other economic actors), so it inherently involves coevolution. It is also likely to be highly non-linear: for example, that

apparently minor change in supply chain controls allow for catastrophic events to potentially occur (Choi, Dooley & Rungtusanatham, 2001; Surana *et al*., 2005; Pathak *et al*., 2007; Hearnshaw & Wilson, 2013). The non-linearity and interdependence of SCRES can also be demonstrated by the terrorist activities in Kenya which has scared away tourist. This has caused massive loss in foreign exchange and this has resulted to the deterioration of the Kenyan Shillings against major currencies like Dollars and Staring pound in international market. Hence manufacturing firms are experiencing tough times as major inputs are imported.

Supply chain resilience is manifested through the process of self-organization – another property of a CAS – rather than as a result of being deliberately managed or controlled by a single firm. No single firm, however large it may be, can claim to manage and control the resilience of the entire supply chain. This is partly because a supply chain is complex to the extent that most of what happens therein is beyond the visibility and reach of a focal firm (Choi & Krause, 2006). Similarly, a survey by the Business Continuity Institute (2013) found that 75% of respondents lacked visibility of their supply chains. Managers in the Kenya manufacturing firms should be aware that supply chain resilience is manifested through the process of self-organization rather than as result of being deliberately managed or controlled by a single firm. No single firm can claim to manage and control the resilience of the entire supply chain.

This is partly because a supply chain is complex to the extent that most of what happens therein is beyond the visibility and reach of a focal firm. Therefore managers should learn to be flexible in order to collaborate with other manufacturing firms and other stakeholders like suppliers, customers and government in order to be able to create resilience in manufacturing firms.

2.3 Conceptual Framework

A conceptual framework is a model of presentation where a researcher conceptualizes or represents the relationships between variables in the study and shows the relationship graphically or diagrammatically (Orodho, 2008). In this context, Orodho posits, a

conceptual framework is a hypothesized model identifying the concepts or variables under study and showing their relationships. Kothari (2009) defines a variable as a concept that can take different quantitative value such as weight, height, or income. Mugenda (2008), on the other hand, defines a variable as a measurable characteristic that assumes different values among units of specific population.

The key variables in this study are categorized as independent variable and dependent variable. Mugenda (2008) explains that the independent variables are called predictor variables because they predict the amount of variation that occurs in another variable while dependent variable, also called criterion variable, is a variable that is influenced or changed by another variable. The dependent variable is the variable that the researcher wishes to explain. Therefore, this study sought to investigate on how strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness influence supply chain resilience in manufacturing firms Kenya. The variables in the conceptual framework were derived from the theories identified and literature from different scholars in this study.

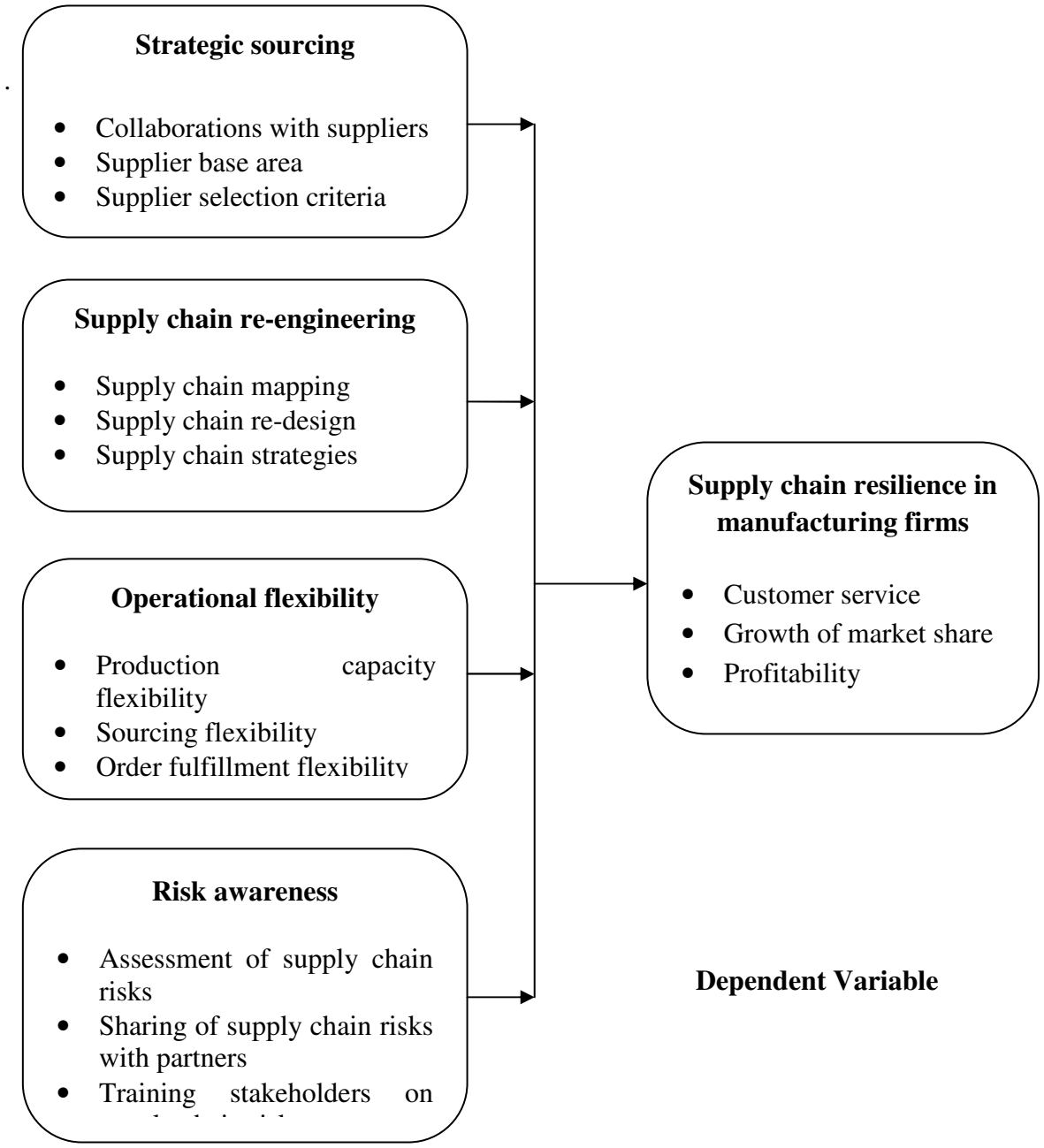

Figure 2.1: Conceptual Framework

2.4 Review of Literature on Variables

2.4.1 Strategic Sourcing and Supply Chain Resilience

Strategic sourcing is the employment of appropriate strategy which carefully considers profit potential and risk factors (Mingu & Xiaobo, 2009). Strategic sourcing is underpinned by four fundamental issues by managing them properly managers will be able to develop good relationships with suppliers' and they include: collaboration; supplier relationships; supplier selection and supplier base (Carla *et al*., 2014). Supply chain management is essentially a network theory; the management of risk must also be examined from a network perspective (Christopher & Peck, 2004). Collaboration among organizations in a supply chain is what integrates the network as a whole and makes a holistic approach, which is needed to build supply chain resilience, possible (Sheffi, 2001); there is consent in the literature that collaboration is an essential element of building supply chain resilience. The fundamental principle of supply chain collaboration is that the exchange of information and application of shared knowledge across the chain can decrease uncertainty (Christopher & Peck, 2004), increase visibility (Faisal *et al*., 2006), operational effectiveness and efficiency, and enhance customer service.

Collaboration amongst supply chain members can be vertical or horizontal, and can either be an operational matter emphasizing how working together can support supply chain efficiency or can involve strategic knowledge or innovation perspectives, as ways for members to access complementary skills to improve chain performance (Juttner & Maklan, 2011).

While vertical collaboration involves different members at different value chain stages (suppliers, manufacturers, customers, etc.), horizontal collaboration takes place between different organizations working at the same level, usually in partnerships, or between different functional departments within an organization. Collaboration is not only important before and during a disruption but also after a disruption, in order to share experiences among the parties to increase the ability of the system to deal with future risks and hence creating SCRES (Juttner & Maklan, 2011; Sheffi, 2005).

Regarding supplier relationship, Christopher (2000) and Christopher and Jüttner (2000) affirm that different structural interfaces between buyer and supplier may increase the level of connectivity between both parts. As a result, agility enhances flow of information between buyer and supplier, and hence increases the information sharing among other functions. Because of that Christopher (2000) states that agile companies normally have a small supplier base, prioritizing strong relationships and more information sharing to increase the level of connectivity. Considering the trade-off of having a single or multiple sourcing it is recognized here that employing a balance source of suppliers would be a reasonable choice to create resilience in the supply chain. This would allow companies to skip out the risk of relying on only one supplier by having other suppliers if the need arises. It also helps to keep reasonable material quality, product cost and reliable delivery.

Following this line of thought, one of the criteria to select suppliers is their financial situation. Thus, Zsidisin *et al.* (2000, 188) state that "if a supplier is not profitable, it may not stay in business for very long", recognizing that it can be a risk for the buyer company. For this reason, financial strength is highlighted here as a resilient enabler which impacts on procurement activities. Furthermore, collaboration is found to be a good way to achieve effectiveness of the supplier's management team, while velocity and acceleration is normally related to suppliers' location (Tang, 2006; Zsidisin & Wagner, 2010).

Therefore, Managers should be able to develop a good relationship with suppliers, and hence find beneficial ways to make strategic and effective decisions in order to create SCRES and increase resilience of manufacturing firms. Strategic sourcing can help the supply chain design (or supply chain configuration or even re-engineering) to reduce complexity and enhance the alignment of the flows throughout the supply chain (Carla *et al*., 2014).

2.4.2 Supply Chain Re-engineering and Supply Chain Resilience

Supply chain re-engineering is the conceptualization, design, implementation and operational of supply chains (Naim *et al* 2000). When a disruption happens, it is already too late to try to develop preventative solutions (Tomasini & Van Wassenhove, 2009). Resilience must be built into a supply chain in advance of a disturbance and incorporate readiness to enable an efficient and effective response (Ponomarov & Holcomb, 2009). Robust supply chain strategies enhance a firm's capability to sustain its operations when a major disruption hits (Tang, 2006) by preventing risks from having negative effects and enabling resistance to change without adapting the chain's initial stable configuration (Wieland & Wallenburg, 2012). This requires all chain members to have an understanding of the network (Christopher & Peck, 2004; Ponomarov & Holcomb, 2009) to be aligned in the event of a disruption occurring (Juttner & Maklan, 2011).

Mapping the supply network involves understanding who owns what, as well as key measures that are currently in place. Such maps can then direct management attention and enable the prioritisation of planning (Sheffi & Rice, 2005) as processes and structures to absorb risks are already in place when the risk event occurs (Wieland & Wallenburg, 2012). This is especially relevant to balancing efficiency of operations (Pettit *et al*., 2010, 2013) with the need for redundant capacity (Sheffi & Rice, 2005; Sheffi, 2005) to provide a buffer that can buy time for a firm to recover from a disruption (Zsidisin & Wagner, 2010), for example safety stocks or multiple suppliers.

Obtaining a holistic understanding of cost/benefit trade-offs when managing risks and understanding where inventory should be strategically placed, in what form it should be held, and how much is necessary, enables an effective handling of disruptions and increases resilience (Blackhurst *et al*., 2011). This can only be achieved through collaboration between the different members of the supply chain.

2.4.3 Operational flexibility and Supply Chain Resilience

Erol, Sauser, and Mansouri (2010) defined operational flexibility as the ability of an enterprise to adapt to the changing requirements of its environment and stakeholders with minimum time and effort. Literature reveals various flexibility practices that can enhance SCRES, such as postponement, a flexible supply base, flexible transportation, flexible labour arrangements, and order fulfilment flexibility (Tang 2006; Christopher & Holweg, 2011; Pettit, Croxton, & Fiksel, 2013). For example, it is argued that flexibility through postponement enhances resilience during a crisis by deferring demand to a future period (Tang, 2006). Thus, flexibility creates SCRES by enhancing prompt adaptability during turbulence (Christopher & Holweg, 2011). It also aids a supply chain's rapid response and recovery, and this can be facilitated by the availability of alternative choices (redundancy), including alternative suppliers (Sheffi & Rice, 2005). Operational flexibility also enables resources to be more easily redeployed, including transportation and labour resources (Pettit, Croxton, & Fiksel, 2013). Operational flexibility may apply both to a firm and to the supply chain (Stevenson & Spring, 2007). Recent work has examined how Extreme Value theory can be used to price the value of flexibility when threatened with disruption, including the value of dual sourcing (Bicer, 2015) and this may be a promising line of further study.

Regarding sourcing flexibility, Yi *et al.* (2011) explain that firms normally employs this strategy to maintain supplier availability to support the company with good quality materials in case of needs. In this sense, Jüttner and Maklan (2011) assert that sourcing flexibility can be considered a key enabler to resilience owing to the ability to shift cost-effective supply sources by choosing the cheapest source or strengthening the companies' bargaining power in price negotiations with their suppliers. In addition,

Carvalho *et al.* (2012) highlight its benefits in terms of cost reduction, critical paths and lead-times. They propose that supplier flexibility implies in agility and resilience through a conceptual model, which increases the responsiveness of the company in critical times.

In terms of product, flexibility also enables a rapid change in product design by providing a range of products which will respond effectively in case of an immediate change (Yi *et al.*, 2011). To doing so, managers have roles of developing purchasing strategies to match and fulfill the internal requirements. However, although flexibility seems to be an advantageous way of increasing agility and resilience in the end, a high level of product flexibility may cause complexity and difficulties to handle all specifications in only one manufacturing plant. For this reason, Blackhurst *et al.* (2011) propose practices such as postponement, mass customization and centralized inventory management which aims to reduce complexity by creating a modular product. These practices help reduce risk and vulnerability by sharing risk among members of the supply chain (Carla *et al*., 2014).

Flexibility in terms of transportation is also a good strategy when the transportation issue is uncertain and unexpected events (Sheffi & Rice, 2005; Tang, 2006). In this regard, the widespread case of Ford and Chrysler after the 9/11 terrorist attack is a good example. Chrysler by quickly changing the transportation mode of delivery could load its delivery in time and without huge losses. Because of this transport flexibility, Chrysler had a more resilient reaction than Ford (Sheffi, 2005; Carla *et al*., 2014) which bore the loss of five non-working manufacturing plants.

Flexibility in order fulfillment is the ability to quickly change outputs or the mode of delivery outputs (Pettit *et al.*, 2010). The ability to quickly ramp up production to meet surge demand without carrying large amounts of excess capacity is extremely profitable when facing unpredictable or seasonable demand. However, results of a study have shown that companies typically enhance shop-floor flexibility over down-stream flexibility, when the latter was shown to be more positively related to firm performance (Pettit *et al.*, 2010). Similarly, demand pooling improves flexibility and reduces

inventory costs through statistical economies of scale that can be achieved in numerous ways, including inventory centralization, order splitting and emergency transshipments (Pettit *et al.*, 2010).

Effective inventory management is another critical tool for flexibility. Visibility systems provide knowledge of where assets are and inventory management combines this data with demand projections and current orders to best compute cycle and safety stock, as well as reallocating inventories as needed. This management system requires efficient data exchange among various internal functional departments and supply chain partners to create a more flexible, customer-driven process (Pettit *et al.*, 2010).

2.4.4 Risk Awareness and Supply Chain Resilience

Regarding the growing level of risk faced by companies nowadays, Ponomarov and Holcomb (2009, p. 137) assert that "risk assessment and sharing among the members of a supply chain is an essential element of risk mitigation". Also Jüttner and Maklan (2011) state, as a result of their study, that monitoring supply risks had a positive impact on the supply chain visibility. To be resilient, organizations need to develop appropriate management policies and actions that assess risk continuously and coordinate the efforts of their supply network (Kleindorfer & Saad, 2005): supply chain partners must share a common understandings and awareness of the risks that could occur within their operations (Faisal *et al*., 2006). The capacity to learn from past disruptions to develop better preparedness for future events is a principal property of resilience (Ponomarov & Holcomb, 2009).

Therefore, leading companies provide training to employees, suppliers and customers about security and supply network risks raising awareness and reinforcing the importance of supply chain resilience (Blackhurst *et al*., 2011; Rice & Caniato, 2003). Furthermore, knowledge and understanding of supply chain structures both physical and informational are important elements of supply chain resilience (Choi & Hong, 2002). Frequently there is a time lag between awareness of an impending event and the occurrence of that event. The ability to correctly forecast demand within sufficient lead

time feeds the procurement, production and distribution processes to operate most efficiently and improve customer service levels (Pettit *et al.*, 2010).

Forecasting methods can be quantitative or qualitative, but some events will still be unpredictable (e.g. a technology innovation). Risk identification, requires at least some historical data or subjective estimates. Where data is available, historically accurate and the assumption that the past is representative of the future holds relatively true, managers can use traditional risk management techniques to prioritize risks to make valuable investments in mitigation programs (Pettit *et al.*, 2010). However, these assumptions do not always hold, but when valid, risk management is a critical component of a resilience development process. In addition, the complexities in the modern environment create vast interdependencies that may invalidate even the simplest of risk assessments (Pettit *et al.*, 2010). Therefore, risk management seems to be a prominent activity to the firms and which intends to be closely monitored contingencies from various risk resources, normally focused on the upstream of the company.

2.4.5 Supply Chain Resilience

Resilience is defined as the capacity of a system to survive, adapt and grow in the face of turbulent change (Fiksel 2006; Scholten *et al*., 2014). Business systems face technological change, financial risk, political turbulence and mounting regulatory pressures; industrial growth does not proceed smoothly. The traditional tool to manage uncertainty is risk management, which is especially challenging when threats are unpredictable. Deliberate threats such as theft or terrorism can even adapt to new security measures. At the same time, corporations are accepting broader responsibility for the social and environmental impacts of their supply chains. The entire enterprise has a role to play in creating and maintaining supply chain resilience (Pettit *et al*., 2010).

Supply chain resilience is based on the underlying assumption that not all risks can be prevented. Resilience is a proactive and holistic approach to managing supply chain risks enhancing traditional risk management strategies (i.e. risk assessment, vulnerability analysis, continuity planning): as it does not require risk identification and

quantification, supply chain resilience can deal with unforeseeable disruptions and events (Pettit *et al*., 2010).

The concept refers to an organization's capacity to survive, adapt and grow when confronted with change and uncertainty (Knemeyer *et al*., 2009) and has been defined in supply chain terms as "the adaptive capability of the supply chain to prepare for unexpected events, respond to disruption and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structures and function" (Ponomarov & Holcomb, 2009).

Christopher and Peck (2004) developed an initial framework for a resilient supply chain. They asserted that supply chain resilience can be created through four key principles namely: resilience can be built into a system in advance of a disruption (i.e. re-engineering), a high level of collaboration is required to identify and manage risks, agility is essential to react quickly to unforeseen events and the culture of risk management is a necessity. Tang (2006) on the other hand presented nine supply chain strategies that can help a firm to excel under normal operations and recover quickly following disruptions: postponement, strategic stock, flexible supply base, make-and-buy, economic supply incentives, flexible transportation, revenue management, dynamic assortment planning and silent product rollover.

Despite the increase in SCRES publications, few focus on assessing and measuring SCRES and its relationship to the performance of the organization. Referring to the different SCRES phases, Sheffi and Rice (2005) outline a plot demonstrating that economic turbulences will have a fluctuating effect on performance measures such as sales, production levels, profits or customer service. Pettit *et al*. (2010) present an agent-based framework aiming to strengthen supply chain flexibility and SCRES by studying multi-product, multi-country supply chains subject to demand variability, production and distribution capacity constraints. The SCRES level was assessed by four measures: customer service level, production change over time, average inventory at each distribution center and total average network inventory across all distribution centers.

Zsidisin and Wagner (2010) present in their empirical study the practices of flexibility and redundancy to build SCRES. Flexibility includes auditing supplier processes, monitoring supplier financial conditions and certifying suppliers. Redundancy consists of using dual or multiple supply sources, ensuring excess supplier capacity, establishing supply continuity plans, requiring suppliers to report disruptions and having suppliers hold inventory to prevent stock-outs hence leading high performance of organizations.

Wu *et al.* (2013) examine retail stock-outs quantitatively through an agent-based simulation model to enhance understanding of the effect of different stock-out lengths for different products. To evaluate the stock-out's impact, they used the market-share level as a measure of SCRES (the ability to respond to and recover from a stock-out disruption). By using a timeline to show the impact of a stock-out before, during and after it occurs, the authors demonstrated that SCRES magnitude of both the retailer and manufacturer. Therefore, a timeline can illustrate the impact before, during and after a disruption to measure SCRES and display how quickly a firm has recovered.

Giunipero *et al*. (2015) used sand cone model to illustrate the different supply chain resilience (SCRES) phases and their relative importance to performance. They came up with four SCRES phases namely; readiness, responsiveness, recovery and growth phases. Thus, they examined SCRES as the ability to avoid/reduce the probability of disruptions and to respond and recover quickly, they identified that SCRES can be quantified through three essential performance metrics that enable reporting on how severe a disruption impact is and how a firm's SCRES performs: (1) customer service (2) market share (3) financial performance.

They further suggested various enhancers of supply chain resilience across the two phases which can prevent disruption of supply chain. In ex-ante disruption phase the organization can use collaboration to share crucial information, human resource management to train and educate employees in dealing with risk events, inventory management by using safety stocks to buffer unexpected events and redundancy such as multiple suppliers.

In post-disruption phase, the organization can adopt flexibility through backup suppliers, collaboration to share crucial information, human resource management to train and redundancy to respond to sudden changes through multiple suppliers. Thus, this will increase supply chain resilience and eventually increase the performance of the organization.

Based on Giunipero *et al*. (2015) ability to measure resilience, thus this study adopted customer service, growth market share and profitability to measure supply chain resilience in manufacturing firms. In order to group and synthesize the SCRES enhancers, the study proposed a classification that distinguished between proactive strategies for the ex-ante disruption stage and reactive strategies in the post-disruption stage to strengthen SCRES and sustain business performance (Giunipero *et al*., 2015). The study assigned proactive actions to the readiness phase while reactive measures embraced the response, recovery and growth phases after a supply chain disruption. The four variables identified in this study can act both as the ex-ante disruption and ex-post disruption phases, the following enhancers and their corresponding sub-elements can help to assess the level of SCRES readiness by anticipating and mitigating the impact of disruptions or response, recovery and growth provide the ability to cope and adapt reactively to unexpected disturbances in manufacturing firms as shown in figure 2.2.

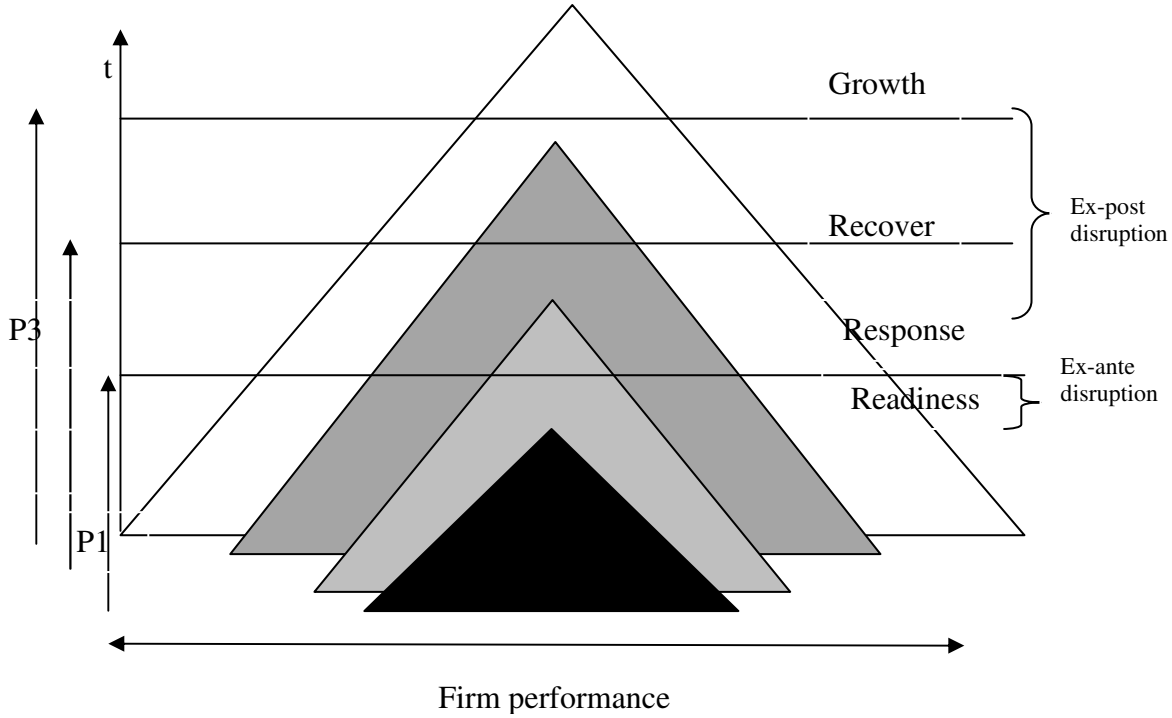

Figure 2.2: Sand cone model; resilience measurement model

Source: Adapted from Giunipero *et al*. (2015)

Strategic sourcing which includes: collaboration with suppliers; supplier relationships; supplier selection criteria and supplier base area (Carla *et al*., 2014). For example, collaboration can help to mitigate disruptions before they occur, e.g. by facilitating information sharing and the use of other strategies, such as building security and supplier development (Juttner & Maklan, 2011; Pettit *et al*., 2013). But it can also be used to aid recovery after a disruption by enabling supply chain actors to share resources and provide a coordinated response (Fiksel, 2006; Scholten *et al*., 2014). Also, using appropriate supplier selection criteria would help to minimize disruptions and their impact, such as political stability in suppliers' territories, quality, capabilities (e.g. technological), financial stability, business continuity and reliability (Ponomarov & Holcomb, 2009).

Supply chain re-engineering is the conceptualization, design, implementation and operational of supply chains (Naim *et al.,* 2000). It entails robustness, supply chain mapping, redundancy and efficiency of operations (Pettit *et al*., 2010, 2013). Firms are required to construct supply chain network for resilience, e.g. balancing redundancy, efficiency, and vulnerability can minimize disruptions and also respond to recovery in case of disruptions (Juttner & Maklan, 2011; Pettit *et al*., 2013; Sheffi, 2005; Pereira *et al*., 2014). Thus, those firms would embrace supply chain re-engineering would be regarded as resilient.

Risk assessment and sharing among the members of a supply chain is an essential element of risk mitigation (Ponomarov & Holcomb 2009). Risk awareness it comprises of; risk identification, monitoring, preparedness and forecasting (Kunreuther, 2006; Pettit *et al.*, 2010). Creating risk management will ensure that all organizational members embrace supply chain risk management, and this involves for example, top management support and firms integration/team work (Sheffi, 2005; Blackhurst *et al*., 2011). Flexibility is a strategy which the firm would use to prevent disruptions (Pettit *et al.*, 2010; Chiang *et al.*, 2012).

Firms should ensure that supply chains are agile to be able to respond quickly to unpredictable changes in demand or supply (Scholten *et al*., 2014) and this would make the firms more resilient and hence increase their performance. Also firms should increase flexibility in order to adapt to changing requirements within minimum time and effort (Pettit *et al.*, 2013).

2.5 Empirical Review

Previous research has also looked at the ability of the company to recover from or adjust easily to a supply chain disruption. Researchers use the word “resilience” to characterize the ability of firms to react and quickly respond to supply chain disruptions. A study by Christopher and Peck (2004) suggested ways to build a resilient supply chain, including improving the collaboration and understanding among supply chain partners, updating supply chain engineering models, and increasing the ability of supply chain members to

respond to problems. Chopra and Sodhi (2004), in their study recommended that firms should increase inventory, capacity, responsiveness, flexibility, capabilities; acquire redundant suppliers and pool demand in order to create resilience.

Tang (2006) described several strategies that firms can employ to prevent supply chain disruptions. These practices include postponement, developing a strategic stock, employing a flexible supplier base, mixing between in-house production and outsourcing, and offering economic supply incentives to increase the number of suppliers. Strategies such as these are prevalent in practitioner articles as well. Suggestions have included adding strategic inventory buffers, using financial modeling to simulate disruption scenarios and becoming stricter with suppliers through more formal contracts and purchase orders with ramifications for lateness.

Carla *et al*. (2014) in their study revealed that procurement activities do make a significant contribution to creating supply chain resilience. Emerging from the literature review, certain intra- and inter-organizational issues were identified that could impact supply chain resilience. Inter-organizational issues identified are: strategic sourcing, supply chain design, and transportation. Intra- organizational issues identified are: knowledge acquired, inventory, product and technology. Also the possible actions that procurement could take to enable the enhancement of supply chain resilience were identified.

Scholten *et al*. (2014) in their study of mitigation process-antecedents for building supply chain resilience developed an integrated supply chain resilience framework capturing the interplay of disaster management processes and capabilities required to build supply chain resilience. They recommended that management formally apply processes that set up networks and infrastructures prior to disruption to create resilience.

Also, they highlighted that the integration of processes and capabilities for building supply chain resilience has to iterative and staged; creating and maintaining resilience is not one-time event, but rather a process in itself (Pettit *et al*., 2013). They concluded that mitigation processes are paramount important as they are antecedents to building supply chain resilience capabilities which in form enable the execution of necessary processes during preparedness, response and recovery.

The study by Giunipero *et al*. (2015) on the phenomenon of supply chain resilience grouped and synthesized the different terms into a proactive SCRES strategy for the ex-ante disruption phase that constitutes the elements collaboration, human resource management, inventory management, predefined plans, redundancy and visibility to create readiness. The research also revealed that overall SCRES can be measured through three crucial performance indicators (customer service, market share and financial performance) which can quantify the ability to manage supply chain disruption. A timeline can display a firm's negative consequences from risk events and the speed in returning to stable conditions.

The study by Urciuoli, Mohanty and Hintsa (2014) on the resilience of energy supply chains show that today, oil and gas supply chains have in place a good combination of disruption strategies, including portfolio diversification, flexible contracts, transport capacity planning and safety stocks. The most relevant security threats the companies fear, include hijacking of vessels (sea piracy), but also terrorism, and wars. Finally, the study highlights that the European Union has built a comprehensive portfolio of strategies to deal with scarcity of oil and gas resources. However, these approaches are not often synchronized with supply chain strategies. The study recommended that the mediation of buyers and sellers negotiations or the access to local supply markets may help companies in opening new market opportunities, expanding their supplier portfolios or increase their negotiation power to obtain more advantageous contracts.

In addition, this study suggested that a closer collaboration with governments may improve the opportunities for energy companies to highlight current pitfalls in regulations, harmonization of quality standards and environmental programmes driven by the automotive lobbies. More specifically, this could be achieved with the creation of a pan-European sector alliance that is able to communicate with the European Union.

A study by Guyo, Kangongo, Bowen and Ragui (2013) in the floriculture industry in Kenya indicated that the most significant amongst the factors contributing to supply chain disruption in the floriculture industry in Kenya are natural disasters, logistics process design, labor union actions and finally production function mechanics. To address supply chain disruptions, the study recommends: implementation of comprehensive business continuity plans to mitigate against the supply chain effects of natural disasters, development of logistical process redundancies, formulation of creative policies to contain labor unions agitations and investment in research to develop resilient and scalable production function mechanics.

Kathryn *et al*. (2014) in their study on mitigating supply chain disruptions-a normal accident perspective, they found that interactive complexity plays an important role in predicting the likelihood of supply chain disruptions. The study also found that in more complex processes, increased buffers lead to an increased likelihood of supply chain disruptions occurring at downstream customers' facilities. The study suggested that simplifying processes may mitigate normal supply chain disruptions and recommended that firms should consider simplification prior to adding countermeasures that increase slack in the system.

Juttner and Maklan (2011) in their study to conceptualize supply chain resilience (SCRES) and to identify and explore empirically its relationship with the related concepts of supply chain vulnerability (SCV) and supply chain risk management (SCRM). They found that there is a positive impact of supply chain risk (SCR) effect and knowledge management on SCRES and from SCRES on SCV.

Supply chain risk (SCR) effect and knowledge management seem to enhance the SCRES by improving the flexibility, visibility, velocity and collaboration capabilities of the supply chain. Thereby, they decrease the SCV in a disruptive risk event. The positive effects manifest themselves in upstream supplier networks of supply chains as well as in distribution channels to the customers.

Scholten and Schilder (2015) in their study to explore how collaboration influences supply chain resilience. Collaborative activities and their underlying mechanisms in relation to visibility, velocity and flexibility are investigated. They found that the key findings show how specific collaborative activities (information-sharing, collaborative communication, mutually created knowledge and joint relationship efforts) increase supply chain resilience via increased visibility, velocity and flexibility. The study demonstrates that engaging with competitors, who might be counterintuitive for some managers, can increase resilience by enabling flexibility.

Also the study found that the longer companies have been working together, the more resilient they become because of increased visibility and velocity. This theoretical insight is particularly relevant for managers, as it offers important guidance on questions in relation to sourcing: another supplier might offer better value; however, even when engaging in the same level of collaborative activities with the new supplier, resilience will be reduced. This might ultimately decrease the initial value promised by the new supplier (Scholten & Schilder, 2015).

2.6 Critique of the Existing Literature

The four core enhancers discussed in the literature review have received the major attention in the SCRES literature. Beyond these four enhancers, the literature on developing resilience to supply chain threats or disruptions is broad but limited in depth. Moreover, although the SCRES literature has identified many enhancers for creating SCRES, few studies have gone beyond this to focus on how firms can actually develop or implement these enhancers (Blackhurst, Dunn, & Craighead, 2011). Yet, SCRES research should not only be about identifying strategies, but also about understanding how they can be successfully implemented.

For example, it is clear that SCRES enhancers have financial implications that may limit their implementation. Other issues, such as corruption, sociopolitical instability and unethical competitive practices, which are common sources of business risks (Lakovou, Vlachos & Xanthopoulos, 2007), may also pose a threat to a SCRES strategy implementation. Similarly, how firms can choose between different SCRES strategies is under-researched. Given that a firm has limited resources to deploy, what factors should a manager take into consideration when deciding how to improve SCRES? One of the factors influencing the choice of strategy to adopt is likely to be a firm's or individual's perceptions of risk (Park, 2008).

The SCRES research literature reviewed on the above has not focused on particular threats or developed enhancers to build resilience towards threats individually. Scholars have however, claimed that in order to develop appropriate supply chain risk management approaches, risks should be segmented and categorized in some way. Hence, enhancers might be adopted to deal with categories of threats. Categories may relate, for example, disruptions caused by intentional actions or physical events, to threats that are endogenous or exogenous to the supply chain and so on. These categories may then require different treatments or specific resilience strategies.

For example, adaptive threats such as posed by product counterfeiting, terrorism and other criminal acts are perpetrated by rational actors who also undertake research and change, and who craft new counter-strategies to evade detection (Benjamin *et al*., 2015). The enhancers implemented to deal with this type of threat would therefore most likely have to take on similarly adaptive characteristics (Benjamin *et al*., 2015).

Indeed, Pettit, Fiksel, and Croxton (2010) contended that the desired level of resilience is achieved when there is a match between vulnerabilities and corresponding capabilities. But it is not well known how broadly applicable some SCRES enhancers are, i.e. whether they are suitable for dealing with a wide range of threats. If so, it may be these that are favoured by managers in practice (Benjamin *et al*., 2015). Furthermore, most literatures reviewed does not support their variable with the theories in order to help in understanding a phenomenon, in identifying the relationships among variables and in enhancing the generalizability of findings across different contexts (Foy *et al*. 2011).

For example, Carla *et al*. (2014) in their study revealed that procurement activities do make a significant contribution to creating supply chain resilience. Emerging from the literature review, certain intra- and inter-organizational issues were identified that could impact supply chain resilience. Inter-organizational issues identified are: strategic sourcing, supply chain design, and transportation. Intra- organizational issues identified are: knowledge acquired, inventory, product and technology. Also the possible actions that procurement could take to enable the enhancement of supply chain resilience were identified.

But the finding of this study was purely exploratory based on the body of knowledge presented in two databases in the past 13 years. The study also focused on procurement activities which although have a strategic and important function that interfaces focal company and supplies, is only one part of the organization. The study also restricted to the upstream of the supply chain and ignoring downstream and the study was not supported by theories.

The study by Giunipero *et al*. (2015) on the phenomenon of supply chain resilience grouped and synthesized the different terms into a proactive SCRES strategy for the ex-ante disruption phase that constitutes the elements collaboration, human resource management, inventory management, predefined plans, redundancy and visibility to create readiness. The research also revealed that overall SCRES can be measured through three crucial performance indicators (customer service, market share and financial performance) which can quantify the ability to manage supply chain disruption. The study lacked theories to support and show relationships among the variables. Also its findings were based on literature review and therefore lack quantitative methods to validate and prove theoretical concepts.

Juttner and Maklan (2011) in their study to conceptualize supply chain resilience (SCRES) and to identify and explore empirically its relationship with the related concepts of supply chain vulnerability (SCV) and supply chain risk management (SCRM). They found out that there is a positive impact of supply chain risk (SCR) effect and knowledge management on SCRES and from SCRES on SCV. Supply chain risk (SCR) effect and knowledge management seem to enhance the SCRES by improving the flexibility, visibility, velocity and collaboration capabilities of the supply chain. Thereby, they decrease the SCV in a disruptive risk event. The positive effects manifest themselves in upstream supplier networks of supply chains as well as in distribution channels to the customers. The study did not investigate any antecedents to SCRES. The study findings were based from the literature review and quantitatively were not tested. Also the research design used did not explore the resilience of the case companies before, throughout and after the disruption. The study preferably could have used longitudinal design.

A study by Guyo, Kangongo, Bowen and Ragui (2013) in the floriculture industry in Kenya indicated that the most significant amongst the factors contributing to supply chain disruption in the floriculture industry in Kenya are natural disasters, logistics process design, labor union actions and finally production function mechanics. To address supply chain disruptions, the study recommends: implementation of

comprehensive business continuity plans to mitigate against the supply chain effects of natural disasters, development of logistical process redundancies, formulation of creative policies to contain labor unions agitations and investment in research to develop resilient and scalable production function mechanics. But the study findings were limited to the descriptive case study and therefore, the findings cannot be generalized in the whole manufacturing firms because there are different manufacturing sectors which are unique from one another. Also, the study recommends firms to invest in developing resilient but the study does not give details of resilient to be developed.

Scholten and Schilder (2015) in their study to explore how collaboration influences supply chain resilience. Collaborative activities and their underlying mechanisms in relation to visibility, velocity and flexibility are investigated. They found that the key findings show how specific collaborative activities (information-sharing, collaborative communication, mutually created knowledge and joint relationship efforts) increase supply chain resilience via increased visibility, velocity and flexibility. The study demonstrates that engaging with competitors, who might be counterintuitive for some managers, can increase resilience by enabling flexibility. But the study findings were not quantitatively validated and therefore, are limited to the generalization. Also, the study has not explored redundant resources that are required for supply chain resilience and the balance of such redundancies to find out how much resiliency a resilient supply chain can take.

Finally, from the reviewed literature it shows that there is limited application of theory in SCRES research was also acknowledged by (Fang, Li & Xiao, 2012; Benjamin *et al*., 2015). The lack of theory application may have limited our ability to understand resilience and its related variables as well as the relationships between them. It also makes the generalization of research findings from one context to another difficult. It is therefore important that the SCRES research literature makes greater use of theory to improve our understanding of the phenomenon (Benjamin *et al*., 2015).

2.7 Research Gaps

Inadequate empirical work on SCRES presents a distinct knowledge gap. It means that we cannot clearly understand how SCRES can be either achieved or, indeed, lost in practice. What is proposed in theory may not apply in practice (Benjamin *et al*., 2015). Supply chain resilience research to date has concentrated almost exclusively on the developed world context. Yet, there are grounds for believing that the most catastrophic effects of supply chain failures (particularly on human life) have occurred in developing countries. For instance, the infiltration of counterfeit drugs into the pharmaceutical supply chain has been more prevalent and caused more severe effects in the developing world than in developed countries (Chika *et al*., 2011; Benjamin *et al*., 2015). For example, it has been suggested that counterfeit pharmaceuticals led to the death of 2500 people in 1995 and 192,000 people in 2001 in Nigeria and China, respectively (Chan *et al*., 2010).

Furthermore, developing countries are more vulnerable to particular supply chain threats such as political turmoil, including rebel activities and post-election violence, and to bribery, corruption and other unethical business practices (Transparency International, 2013). Moreover, the cultural and economic differences that exist between developed and developing economies suggest that perceptions and responses to threats may differ between these contexts.

Meanwhile, differences in economic development and the quality of infrastructure, such as road and rail networks, may mean certain developing countries are more susceptible to certain disruptions than more mature, developed countries. Thus, investigating how SCRES issues are handled in developing countries is an important future research direction (Benjamin *et al*., 2015).

Also, from literature it shows that there is limited application of theory in SCRES research which was also acknowledged by (Fang, Li & Xiao, 2012; Benjamin *et al*., 2015). The lack of theory application may have limited our ability to understand resilience and its related variables as well as the relationships between them. It also

makes the generalization of research findings from one context to another difficult. It is therefore important that the SCRES research literature makes greater use of theory to improve our understanding of the phenomenon (Benjamin *et al*., 2015). Moreover, the few literature reviewed contain theories, are dominated by resource based view theory which is not sufficient for explaining SCRES.

Resource based view theory focuses on a firm's internal resources and does not routinely extend beyond the firm level. Yet, SCRES is a system level phenomenon that occurs at the level of a supply chain rather than an individual firm, and it involves connections between firms. Further, RBV assumes reasonably predictable environments where the future value of resources is determinable (Kraaijenbrink, Spender & Groen, 2010). But SCRES has emergent characteristics due to the non-linear, dynamic and unpredictable nature of the environment to which it is a response (Benjamin *et al*., 2015). Furthermore, the findings of majority reviewed literature were based on qualitative and therefore lack quantitative methods to validate and prove theoretical concepts.

In the Kenyan context, the role of supply chain resilience in the Kenya manufacturing firms remains new and there is lack of a guiding framework on how manufacturing firms should embrace and build sound supply chain resilience. The majority of the studies on supply chain resilience however, have been carried out in developed countries (Pereira *et al*., 2014; Benjamin *et al.,* 2015).

Perhaps, the cultural and economic differences that exist between developed and developing economies suggest that perceptions and responses to threats may differ between these contexts. Benjamin *et al*., (2015) pointed out that supply chain resilience is an issue in developing countries and a study need to be to be carried out in future.

Indeed, a study by Guyo, Kangongo, Bowen and Ragui (2013) in the floriculture industry in Kenya indicated that disruptions in the floriculture industry are caused by natural disasters, logistics process design, labor union actions and production function mechanics. The study failed to address on how disruptions can be addressed to build supply chain resilience in industries and recommended that firms to invest in research to develop resilient. Hence this creates major gaps this study is going to fulfill.

2.8 Summary

This chapter reviews the relevant literature and the considerable discussion and deconstruction of SCRES. Supply chain resilience can be quantified through three essential performance metrics that enable reporting on how severe a disruption impact is and how a firm's SCRES performs: (1) customer service (2) market share (3) financial performance. To understand resilience and its related variables as well as the relationships between them the study has used four theories, namely: system, strategic contingency, strategic choice and complex adaptive theories.

A conceptual framework has been proposed to conceptualize or represents the relationships between variables in the study and shows the relationship graphically or diagrammatically. Some of the variables used are deemed to the best enhancers in building SCRES in manufacturing firms because they are the most reviewed the literature, for example could prevent an actual disruption; mitigate the effects of disruption or adoption following a disruption (Pettit, 2008; 2010 & 2013) and they are: strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness.

Furthermore, reviewed literature shows that supply chain resilience research to date has concentrated almost exclusively on the developed world context and has limited application of theory in SCRES. Thus limit our ability to understand resilience and its related variables as well as the relationships between them and creates major gaps this study would fulfill.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents a systematic description of the methodology which was used to conduct the research. It comprises sections on research design, population, sampling frame, sample and sampling technique, instruments, data collection procedure, pilot test, data processing and measurement variables.

3.2 Research Design

A research design is a framework that guides the collection and analysis of the data and is a detailed plan for how research study is conducted according to the data required in order to investigate the research questions in an economical manner. It is a presentation of the plan, the structure and strategy of investigation, which seeks to obtain or answer various questions (Mugenda & Mugenda, 2003). Research design constitutes the blue print for collection, measurement and analysis of the data (Cooper & Schindler, 2011; Kothari, 2009). Cooper and Schindler (2011) posit that research design enables the researcher in allocation of limited resources by posing crucial choices in methodology. Kothari (2009), on the other hand, clarify that the design includes an outline of what the researcher will do from writing hypothesis and its operational implications to the final analysis of data.

This study adopted cross-sectional survey design using both quantitative and qualitative approaches. Quantitative approach emphasizes measurement and data is analyzed in a numerical form to give precise description. According to Mugenda and Mugenda (2003), quantitative approach also known as the scientific method has traditionally been considered as the traditional mode of inquiry in both research and evaluation. Quantitative approach places emphasis on methodology, procedure and statistical measures to test hypothesis and make predictions.

According to Berg (2001), qualitative research helps in analyzing information in a systematic way by use of common words or phrases in order to come to some useful conclusions and recommendations on the social settings and the individuals who portray those characteristics. Cross-sectional survey design, on the other hand, helped the study to gather the data just at once; perhaps it was over a period of three months which assisted in answering research questions and hypothesis formulation to establish testing the analysis of the relationship between variables (Kothari, 2004). Therefore, this design was appropriate for this study which extensively tested the analysis of the relationships between variables. It is also evident that the articles reviewed in this study are predominantly cross sectional studies focusing, for example Ponomarov (2012) in his study of antecedents and consequences of supply chain resilience in US, he used cross-sectional research design to study 391 manufacturing firms of consumer packaged goods, medical/pharmaceuticals, industrial products, electronics, appliances, automotive, apparel/ textile and aerospace. Other researchers who used cross-sectional research design are, Park (2011); Mandal (2012); Wieland and Wallenburg(2013).

The study also was guided by an epistemological research philosophy. Research philosophy relates to the development of knowledge and the nature of that knowledge (Saunders, Lewis & Thornhill, 2009). There are three epistemological positions: realism, interpretivism and positivism (Saunders, Lewis & Thornhill, 2009). This study adopted a positivist research paradigm which is an epistemological position. Positivism is characterized by a belief in theory before research and statistical justification of conclusions from empirically testable hypothesis, the core of tenets of social science (Cooper & Schindler, 2011).Epistemological research in the positivist paradigm is how the social world can be investigated as natural science (Koul, 2008).

Hypotheses have to be tested by empirical approaches. Koul posits that since the focus of the positivist paradigm is to discover the „truth‟ through empirical investigation, the quality standards under this paradigm are validity and reliability. Positivism is characterized by a belief in theory before research and statistical justification of conclusions from empirically testable hypothesis, the core of tenets of social science (Cooper & Schindler, 2011).

Epistemological research in the positivist paradigm is how the social world can be investigated as natural science (Koul, 2008). Hypotheses have to be tested by empirical approaches. Koul noted that since the focus of the positivist paradigm is to discover the „truth‟ through empirical investigation, the quality standards under this paradigm are validity and reliability. Bryman (2012), states that the question of what is, or should be regarded as acceptable knowledge in a discipline is the main focus of epistemology, or the study of how knowledge develops. Epistemology is categorized as descriptive where one can describe the philosophical position than can be discerned in research (Bryman & Bell, 2007).

3.3 Target Population

Zikmund, Babin, Carr and Griffin (2012) define population as the large collection of all subjects from where a sample is drawn. Kombo and Tromp (2009) define the target population as a group of individuals, objects or items from which samples are taken for measurement. The target population for this study was all the 613 manufacturing firms in Nairobi and its surrounding (in a radius of 30 km) who are registered member of KAM. Manufacturing sector was classified into 14 key industrial sub sectors and by the type of raw materials companies import or the products they manufacture, in addition to service sector and affiliate associations (KAM, 2015).

3.4 Sampling Frame

A sampling frame is a list of all items where a representative sample is drawn for the purpose of research. In this study, the sampling frame was a list of all (613) the

manufacturing firms in the 14 key industrial subsectors of the manufacturing sector in Kenya. These subsectors were: Building, Construction and Mining; Chemical and Allied; Energy, Electrical and Electronics; Food and Beverage; Leather and Footwear; Metal and Allied; Motor Vehicle and Accessories; Paper and Board; Pharmaceutical and Medical Equipment; Plastic and Rubber; Textiles and Apparels; Timber, Wood and Furniture; service and consultancy; and fresh produce. The sampling frame was obtained from the directory of Kenya Association of Manufacturers and exporter (KAM, 2015) which is a premier representative organization for manufacturing value added industries.

3.5 Sample and Sampling Technique

A sample is a portion or part of the population of interest. The purpose of sampling is to gain an understanding about some features or attributes of the whole population based on the characteristics of the sample. The study used stratified random sampling where the subjects are selected in such a way that the existing subgroups in the population are more or less reproduced in the sample (Mugenda & Mugenda, 2003). Using the sampling frame, it was established that there were 14 key industrial subsectors of the 613 manufacturing sector, in addition to service sector and affiliate associations. The manufacturing firms were divided into 14 groups/ strata (Table 3.1), each key subsector forming a stratum and a random sampling method was used to pick the study unit from each stratum. Stratified random sampling technique guarantees that each stratum was represented in the sample and was more accurate in reflecting the characteristics of the population.

According to Kothari (2004), a population is stratified based on different features of the population and a random sample is picked from each stratum. In this sampling method, sampling error is considerably reduced. According to Cooper and Schindler (2006) every sample must have a non-zero probability of selection. Taking a non-zero probability of selection of 0.101 the sample size was: $0.101 = \frac{\text{Sample size}}{613}$.

This gave a sample size of 62 manufacturing firms. The study therefore involved 62 manufacturing firms in Nairobi and its surroundings (in a radius of 30 km) that were proportional to the population. The study selected supply chain managers from each of the firms who participated in the study. Table 3.1 shows how the sample size was arrived at.

Table 3.1: Number of choosing a stratified random sample

Sector	No. of firms	Percentage in sector	Respondents
Building	19	3.1	2
Food, Beverages	101	16.5	10
Chemical	72	11.7	7
Energy	38	6.2	4
Plastics	62	10.1	6
Textiles	25	4.1	3
Wood Products	15	2.4	2
Pharmaceutical	24	3.9	2
Metal and Allied	60	9.8	6
Leather	4	0.7	1
Motor	35	5.7	3
Paper	65	10.6	6
Service & consultancy	88	14.3	9
Fresh produce	5	0.8	1
Total	**613**	**100**	**62**

3.6 Data Collection Instruments

A standardized questionnaire was developed to capture the various variables under study, and for the independent variables. A questionnaire is a research instrument that gathers data over a large sample and its objective is to translate the research objectives into specific questions, and answers for each question provide the data for hypothesis testing (Mugenda & Mugenda, 2003). The advantages of a questionnaire over other instruments include: information can be collected from large samples, no opportunity for bias since it is presented in paper form and confidentiality is upheld. The questionnaire was divided into two sections.

Part A was the organizational data. Part B asked the respondents to provide information concerning the major areas of this study. The questionnaire contained both closed and open ended questions. The closed ended questions were aimed at giving precise information which minimized information bias and facilitate data analysis, while the open ended questions gave respondents freedom to express themselves.

3.7 Data Collection Procedure

Data collection is the gathering of information to serve or prove some facts (Kombo & Tromp, 2009). Questionnaire was self-administered to the respondents and two research assistants were recruited and trained so that they can be able to get quality results. Secondary data was also collected from published sources such as library, internet and research done by other scholars. The target participants were supply chain managers who filled in the questionnaires. These target participants had adequate knowledge about the strategies manufacturing firms were putting in place to create supply chain resilience, considering their crucial role in top management involvement.

Manufacturing firms were first contacted and the intention to drop the questionnaires and the request to explain to the supply chain managers. The questionnaires were delivered to the respondents (supply chain managers) and the researcher waited for them to be filled. The number of questionnaires that were used to collect data for this study was 62, since the firm was the unit of analysis and equally, the sample size was 62 manufacturing firms.

3.8 Pilot Test

Cooper and Schindler (2011) explain that pilot test is conducted to detect weaknesses in design, instrumentation and to provide proxy data for selection of probability sample. The procedures which were used in pre-testing the questionnaire were identical to those that were used during the actual study or data collection. The number in the pre-test should be small, about 1% to 10% of the target population (Mugenda & Mugenda, 2003).

In this study the questionnaire was tested on 10% of the entire sample size, which translated into six respondents. The questionnaire was pilot tested on six manufacturing firms that were part of the target population but not in the sample, and supply chain managers filled in the questionnaire.

3.8.1 Reliability of the Research Instruments

This study adopted the internal consistency method. Reliability is consistency of measurement (Bollen, 1989), or stability of measurement over a variety of conditions in which basically the same results should be obtained. The internal consistency method was adopted because it was more stable than the other methods (Bryman, 2012; Cooper & Schindler, 2011). Internal consistency was tested using the Cronbach's alpha statistic. For a test to be internally consistent, Drost (2011) suggests that estimates of reliability should be based on the average inter correlations among all the single items within a test. Pallant (2010) advises that where Cronbach‟s Alpha coefficient is used for

reliability test, the value should be above 0.7. Cronbach‟s alpha (α) was computed as follows:

$$\alpha = K / (K - 1) [1- (\Sigma\sigma_k^2 / \sigma_{total}^2)] \text{ ---------- Equation (1)}$$

Where K is the number of items, $\Sigma\sigma_k^2$ is the sum of the k item score variances, and σ_{total}^2 is the variance of scores on the total measurement (Cronbach, 2004).

3.8.2 Validity of the Research Instruments

This study adopted construct validity. Mugenda and Mugenda (2003) define validity as the degree to which results obtained from the analysis of the data actually represent the phenomenon under study. Validity also refers to the degree to which an instrument measures what it purports to measure (Mugenda, 2008; Bryman, 2012). Validity therefore, is concerned with the meaningfulness of research components.

Construct validity refers to how well you translated or transformed a concept, idea, or behavior (a construct) into a functioning and operating reality, the operationalization (Trochim, 2006). Construct validity was achieved through restricting the questions to conceptualization of the variables and ensuring that indicators of each variable fell with the same construct. The purpose of this check was to ensure that each measure adequately assessed the construct it purported to assess.

The study also adopted content validity. Content validity is a qualitative type of validity where the domain of the concept is made clear and the analyst judges opine whether the measures fully represent the domain (Bollen, 1989). Drost (2012) posits that there are basically two ways of assessing content validity, that is, ask a number of questions about the instrument or test and/or ask the opinion of expert judges in the field.

Content validity was tested by formulating questionnaire and operationalizing it as per the study variables. This ensured adequacy and representativeness of the items in each variable in relation to the purpose and objectives of the study. Further, content validity was verified through expert opinions from supervisors and supply chain practitioners.

3.9 Data Analysis and Presentation

Zikmund *et al.* (2012) posit that data analysis is the application of reasoning to understand the data that have been gathered with the aim of determining consistent patterns and summarizing the relevant details revealed in the investigation. Data processing entails editing, classification and tabulation of data collected so that they are amenable to analysis (Kothari, 2009). Data entry converts information gathered by secondary or primary methods to a medium for viewing and manipulation. In this study, the quantitative data was collected and analyzed by calculating response rate with descriptive statistics such as mean, median, standard deviation and proportions using Statistical Package for Social Sciences (SPSS) version 24 and Microsoft Excel. Quantative data analysis was carried out by the use of factor analysis and correlation analysis to determine the strength and the direction of the relationship between the dependent variable and the independent variables.

This study tested normality and outliers. Normality is important in knowing the shape of the distribution and helps to predict dependent variables scores (Paul & Zhang, 2009). Outliers were tested univariately on both independent and dependent variable because the independent and dependent variable constructs were in continuous scales. Univariate outliers are extreme values for a single variable. Outliers within the independent and dependent constructs were dropped.

That is, cases or observations showing characteristics or values that are markedly different from the majority of cases in a data set (Kline, 2005; Hair *et al*., 2010) are normally dropped. The study also tested Variance Inflation Factor (VIF). If no two independent variables are correlated, then all the VIFs will be 1. If VIF for one of the variables is around or greater than 5, there is multicollinearity associated with that variable. In this case one of these variables must be removed from the regression model (Cohen, Cohen, West & Aiken, 2003).

Exploratory Factor Analysis (EFA) was employed in order to identify the constructs that were then be regressed against the dependent variable (Cooper & Schindler, 2003). Prior to the EFA were the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett‟s test of sphericity. These tests were conducted to confirm whether there was a significant correlation among the variables to warrant the application of EFA (Snedecor & Cochran, 1989). In addition, Principal Component Analysis (PCA) was employed to decompose the variations in the multivariate data set into a set of components such that the first component accounts for as much of the variations in the data as possible. Eigen values were used to determine the factor loadings for each component. The larger the eigen value, the more important the associated principal component (Graham & Midgley, 2000).

Lastly, structural equation modeling (SEM) was used for model analyses (Schumacker & Lomax, 1996), including testing for the hypothesized relationships in this study. These were the null hypotheses that strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness had a positive significant influence on the performance of manufacturing firms in Kenya. The study used t-statistics to test whether the hypothesized model was significant at 90% significance level. Structural equation modeling was used in this study because SEM had the ability to correct for measurement error.

3.9.1 Operationalization of Variables

This study used the following rating scales, open-ended questions which allowed the respondents to add information that was not included in the closed-ended questions and Likert scale, developed by Rensis Likert, to examine how strongly subjects agree or disagree with a statement (Cooper & Schindler, 2011). In this study, Likert scales dominated the questionnaire. Chimi and Russel (2009) revealed that Likert scale is everywhere in nearly all fields of scholarly and business research that it is used in a wide variety of circumstances: when the value sought is a belief, opinion or effect; when the value sought cannot be asked or answered definitely and with precision; and when the value sought is considered to be of such a sensitive nature that respondents would not answer except categorically in large ranges. The nature of the data that was collected in this study exhibited majority of these features and so the Likert scale was the most suitable. A Likert Scale can be evaluated easily through standard techniques like, factor analysis and logistic regression analysis (Montgomery, Peck & Vining, 2001). All the hypotheses to test the relationship enhancers and supply chain resilience were measured by structural equation model.

Strategic sourcing it is a proactive measure of searching potential suppliers and appraising them in areas such as quality management practices, long term quality output, supplier´s strength, process capabilities, management practices, cost reduction at the same time as increasing profit, design and development capabilities (Chiang, Hillmer & Suresh, 2012).

Supply chain re-engineering is the conceptualization, design, implementation and operational of supply chains (Naim *et al* 2000). In this study supply chain re-engineering was measured objectively and subjectively by use of supply chain knowledge, supply chain design and supply base strategy. These measurements were modified and adopted from Christopher and Peck (2004).

Operational flexibility is defined as the ability of an enterprise to adapt to the changing requirements of its environment and stakeholders with minimum time and effort (Erol,

Sauser, & Mansouri 2010). In this study flexibility was measured by the use of production capacity, sourcing and order fulfillment adopted and modified from Pettit *et al*., (2010, 2013).

Risk awareness in this study is measured by use of risk assessment, sharing information of risk with the partners and training shareholders on how to mitigate risks.

Supply chain resilience was quantified through three essential performance metrics that enable reporting on how severe a disruption impact is and how a firm's SCRES performs: customer service, growth market share and profitability. These measurements were adopted and modified from Giunipero *et al*. (2015).

Table 3.2: Measurement of Study Variables

Variable	Indicator	Scale	Questionnaire Reference/ Measurement
Strategic sourcing	Collaboration with suppliers	Interval	Questions (a to m)
	Supplier base area		
	Supplier selection criteria		
Supply chain re-engineering	Supply chain mapping	Interval	Questions (a to i)
	Supply chain re-designing		
	Supply chai strategies adopted		
Operational flexibility	Production capacity	Interval	Questions (a to i)
	Sourcing flexibility		
	Order fulfillment		
Risk awareness	Assessment of supply chain risks	Interval	Questions (a to i)
	Sharing of risks with suppliers		
	Training stakeholders on supply chain risks		
Supply chain resilience	Customer service Growth market share Profitability	Interval	Questions(a to d)

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presents the findings of the study and makes reference to relevant research to support the findings of the study. The findings include demographic information about the sample, results obtained from the descriptive statistics for the supply chain resilience, correlations between the supply chain resilience and significant statistical differences between the enhancers of supply chain resilience. In general, analysis was conducted using two-stage process consisting of confirmatory measurement model and confirmatory structural model. Lastly, an overview of the results obtained in the study are presented and discussed in this chapter.

4.2 Response Rate

The targeted respondents in the study were supply chain managers of the manufacturing firms in Kenya and which were registered members of Kenya Association of Manufacturers (KAM) in the year 2015. A total of 59 self-administered questionnaires were filled out of the expected 62 yielding a response rate of 95% as depicted in Table 4.1. This response rate was good and representative and confirms to Mugenda (2008) stipulation that a response rate of 50% is adequate for analysis; a rate of 60% is good and a response rate of 70% and over is excellent. This good response rate was attributed to the data collection procedure, where the researcher personally administered questionnaires to the respondents who filled them. The researcher collected the filled questionnaires later. This response rate demonstrated willingness to respond to study.

Table 4.1: Response rate

Response rate	Sample size	Percentage (%)
Returned questionnaires	59	95
Un-returned questionnaires	3	5
Total	**62**	**100**

4.2.1 Type of manufacturing sectors' responses' rate

Data for this study was collected from 62 manufacturing firms across the 14 manufacturing sectors as indicated in Table 4.2. These sectors were: Building; Food and Beverages; Chemical; Energy; Plastics; Textiles; Wood products; Pharmaceutical; Metal and Allied; Leather; Motor; Paper; Service and Consultancy and Fresh produce.

Table 4.2: Type of manufacturing sectors' responses rate

Sector	Target	Response	% Response
Building	2	2	100%
Food, Beverages	10	9	90%
Chemical	7	7	100%
Energy	4	4	100%
Plastics	6	6	100%
Textiles	3	2	67%
Wood Products	2	2	100%
Pharmaceutical	2	2	100%
Metal and Allied	6	5	83%
Leather	1	1	100%
Motor	3	3	100%
Paper	6	6	100%
Service & consultancy	9	9	100%
Fresh produce	1	1	100%
Total	62	59	95%

4.3 Manufacturing Firm Demographics

The demographic characteristics of the manufacturing firms which were registered members of KAM in the year 2015 was collected and reviewed. The analysis was based on the information that respondents provided in the questionnaire. The firm's ownership, market served and the operation period were analyzed and the results presented as shown in Table 4.3.

Table 4.3: Manufacturing Firm Demographics

Main Factor	Factor Level	Frequency	Percent
	Locally	6	80
Ownership	Foreign	45	11
	Foreign and Local	5	9
Market Served			
	Domestic	13	23
	Foreign	1	2
	Domestic and Foreign	42	75
Operation Period			
	6- 10 years	7	13
	11- 15 years	21	38
	16- 20 years	4	7
	More than 20 years	24	43

The majority of manufacturing firms' (Table 4.3) shows ownership (45) representing 80% of the total sampled were foreign owned and 6 manufacturing firms were locally owned representing 11% of the total sampled manufacturing firms and 5 manufacturing firms were both locally and foreign owned representing 9% of the total sampled

manufacturing firms. In overall, it indicated that majority of the manufacturing firms in Kenya are owned by foreigners. This result concurred with the study conducted by KAM (2013) that 85% manufacturing firms in Kenya are owned by foreigners. Also, majority of the manufacturing firms basically serve both domestic and foreign market, representing 75% of the total sampled from manufacturing firms, 23% of the manufacturing firms sampled serve domestic market and 1% of the manufacturing firms sampled serve foreign market.

The operation period of the manufacturing firms that participated in this study were measured as the number of years an organization had been operating in the country. The majority of the manufacturing firms that participated in this study as indicated in table 4.3 were over 20 years old representing 43% of the sampled firms, 38% were between 11 to 15 years old, 4% were between 16 to 20 years old and 7% had been in operation for between 6 to 10 years old. Generally, majority of the manufacturing firms had existed over 20 year old which was important since over 20 years is a reasonably long duration which can allow the manufacturing firms to build adequate experience and knowledge to offer a good profile and reliable inform for study.

4.4 Descriptive Analysis of the Study Variables

The purpose of descriptive statistics is to enable the researcher, to meaningfully describe a distribution of scores or measurements using indices or statistics. The type of statistics or indices used depends on the types of variables in the study and the scale of measurements. The study used mean average; percentages and deviations to present the study findings. The general objective of this study was to investigate enhancers for supply chain resilience in manufacturing firms in Kenya. The study analysed descriptive statistics for the following observed variables: strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness.

4.4.1 Strategic Sourcing

The study sought to determine the influence of strategic sourcing on supply chain resilience in manufacturing firms in Kenya. This objective was measured using the following indicators: collaborations with suppliers; supplier base area and criteria used in selecting suppliers in the opinion statements given. Respondents were asked to indicate the extent to which they agreed with the implementation of strategic sourcing issues for supply chain resilience in their manufacturing firms. This was on a likert scale of not at all, small extent, moderate, large extent and very large extent. Thus, in this study the scale of not all and small extent meant disagree while large and very large extent meant agreed.

a) Collaborations with suppliers

The majority of the respondents (77%) agreed that manufacturing firms collaborated frequently through sharing information with their key supply chain partners, and 23% indicated moderate. Large number of the respondents (64%) agreed that manufacturing firms collaborated via synchronising decisions with their supply chain partners in areas like planning and operations to optimise benefits. Moderate number of responds (31%) and a small number of respondents (5%) indicated that manufacturing firms' do not collaborated via synchronising decisions with their supply chain partners. Also, 29% of the respondents agreed that manufacturing firms collaborated by aligning incentives with their supply partners in a form of co-developing systems, sharing costs , risks and benefits, 57% of the respondents indicated moderate and 14% of the respondents do not agree. Further, a small number of respondents (17%) indicated that manufacturing firms shared resources with their supply partners in a form of leveraging capabilities, resources and assets, 54% of the respondents indicated moderate and 29% of the respondents do not agree.

However, majority of the respondents (84%) agreed that manufacturing firms had collaborative communication with their supply chain partners, 14% of the respondents indicated moderate and small respondents (2%) disagreed. Lastly, 57% of the respondents agreed that manufacturing firms had joint knowledge creation with their partners by better understanding of markets competitors, 33% of respondents indicated moderate and 10% of the respondents do not agree as shown in Table 4.4.

Table 4.4: Measurement of Collaborations

Collaboration	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Dev.
We frequently share information with our supply chain partners	0	0	23	54	23	4.00	0.68
We synchronise decisions with our supply chain partners (planning ,operations that optimise benefits)	2	3	31	40	24	3.81	0.91
We align incentives with our supply partners (co-developing systems ,sharing costs , risks and benefits)	0	14	57	22	7	3.22	0.77
We share resources with our supply partners (leveraging capabilities , resources and assets)	11	18	54	12	5	2.84	0.96
We have collaborative communication with our supply chain partners	0	2	14	51	33	4.16	0.72
We have joint knowledge creation with our partners (better understanding of markets competitors)	0	10	33	38	19	3.66	0.91

In general, from the study (Table 4.4) found out that manufacturing firms' in Kenya collaborated with their suppliers through sharing information, synchronising decisions such as planning and operations to optimise benefits and joint knowledge creation with their partners for better understanding markets competitors. These findings of the study concurred with the study of Scholten, Scott and Fynes (2014) that collaboration can facilitate the sharing of resources and other complementary skills necessary for recovery from a disruption. Collaboration also enhances supply chain resilience by enabling supply chain partners to support each other during a disruptive event (Jüttner & Maklan 2011) and to provide a flexible and coordinated response. The fundamental principle of supply chain collaboration is that the exchange of information and application of shared knowledge across the chain can decrease uncertainty (Christopher & Peck, 2004).

However, the study found out that manufacturing firms in Kenya do not share resources with their supply partners in a form of leveraging capabilities, resources and assets. Also, manufacturing firms do not collaborate by aligning incentives with their supply partners in a form of co-developing systems, sharing costs, risks and benefits. Gichuru, Iravo and Arani (2015) asserted that companies should collaborate in information sharing, joint decision making areas like new product development and modifications, decisions on forecasting components requirement and many other decisions and developing incentive alignment. Thus, manufacturing firms in Kenya should share resource with suppliers as a form of leveraging capabilities, resources and assets and aligning incentives to create supply chain resilience.

b) Supplier base area

A high percentage of respondents (52%) agreed that manufacturing firms maintained smaller supplier base to be able to manage them, 30% of the respondents indicated moderate and 18% of the respondents disagreed that they do maintained smaller supplier base. Also, majority of the respondents (84%) of manufacturing firms had adopted multiple sourcing to create reliable delivery, 8% of the respondents indicated moderate and 8% of the respondents disagreed as shown in Table 4.5.

Table 4.5: Measurement of Supplier Base Area

Supplier Base Area	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Dev.
We maintain small supplier base to be able to manage them	9	9	30	36	16	3.42	1.13
We have adopted multiple sourcing to create reliable delivery	0	8	8	55	29	4.03	0.85

The study (Table 4.5) found out that manufacturing firms maintained smaller supplier base to be able to manage them and adopted multiple sourcing as a way of creating reliable delivery. These study findings concurred with Christopher and Peck (2004) that supply base strategy has become a major issue as many companies have moved towards reducing supply base but there should be limits to which the process should be pursued. Also, the findings of this study agreed with Simangunsong *et al.* (2012) that companies should consider the trade-off of having a single or multiple sourcing. This would allow companies to skip out the risk of relying on only one supplier by having other suppliers if the need arises. It also helps to keep reasonable material quality, product cost and reliable delivery and therefore, manufacturing firms would be resilient.

c) Criteria selection of suppliers

The study found out that 51% of the respondents in this study agreed that manufacturing firms selected suppliers based on the financial strength, 41% of the respondents indicated moderate and small number of respondents disagreed. In addition, majority of respondents (98%) agreed that manufacturing firms selected suppliers based on quality of products they offer, and a small number of respondents (2%) disagreed. Also, 83% of the respondents agreed that manufacturing firms selected suppliers based on the past

performance, 15% of the respondents indicated moderate and 2% of the respondents disagreed. With regard to capacity production requirements, majority of respondents (84%) agreed that manufacturing firms selected suppliers based on the capacity to production requirements and 16% of the respondents indicated moderate. However, 73% of the respondents agreed that manufacturing firms selected suppliers based on the technology adopted by suppliers, 22% of the respondents indicated moderate and 5% of the respondents disagreed as shown Table 4.6.

Table 4.6: Measurement of criteria selection of Suppliers

criteria selection of suppliers	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Dev.
We select suppliers based on the financial strength	0	8	41	32	19	3.61	0.89
We select suppliers based on quality of products they offer	0	2	0	32	66	4.63	0.58
We select suppliers based on the past performance	0	2	15	58	25	4.07	0.69
We select suppliers based on the capacity to production requirements	0	0	16	50	34	4.19	0.69
We select suppliers based on the technology adopted by supplier	2	3	22	51	22	3.88	0.85

Based on the study findings (Table 4.6), manufacturing firms in Kenya selected suppliers basing on the financial strength, quality of products they offer, past performance, capacity to production requirements and technology adopted by supplier. These findings are in harmony with Zsidisin *et al.* (2000) that one of the criteria to select suppliers is their financial situation and alluded that suppliers who are not profitable may not stay in business for very long. Therefore, financial strength is highlighted as a

resilient enabler. Also, Lysons and Farrington (2006) states that supplier should be appraised based on financial strength, production capacity, human resources, quality, previous performance, environmental and ethical factors and information technology. Supplier appraisal may arise when a prospective vendor applies to be placed on a buyer's list or in the course of negotiation when the buyer wishes to assure him/herself that supplier can meet requirements reliably. Thus, supplier selection criteria can form a very strong base in creating supply chain resilience in manufacturing firms.

4.4.2 Supply Chain Re-Engineering

The study sought to examine the influence of supply chain re-engineering on supply chain resilience in manufacturing firms in Kenya. This objective was measured using the following indicators: supply chain knowledge, supply chain design and supply chain strategy in opinion statements given. Respondents were asked to indicate the extent to which they agreed with the opinion statements given in regard to the implementation of supply chain re-engineering issues for supply chain resilience in their manufacturing firms. This was on a likert scale of not at all, small extent, moderate, large extent and very large extent. Therefore, in this study the scale of not all and small extent meant disagree while large and very large extent meant agreed.

a) Supply chain mapping

The study showed that 45% of the respondents agreed that manufacturing firms used mapping tools to identify bottlenecks and critical path in supply chain, 49% of the respondents indicated moderate and 7% of the respondents disagreed. Also, 61% of the respondents agreed that manufacturing firms used prior knowledge acquired identifying high supply chain risk (demand process control and environment), 36% of the respondents indicated moderate and 4% of the respondents disagreed as shown Table 4.7.

Table 4.7: Measurement of Supply Chain Mapping

Supply chain mapping	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Dev.
We use mapping tools knowledge to identify bottlenecks and critical path in supply chain (long lead time)	5	2	49	31	14	3.46	0.93
We use knowledge to identify high supply chain risk (demand process control and environment)	2	2	36	42	19	3.75	0.84

From the study findings (Table 4.7) it was observed that few manufacturing firms in Kenya used mapping tools to identify bottlenecks and critical path in supply chain (long lead time). Mapping tools should be used in identifying bottleneck and critical items in the manufacturing firms. This is because mapping can enable the prioritization of planning process and structures to absorb risks in manufacturing firms (Sheffi & Rice 2005). Also, from the study it was noted that manufacturing firms in Kenya used prior knowledge acquired in identifying high supply chain risk. This finding agreed with Tang (2006) acknowledge that robust supply chain strategies enhance a firm's capability to sustain its operations when a major disruption hits and this requires all chain members to have an understanding of the network. Therefore, manufacturing firms in Kenya should have mapping knowledge of the supply network in order to understand on who owns what, as well as key measures that are currently in place. Supply chain mapping knowledge can create supply chain resilience in manufacturing firms in Kenya.

b) Supply chain strategy

Majority of the respondents (88%) agreed that manufacturing firms adopted pro-active strategy of supplier developments i.e worked closely with their suppliers, 8% of the respondents indicated moderate and a small number of respondents (3%) disagreed. In addition, 48% of the respondents agreed that manufacturing firms used risk awareness as key criteria for selecting suppliers, 37% of respondents indicated moderate and 16% of the respondents disagreed. However, 40% of the respondents agreed that manufacturing firms used single sourcing by product in order to keep alternative source of supply available, 20% of the respondents indicated moderate and 39% of the respondents disagreed. Also, the study revealed that 32% of respondents agreed that manufacturing firms used single sourcing for multiple sites or branch outlets to gain advantages of single sourcing, 24% of the respondents indicated moderate and 44% of the respondents disagreed as shown in Table 4.8.

Table 4.8: Measurement of Supply Chain Strategy

Supply chain strategy	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Deviation
We adopt pro-active strategy of supplier developments (working closely with suppliers)	3	0	8	54	34	4.15	0.85
We use risk awareness as a key criteria for selecting suppliers	2	14	37	29	19	3.49	1.01
We use single sourcing by product in order to keep alternative source of supply available	12	27	20	32	8	2.98	1.20
We use single sourcing for multiple sites / branch outlets to gain advantages of single sourcing	15	29	24	25	7	2.80	1.19

Generally, it was noted from the study (Table 4.8) that manufacturing firms in Kenya adopted pro-active strategy of supplier developments such as working closely with their suppliers. Likewise the study found out that manufacturing firms in Kenya used risk awareness as key criteria for selecting suppliers. This is a good practice as supplier development would enable manufacturing firms to develop a good relationship with key suppliers. This would only be possible if manufacturing firms are able to maintain

manageable supply base. Manageable supply base would enable manufacturing firms to assess risks from suppliers and hence creating supply chain resilience in manufacturing firms in Kenya.

However, from the study it was observed that few manufacturing firms in Kenya used single sourcing by product and single sourcing for multiple site or branch outlets. These findings were in agreement with Christopher and Peck (2004) who depicted that firms are in a move towards adopting single sourcing where a supplier is responsible for the supply of specific items or services and may be advantageous from the cost and quality management but dangerous in terms of resilience. But recommended that where firms have multiple sites it may be responsible to have single source item or service and if firm makes a range of products it may be possible to single source product thus keeping an alternative source of supply available. Therefore, manufacturing firms in Kenya should keep alternative source of supply as a way of creating resilience in manufacturing firms and use single sourcing for multiple sites to gain advantages of single sourcing.

c) Supply chain re-design principle

The researcher observed that 81% of the respondents agreed that manufacturing firms chose supply chain strategies that keep lowest cost, reduce impact in disruptions, 17% of the respondents indicated moderate and 2% disagreed. Also, the study revealed that 62% of the respondents agreed that manufacturing firms maintained stakeholders to understand supply chain structures, 24% of the respondents indicated moderate and 13% of the respondents disagreed. Further, the study showed that 32% of the respondents agreed that their manufacturing firms' trade-off between efficiency and redundancy stock, 49% of the respondents indicated moderate and 19% of the respondents disagreed as shown Table 4.9.

Table 4.9: Measurement of Supply Chain Re-Design Principle

Supply chain re-design principle	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Dev.
We choose supply chain strategies that keep lowest cost , reduce impact in disruptions	0	2	17	47	34	4.14	0.75
We maintain stakeholders to understand supply chain structures	5	8	24	42	20	3.64	1.06
We trade-off between efficiency and redundancy stock	0	19	49	25	7	3.20	0.83

From the study findings (Table 4.9) it was found that manufacturing firms in Kenya chose supply chain strategies that keep lowest cost and reduce impact in disruptions. This is very important to the manufacturing firms because strategies would assist them to create resilience in supply chain. This finding concurred with Christopher and Peck (2004) that firms should choose supply chain strategies that keep several options open and these options should provide an opportunity to reduce the impact of disruption if and when it occurs. Equally, the study found out that manufacturing firms in Kenya maintained stakeholders to understand supply chain structures as a way of building resilience in manufacturing firms.

However, it was found that few manufacturing firms in Kenya trade-off between efficiency and redundancy stock. Manufacturing firms in Kenya should constantly trade-off between advantages of keeping buffer stock as a way of cautioning disruptions and thus creating resilience. Blackhurst *et al*. (2011) asserts that firms should re-examine the

efficiency versus reducing trade off. Firms should have strategic disposition of additional inventory that can be extremely beneficial in the creation of resilience. Hence, manufacturing firms in Kenya should redesign their network to increase visibility and as a way of creating supply chain resilience in manufacturing firms.

4.4.3 Operational Flexibility

The study sought to establish the influence of operational flexibility on supply chain resilience in manufacturing firms in Kenya. This objective was measured using the following indicators: production capacity, sourcing and order fulfilling in opinion statements given. Respondents were asked to indicate the extent to which they agreed with the opinion statements given in regard to the implementation of flexibility issues for creating supply chain resilience in their manufacturing firms. This was on a likert scale of not at all, small extent, moderate, large extent and very large extent. Thus, in this study the scale of not all and small extent meant disagree while large and very large extent meant agreed.

a) Production capacity

A high percentage of respondents (86%) agreed that their manufacturing firms had reliable back-up utilities (electricity and water), 12% of the respondents indicated moderate and a small percentage of respondents (2%) disagreed. Also, majority of the respondents (56%) agreed that their manufacturing firms maintained access to duplicate or redundant facilities and equipment, 34% of the respondents indicated moderate and 10% of the respondents disagreed. In addition, 61% of the respondents agreed that their manufacturing firms had significant excess capacity of materials, equipment and labour to quickly boost output if needed, 19% of the respondents indicated moderate and 20% of the respondents disagreed as shown Table 4.10.

Table 4.10: Measurement of Production Capacity

production capacity	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Dev.
We have reliable back-up utilities (electricity and water)	0	2	12	42	44	4.29	0.74
We maintain access to duplicate or redundant facilities and equipment	2	8	34	44	12	3.56	0.88
We have significant excess capacity of materials , equipment and labour to quickly boost output if needed	3	17	19	46	15	3.53	1.06

From the results of the study (Table 4.10) it was found that manufacturing firms in Kenya had reliable back-up utilities such as electricity and water. Also, manufacturing firms in Kenya maintained access to duplicate or redundant facilities and equipment. Equally, the study noted that manufacturing firms had significant excess capacity of materials, equipment and labour to quickly boost output if needed. These resources are important to sustain production levels in the manufacturing firms in Kenya. These findings are in agreement with Pettit *et al.* (2010) that capacity is the availability of assets to enable sustained production levels taking the form of resource capacity, redundant capacity and backup capacity. Manufacturing firms should purchase or create a specific level of output capacity based on expected demands with additional capacity to handle variations in demand as well as providing for production uncertainties. Sheffi

(2005) depicted that maintaining reserve production capacity is essential in service industries or in manufacturing may be much more cost-effective than holding reserves of high-value finished goods. Therefore, manufacturing firms in Kenya should have backup capacity of enablers' production and utilities such as electricity and water as a way of building resilience in manufacturing firms.

b) Flexibility sourcing

The study showed that (63%) of the respondents agreed that their manufacturing firms had alternative source of key inputs, 24% of the respondents indicated moderate and 13% of the respondents disagreed. Likewise, 34% of the respondents agreed that their manufacturing firms can easily modify to change specifications, qualities and terms of supply contracts, 44% of the respondents indicated moderate and 22% of the respondents disagreed as shown Table 4.11.

Table 4.11: Measurement of Flexibility Sourcing

Flexibility sourcing	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Deviation
We have alternative source of key inputs	2	11	24	51	12	3.59	0.91
Our supply contracts can be easily modified to change specifications , qualities and terms	10	12	44	20	14	3.15	1.13

In terms of flexibility sourcing, the study (Table 4.11) found out that manufacturing firms in Kenya had alternative source of key inputs. Manufacturing firms with alternative suppliers would provide options in the event of either single or multiple supplier disruptions and hence create supply chain resilience. This finding concurred with Pettit *et al.*, (2010) that alternative suppliers provide options in the event of either single or multiple-supplier disruptions.

Jüttner and Maklan (2011) assert that sourcing flexibility can be considered a key enabler to resilience owing to the ability to shift cost-effective supply sources by choosing the cheapest source or strengthening the companies' bargaining power in price negotiations with their suppliers. Also, Yi *et al.* (2011) explained that firms normally employ sourcing flexibility to maintain supplier availability to support the company with good quality materials in case of needs and thereby increasing resilient of manufacturing firms.

However, few manufacturing firms in Kenya can easily modify to change specifications, qualities and terms of supply contracts. Manufacturing firms in Kenya should be able to modify and change the specifications of supply contract to suit their needs. The supply contract should be flexible to allow any changes which may arise such as quality, the quantities needed and many other. This would enable firms to adopt new changes and create resilience in the manufacturing firms.

c) Flexibility in order fulfillment

The study showed 54% of the respondents agreed that their manufacturing firms could quickly increase capacity of storage and distribution services, 25% of the respondents indicated moderate and 21% of the respondents disagreed. However, 19% of the respondents agreed that their manufacturing firms delayed final production of finished goods until close to the time that customers place orders, 42% of the respondents indicated moderate and 39% of the respondents disagreed. Likewise, 23% of the respondents agreed that their manufacturing firms could quickly change the routing and mode of transportation for outbound shipment, 42% of the respondents indicated

moderate and 35% disagreed. Also, 43% of the respondents agreed that their manufacturing firms could quickly reallocate orders to alternate suppliers, 22% of respondents indicated moderate and 27% of the respondents disagreed as shown Table 4.12.

Table 4.12: Measurement of flexibility in order fulfilment

Flexibility in order fulfillment	Std. Deviation	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Deviation
We can quickly increase capacity of storage and distribution services	2	19	25	46	8	3.41	0.95
We currently delay final production of finished goods until close to the time that customers place orders	15	24	42	12	7	2.71	1.08
We can quickly change the routing and mode of transportation for outbound shipment	25	10	42	15	8	2.69	1.24
We can quickly reallocate orders to alternate suppliers	27	22	8	29	14	2.80	1.46

It was observed from the study (Table 4.12) that manufacturing firms in Kenya could quickly increase capacity of storage and distribution services as a way of responding and meeting customer demands. Hence creating supply chain resilience in the manufacturing firms. However, the study found that few manufacturing firms in Kenya delayed final production of finished goods until close to the time that customers place orders and few manufacturing firms in Kenya could quickly change the routing and mode of transportation for outbound shipment.

Therefore, manufacturing firms in Kenya should delay (postponement) final production of finished goods until the time customers place orders and quickly relocate orders to alternative suppliers if supplier are unable meet the requirements. Thus it would enable firms to be resilient and hence increase the performance of manufacturing firms. For example, Carla *et al*. (2014) described that transport flexibility could help firms to load its delivery in time and without huge losses as it was in the case Ford and Chrysler after the 9/11 terrorist attack. Chrysler quickly changed the transportation mode of delivery that could load its delivery in time and without huge losses.

4.4.4 Risk Awareness

The study sought to analyse the influence of risk awareness on supply chain resilience in manufacturing firms in Kenya. This objective was measured using the following indicators: assessment of supply chain risks, sharing of supply chain risks with partners and training stakeholders supply chain risks in opinion statements given. Respondents were asked to indicate the extent to which they agreed with the opinion statements given in regard to the implementation of risk awareness issues for creating supply chain resilience in their manufacturing firms. This was on a likert scale of not at all, small extent, moderate, large extent and very large extent. Therefore, in this study the scale of not all and small extent meant disagree while large and very large extent meant agreed.

a) Risk assessment

A high percentage of respondents (87%) agreed that their manufacturing firms frequently monitored supply risks (quality, outsourcing risk), 10% of the respondents indicated moderate and a small percentage (3%) disagreed. Similarly, 68% of the respondents agreed that their manufacturing firms developed appropriate management policies to access risk, 27% of the respondents indicated moderate and 5% of the respondents disagreed. Equally, 76% of the respondents agreed that their manufacturing firms had continuity plans addressing major supply chains risks, 14% of the respondents indicated moderate and 10% of the respondents disagreed as shown Table 4.13.

Table 4.13: Measurement of risk assessment

Risk assessment	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Dev.
We frequently monitor supply risks (quality , outsourcing risk)	0	3	10	68	19	4.02	0.66
We develop appropriate management policies to access risk	2	3	27	46	22	3.83	0.87
We have continuity plans addressing major supply chains risks	0	10	14	56	20	3.86	0.86

From the study (Table 4.13) it was found that manufacturing firms in Kenya frequently monitored supply risks such as quality and outsourcing risk, developed appropriate management policies to access risk and continuous plans to address major supply chains

risks. Manufacturing firms in Kenya should monitor supply chain risks and make them part of decision making. This would enable manufacturing firms in Kenya to be resilient which in turn would increase the performance of manufacturing firms. Moreover, Jüttner and Maklan (2011) state that to be resilient, organizations need to develop appropriate management policies and actions that assess risk continuously and coordinate the efforts of their supply network. Equally Faisal *et al*. (2006) suggested that supply chain partners must share a common understandings and awareness of the risks that could occur within their operations. Therefore, manufacturing firms in Kenya should not only frequently monitor supply chain risks but also share the information with key partners as a way of creating supply chain resilience. Also, manufacturing firms in Kenya should have improved management policies for assessing and addressing major supply chain risks. This would create supply chain resilience in the manufacturing firms.

b) Sharing of supply chain risks

Majority of the respondents (60%) agreed that their manufacturing firms shared common understandings of risk with their partners, 32 of the respondents indicated moderate and 8% of the respondents disagreed. Similarly, 69% of the respondents agreed that their manufacturing firms had capacity to learn from past disruptions to be prepared, 27% of the respondents indicated moderate and a small percentage of respondents (3%) disagreed. Likewise, 51% of the respondents agreed that their manufacturing firms employed a team which was dedicated to supply risk management, 22% of the respondents indicated moderate and 27% of the respondents disagreed as shown Table 4.14.

Table 4.14: Measurement of Sharing Supply Chain Risks

Sharing supply chain risks	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Dev.
We share common understandings of risk	0	8	32	41	19	3.69	0.88
We have capacity to learn from past disruptions to be prepared	0	3	27	49	20	3.86	0.78
We employ a team which is dedicated to supply risk management	5	22	22	36	15	3.34	1.14

It was noted from the study (Table 4.14) that manufacturing firms in Kenya shared common understandings of risk with their partners, had capacity to learn from past disruptions to be prepared and employed a team which was dedicated to supply risk management. This was important because manufacturing firms in Kenya had the capacity to learn from the past disruptions and enable them to develop better preparedness for future event of creating resilience. Also, sharing common understanding of risks with key their key partners would enable them to be focused on a common goal of eliminating and curbing disruptions and hence creating supply chain resilience. Likewise Faisal *et al*. (2006) that supply chain partners must share a common understandings and awareness of the risks that could occur within their operations. The capacity to learn from past disruptions to develop better preparedness for future events is a principal property of resilience (Ponomarov & Holcomb, 2009).

c) Training of stakeholders

The study found out that 51% of the respondents agreed that their manufacturing firms provided training of employees, suppliers and customers about security of risks, 36% of the respondents indicated moderate and 13% of the respondents disagreed. Further, 49% of the respondents agreed that their manufacturing firms trained stakeholders to understand supply chain structures, 39% of the respondents indicated moderate and 12% of the respondents disagreed. Similarly, 59% of the respondents agreed that their manufacturing firms had the ability to correct forecast demand such customers and demand as shown Table 4.15.

Table 4.15: Measurement of Training Stakeholders

Training stakeholders	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Deviation
We provide training of employees , suppliers and customers about security of risks	8	5	36	37	14	3.42	1.07
We train stakeholders to understand supply chain structures	10	2	39	41	8	3.36	1.03
We have the ability to correct forecast demand (customers, demand)	8	0	32	42	17	3.59	1.05

From the result (Table 4.15) it was found that manufacturing firms in Kenya provided training of employees, suppliers and customers about security of risks, and other

stakeholders to understand supply chain structures. Training of employees, suppliers and customers would raise their awareness in order to reinforce the importance of creating supply chain resilience. Thus manufacturing firms in Kenya should improve and train all stakeholders in order to create resilience. This finding concurred with Blackhurst *et al*. (2011); Rice and Caniato, (2003) that leading companies provide training to employees, suppliers and customers about security and supply network risks to raise awareness and reinforce the importance of supply chain resilience. Also, it was found from the study that manufacturing firms in Kenya had the ability to correct forecast demand such customers and demand.

Thus, manufacturing firms would use historical data available to be able to predict the future with regard to disruptions. Therefore, forecasting would assist manufacturing firms to be prepared for uncertainties and hence develop resilient supply chains. Pettit *et al.* (2010) noted that risk identification, requires at least some historical data or subjective estimates. Where data is available, historically accurate and the assumption that the past is representative of the future holds relatively true, managers can use traditional risk management techniques to prioritize risks to make valuable investments in mitigation programs. Therefore, manufacturing firms in Kenya should improve risk management by using forecasting method to monitor contingencies from various risk resources, normally focusing on the upstream of the company to create resiliencein manufacturing firms.

4.4.5 Supply chain resilience

The study sought to determine the rate of customer service, growth of market share and profitability of manufacturing firms as a result of having resilient supply chains. Respondents were asked to indicate the extent to which they agreed with the opinion statements given in regard to the rating performance of in their manufacturing firms. This was on a likert scale of not at all, small extent, moderate, large extent and very large extent. In this study the scale of not all and small extent meant disagree while large and very large extent meant agreed.

a) Customer service

A high percentage of the respondents (90%) agreed that their manufacturing firms had representatives of firms who communicate effectively with customers, 7% of the respondents indicated moderate and small percentage (3%) disagreed. Similarly, 93% of the respondents agreed that their manufacturing firms had strong and long-term relationships with customers, 3% of the respondents indicated moderate and 4% of the respondents disagreed.

Equally, 85% of the respondents agreed that their manufacturing firms' brands had excellent customer recognition and strong reputation for quality, 10% of the respondents indicated moderate and only 5% of the respondents disagreed. Likewise, 83% of the respondents agreed that their manufacturing firms responded to customer complaint in time, 15% of the respondents indicated moderate and only 2% of the respondents disagreed as shown Table 4.16.

Table 4.16: Measurement of Customer service

Customer service	Not at all (%)	Small Extent (%)	Moderate (%)	Large Extent (%)	Very Large Extent (%)	Mean	Std. Deviation
Representatives of our firms communicate effectively with customers	0	3	7	49	41	4.27	0.74
Our firm has strong , long term relationships with customers	2	2	3	46	47	4.36	0.78
Our brands have excellent customer recognition and strong reputation for quality	0	5	10	51	34	4.14	0.80
We respond to customer complaint in time	0	2	15	58	25	4.07	0.69

From the study (Table 4.16)it was found that manufacturing firms in Kenya had representatives of firms who communicates effectively with customers, the firms has strong and long-term relationships with customers, the firms has brand excellent customer recognition and strong reputation for quality and respond to customer complaint in time. Therefore, manufacturing firms who effectively communicate with their customers, have brand excellent customer recognition and strong reputation for quality and responding customer complains in time are regarded to be resilient. Pettit *et al*. (2010) assessed supply chain resilience using four levels including customer service level and found that firms with high customer service level were found to be more

resilient. Also, Giunipero *et al*. (2015) used sand cone model to illustrate the different Supply Chain Resilience phases and their relative importance to performance. They used customer service to quantify the performance of supply chain resilience. They found that firms' with high customer service were more resilient than those with low customer.

b) Growth of market share

From the result, it was found out that in 2013 the market share grew at average price of 20% and 30%. But are also few firms whose market share grew over 30% price. Also, in 2014 the market share grew at average price of 20% and 30%. In 2015 there was an improvement has most firms' market share grew at an average price 30% and 40%. In general, the trend average of market share grew steadily from 2.4, 2.77 and 2.95 respectively as shown in Table 4.17.

Table 4.17: Measurement of Growth of Market Share

Growth of Market Share	Less than 10 (%)	10-20 (%)	20-30 (%)	30-40 (%)	More than 40 (%)	Mean	Std. Deviation
2013	15	43	34	5	3	2.4	0.91
2014	12	25	41	17	5	2.77	1.04
2015	10	31	26	21	12	2.95	1.20

From the result (Table 4.17), the study found that the growth of market share of manufacturing firms was attributed as a result of building resilient supply chains. Thus resilient supply chains protected manufacturing firms from unexpected disruptions such as high costs of production, equipment malfunctions and information technology breakdown. This was also noted by Giunipero *et al*. (2015) who used market share as one of variable in measuring supply chain resilience of manufacturing firms in Brazil. They found that manufacturing firms who whose market share steadily increases and command significant share market were more resilient. In addition Wu *et al.* (2013) examine retail stock-outs quantitatively through an agent-based simulation model to

enhance understanding of the effect of different stock-out lengths for different products. To evaluate the stock-out's impact, they used the market-share level as a measure of SCRES (the ability to respond to and recover from a stock-out disruption).

c) Profitability

The profitability of the manufacturing firms in Table 4.18 shows that the Return on Investments (ROI) worked out as annual percentage changes. To achieve this, the profit was calculated from the profit in Kenyan shillings (Ksh) divided by capital invested. The ROI index was then calculated as the percentage for each year. An index of over 100 is an indication that there was an improvement on value of return on Investment employed.

Table 4.18: Measurement of Profitability (In billions Ksh)

Profitability Ratio	**2011**	**2012**	**2013**	**2014**	**2015**
Total Assets	25,4948	295,943	248,971	184,993	132,115
Net profit (loss) After tax	4,729	4,780	19	4,984	17,159
Total Equity	6,409	24,705	13,845	-(25,279)	22,521
Return on Assets (ROA)	-(1.85)	1.58	0.01	2.37	-(12.99)
Return on Equity (ROE)	-(13)	19	0.14	-(17)	76

From the study (Table 4.18) it was found that from 2011to 2015 the net profit of manufacturing firms grew positively. The increase of profitability might have been attributed be as a result of resilient supply chains of manufacturing firms. Resilient supply chain can enhance firms to respond and recover quickly to its original position and grow to make profits. Thus, manufacturing firms with high net profit margin are regarded to resilient. This is study findings concurred with the study of Giunipero *et al*.

(2015) who asserted that firms with high profit margin are regarded to be more resilient than those firms whose profit margin are low.

4.5 Reliability and factor analysis for independent and dependent variables

The study conducted factor analysis to select a subset of variables from a larger set, based on the original variables with the highest correlations with the principal component factors. Factor analysis is an interdependence technique in which all variables are simultaneously considered, each related to all others (Ghauri & Gronhaug, 2005). Reliability is consistency of measurement (Bollen, 1989), or stability of measurement over a variety of conditions in which basically the same results should be obtained. The internal consistency method was adopted because it is more stable than the other methods (Bryman, 2012; Cooper & Schindler, 2011). To measure the reliability of the gathered data, Cronbach's alpha was applied.

4.5.1 Reliability and Factor Analysis for Strategic Sourcing

Realibility analysis for testing the internal consistency of all items in each dimension of strategic sourcing was conducted in this study. All the items achieved Cronbach's alpha of 0.7 suggesting that the questionnaire had high reliability as shown in Table 4.18. The researcher also, tested the validity of the questionnaire. According to Mugenda (2008); Bryman (2012), construct validity refers to how well you translated or transformed a concept, idea, or behavior (a construct) into a functioning and operating reality, the operationalization. Construct validity was achieved through restricting the questions to conceptualization of the variables and ensuring that indicators of each variable fell with the same construct.

The purpose of this check was to ensure that each measure adequately assessed the construct it was purported to assess. The factor loading of the items in the model of strategic sourcing were all positive and significant. The meant that although these items

were developed from reviewed literature focusing on the context of developed countries, the items converged very well to their respective dimensions and were applicable in the Kenyan context.

Table 4.19: Reliability and Factor Analysis for Strategic Sourcing

Construct	Items	Cronbach's Alpha	Total to Item correlation	KMO	Loadings	Variance explained
Collaboration	SS1	0.715	0.491	0.726	0.72	54.341
	SS2		0.559		0.788	
	SS3		0.503		0.727	
Supplier base	SS6		0.477		0.711	
	SS7	0.702	0.542	0.5	0.878	77.076
	SS8		0.542		0.878	
Criteria selection of suppliers.	SS9	0.708	0.667	0.657	0.681	47.283
	SS10		0.697		0.578	
	SS11		0.551		0.879	
	SS12		0.691		0.617	
	SS13		0.678		0.642	

4.5.2 Reliability and Factor Analysis for Supply Chain Re-Engineering

Reliability and factor analysis was performed for all sub dimension of supply chain re-engineering. The results of the analysis are illustrated in Table 4.20. The Cronbach's alpha values of supply chain re-engineering and factor loading of all supply chain re-engineering statements had higher absolute value of the loading.

Table 4.20: Reliability and Factor Analysis for Supply Chain Re-Engineering

Construct	Items	Cronbach's Alpha	total to Item correlation	KMO	Loadings	Variance explained
Supplier chain	SCR1	0.701	0.358	0.5	0.827	68.463
knowledge	SCR2		0.358		0.827	
	SCR3	0.775	0.746	0.709	0.896	61.512
Supply base	SCR4		0.547		0.747	
strategy	SCR5		0.618		0.829	
	SCR6		0.444		0.643	
Supply chain	SCR7	0.713	0.596	0.662	0.823	62.239
design	SCR8		0.504		0.766	
principle.	SCR9		0.499		0.777	

4.5.3 Reliability and Factor Analysis for Flexibility

Reliability and factor analysis was conducted in all sub dimension of flexibility as indicated in table 4.20. The value of loading factors were above 0.5 and significant $p< 0.05$ (Kaiser, 1974). The Cronbach's alpha values reached the threshold of 0.7 indicating strong consistency, thus verifying reliability. The coefficient between the items and factors were positive and significant at $p< 0.05$, indicating convergent validity as shown Table 4.21.

Table 4.21: Reliability and Factor Analysis for Flexibility

Construct	Items	Cronbach's Alpha	Total to Item correlation	KMO	Loadings	Variance explained
Production capacity.	F1	0.785	0.697	0.681	0.88	70.141
	F2		0.599		0.821	
	F3		0.582		0.81	
Flexibility sourcing.	F4	0.712	0.374	0.6	0.88	77.427
	F6		0.374		0.88	
Flexibility in order fulfillment	F6	0.764	0.648	0.684	0.84	61.701
	F7		0.584		0.775	
	F8		0.697		0.893	
	F9		0.411		0.603	

4.5.4 Reliability and Factor Analysis for Risk Awareness

A confirmatory factor analysis by extraction method of principle components was conducted for all items and factor loadings were above 0.5 and significant $p< 0.05$ as indicated Table 4.22. The Cronbach's alpha values reached the threshold of 0.7 indicating strong consistency, thus verifying reliability. To assess the factorability of items, the researcher examined this indicator (Kaiser Meyer-Olin Measure of Sampling Adequacy). For every EFA, it was found that manifest variables have KMO Measures of Sampling Adequacy above the threshold of 0.6 (Kaiser, 1974).

Table 4.22: Reliability and Factor Analysis for Risk Awareness

Construct	Items	Cronbach's Alpha	Total to Item correlation	KMO	Loadings	Variance explained
Risk assessment	RA1	0.787	0.575	0.626	0.804	70.697
	RA2		0.756		0.911	
	RA3		0.589		0.803	
Sharing risks	RA4	0.763	0.588	0.694	0.822	69.25
	RA5		0.654		0.859	
	RA6		0.585		0.815	
Training stakeholders	RA7	0.743	0.585	0.676	0.825	66.642
	RA8		0.619		0.849	
	RA9		0.521		0.773	

4.5.5 Reliability and factor analysis for the performance of firms

On the performance of manufacturing firms, reliability and factor analysis results are presented in Table 4.23. The overall performance of of manufacturing firms was measured using customer service, growth market share and profitability. The results showed that the performance of manufacturing firms had Cronbach's alpha values above 0.7 and the factor loading value is greater than 0.5 and was accepted. Also, the researcher examined the factorability of items using Kaiser Meyer-Olin Measure of Sampling Adequacy. For every EFA, it was found that manifest variables have KMO Measures of Sampling Adequacy above the threshold of 0.6 (Kaiser, 1974).

Table 4.23: Reliability and factor analysis for Supply chain resilience

Construct	Items	Cronbach's Alpha	Total to Item correlation	KMO	Loadings	Variance explained
	SCR1	0.814	0.731	0.72	0.87	64.364
Customer	SCR2		0.65		0.822	
service.	SCR3		0.646		0.809	
	SCR4		0.514		0.699	
	SCR5	0.797	0.58	0.692	0.798	72.332

4.6 Quantitative Results

4.6.1 Correlations of Study Variables

Correlation among the independent variables was illustrated by the correlations matrix in Table 4.24. Correlation is often used to explore the relationship among a group of variables (Pallant, 2010), in turn helping in testing for multicollinearity. That the correlation values are not close to 1 or -1 is an indication that the factors are sufficiently different measures of separate variables (Farndale, Hope-Hailey & Kelliher, 2010). It is also an indication that the variables are not multicollinear. Absence of multicollinearity allows the study to utilize all the independent variables.

The study showed that the lowest correlation was between operational flexibility and supply chain resilience ($r=0.454$, $p<0.01$). The highest correlation was between supply chain re-engineering and supply chain resilience ($r=0.675$, $p<0.01$) as shown in Table 4.24. A correlation of above 0.90 is a strong indication that the variables may be measuring the same thing (Tabachnick & Fidell, 2013). The fact that all the correlations were less than 0.90 was an indication that the factors were sufficiently different measures of separate variables, and consequently, this study utilized all the variables.

Table 4.24: Correlations of Study Variables

		BSCR	SS	SCR	Flexibility	RA
BSCR	Pearson Correlation	1	.611**	.675**	.454**	.521**
	N	59	59	59	59	59
SS	Pearson Correlation	.611**	1	.184	.455**	.497**
	N	59	59	59	59	59
SCR	Pearson Correlation	.675**	.184	1	.249	.266
	N	59	59	59	59	59
Flexibility	Pearson Correlation	.454**	.455**	.249	1	.386**
	N	59	59	59	59	59
RA	Pearson Correlation	.521**	.497**	.266	.386**	1
	N	59	59	59	59	59

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

Also, the study indicated that there was a positive significant linear relationship between strategic sourcing and supply chain resilience in manufacturing firms in Kenya. This relationship had been illustrated by the correlation coefficient of 0.611 at 0.01, significance level as shown in Table 4.24. This implied that there was a strong relationship between strategic sourcing and supply chain resilience in manufacturing firms in Kenya. Strategic sourcing is the employment of appropriate strategy which carefully considers profit potential and risk factors. Strategic sourcing is underpinned by four fundamental issues and managing them properly managers will be able to develop good relationships with suppliers' and they include: collaboration; supplier relationships; supplier selection and supplier base (Carla *et al*., 2014). Therefore, collaboration is not only important before and during a disruption but also after a disruption, in order to share experiences among the parties to increase the ability of the system to deal with

future risks and hence creating supply chain resilience (Juttner & Maklan, 2011; Sheffi, 2005).

Likewise the study found that supply chain re-engineering had a positive significant linear relationship with supply chain resilience in manufacturing firms in Kenya with Pearson correlation coefficient of 0.675 at 0.01, significance level as shown in Table 4.24. This implied that there was a positive correlation between supply chain re-engineering and supply chain resilience. Thus, resilience must be built into a supply chain in advance of a disturbance and incorporate readiness to enable an efficient and effective response (Ponomarov & Holcomb, 2009). Robust supply chain strategies enhance a firm's capability to sustain its operations when a major disruption hits by preventing risks from having negative effects and enabling resistance to change without adapting the chain's initial stable configuration (Wieland & Wallenburg, 2012).

In addition, the study revealed that operational flexibility had a positive significant linear relationship with supply chain resilience in manufacturing firms in Kenya. This relationship was illustrated by Pearson correlation coefficient of 0.454 at 0.01, significance level as shown in Table 4.24. This implied that there was a fairly positive relationship between flexibility andsupply chain resilience inmanufacturing firms in Kenya.

Literature reveals various flexibility practices that can enhance supply chain resilience, such as postponement, a flexible supply base, flexible transportation, flexible labour arrangements, and order fulfilment flexibility (Tang 2006b; Christopher & Holweg, 2011; Pettit, Croxton, & Fiksel, 2013).

Hence, flexibility creates supply chain resilience by enhancing prompt adaptability during turbulence (Christopher & Holweg, 2011). It also aids a supply chain's rapid response and recovery, and this can be facilitated by the availability of alternative choices (redundancy), including alternative suppliers (Sheffi & Rice, 2005).

Similarly, risk awareness had a positive significant linear relationship with supply chain resilience inmanufacturing firms in Kenya. This relationship was illustrated in Table 4.24 with Pearson correlation coefficient of 0.521 at 0.01, significance level. This inferred that there was a fairly positive relationship between risk awareness and supply chain resilience in manufacturing firms in Kenya. Ponomarov and Holcomb (2009, p. 137) assert that "risk assessment and sharing among the members of a supply chain is an essential element of risk mitigation". Also Jüttner and Maklan (2011) state, as a result of their study, that monitoring supply risks had a positive impact on the supply chain visibility. To be resilient, organizations need to develop appropriate management policies and actions that assess risk continuously and coordinate the efforts of their supply network (Kleindorfer & Saad, 2005), supply chain partners must share a common understandings and awareness of the risks that could occur within their operations (Faisal *et al*., 2006).

4.6.2 Testing of Outliers of the study variables

Outliers were tested univariately on both independent and dependent variable because the independent and dependent variable constructs were in continuous scales. Univariate outliers are extreme values for a single variable. Outliers within the firm performance constructs were dropped. That is, cases or observations showing characteristics or values that are markedly different from the majority of cases in a data set (Kline, 2005; Hair et *al*., 2010) are normally dropped. This is because they distort the true relationship between variables, either by creating a correlation that should not exist or suppressing a correlation that should exist (Abbott & McKinney, 2013).

Consequently, multivariate testing of outliers on the dependent variable using Mahalanobis d-squared, produced reasonable boxplots as shown (Appendix vi) where all the constructs are symmetrical and with no outliers identified. Multivariate outliers are an unusual combination of scores on a number of variables (Tabachnick & Fidell, 2007).

a) Normality Tests of the Study Variables

The normality of data distribution was assessed by examining its skewness and kurtosis (Kline, 2005). A variable with an absolute skew-index value greater than 3.0 is extremely skewed while a kurtosis index greater than 8.0 is an extreme kurtosis (Kline, 2005). Cunningham (2008) stated that an index smaller than an absolute value of 2.0 for skewness and an absolute value of 7.0 is the least violation of the assumption of normality. The results of the normality test of the dependent variable indicated skewness and kurtosis in the range of -1 and +1 as shown in Table 4.25. This implies that the assumption of normality was satisfied.

Table 4.25: Normality test of independent and dependent varaibles

construct		Statistic	SE (±)
Supply chain re-engineering	Mean	2.2199	.7972
	Median	2.3689	
	Std. Deviation	.612333	
	Range	2.44	
	Skewness	-0.649	0.311
	Kurtosis	.523	0.613
Strategic sourcing	Mean	3.3889	0.10252
	Median	3.2327	
	Std. Deviation	.78745	
	Range	3.49	
	Skewness	0.193	0.311
	Kurtosis	-0.111	0.613
Flexibility	Mean	3.2304	0.108
	Median	3.5395	
	Std. Deviation	1.13241	
	Range	4.03	
	Skewness	0.100	0.311
	Kurtosis	0.549	0.613
Risk awareness	Mean	3.4336	0.07441
	Median	3.2361	
	Std. Deviation	.57158	
	Range	2.48	
	Skewness	-1.085	0.311
	Kurtosis	1.881	0.613
Performance of firms	Mean	3.5287	.1309
	Median	3.4753	
	Std. Deviation	.93604	
	Range	4.05	
	Skewness	0.220	0.311
	Kurtosis	-0.277	0.613

To corroborate the skewness and kurtosis results, the graphical analysis results showed the line representing the actual data distribution closely follow the diagonal in the normal Q-Q plot as shown in figures 4.1 to 4.5, suggesting normal distribution (Hair, Tatham, Anderson & Black, 2006). In q-q plot, or the normal probability plot, the observed value for each score is plotted against the expected value from the normal distribution, where, a sensibly straight line suggests a normal distribution (Pallant, 2007). By and large, if the points in a q-q plot depart from a straight line, then the assumed distribution is called into question (Aas & Haff, 2006).

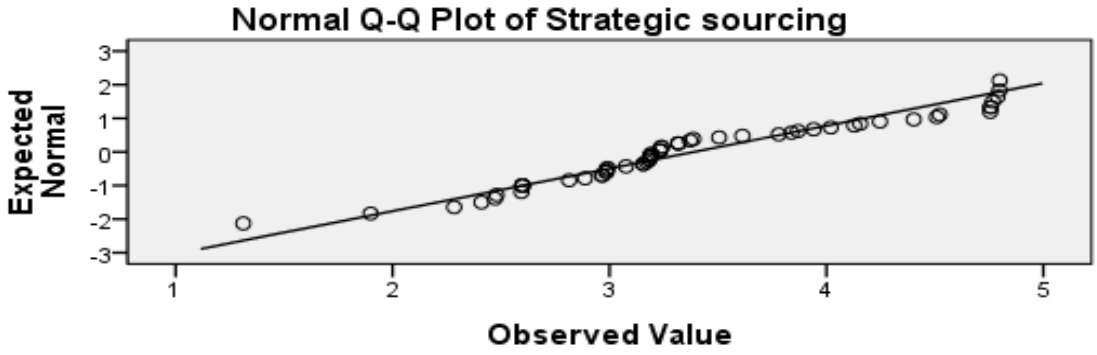

Figure 4.1: Q-Q plot of strategic sourcing

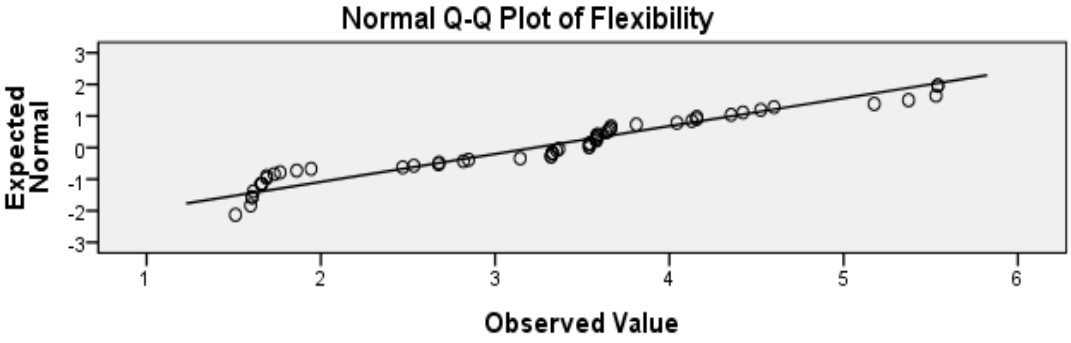

Figure 4.2: Q-Q plot of flexibility

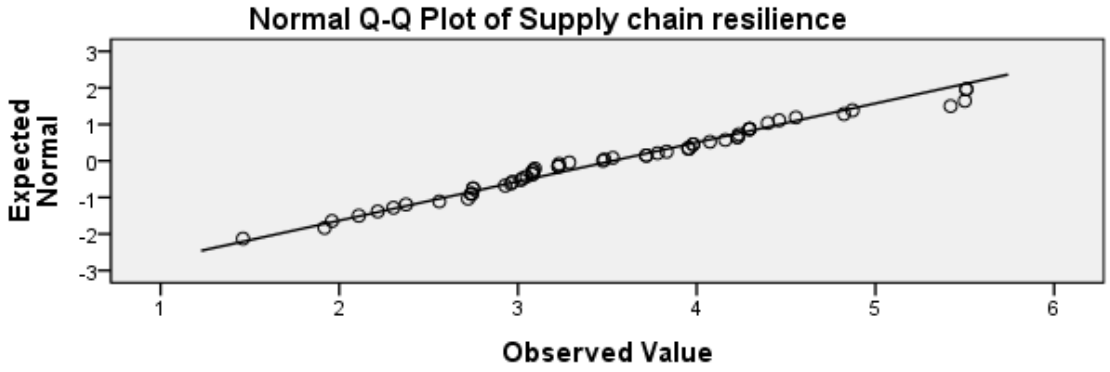

Figure 4.3: Q-Q plot of supply chain resilience

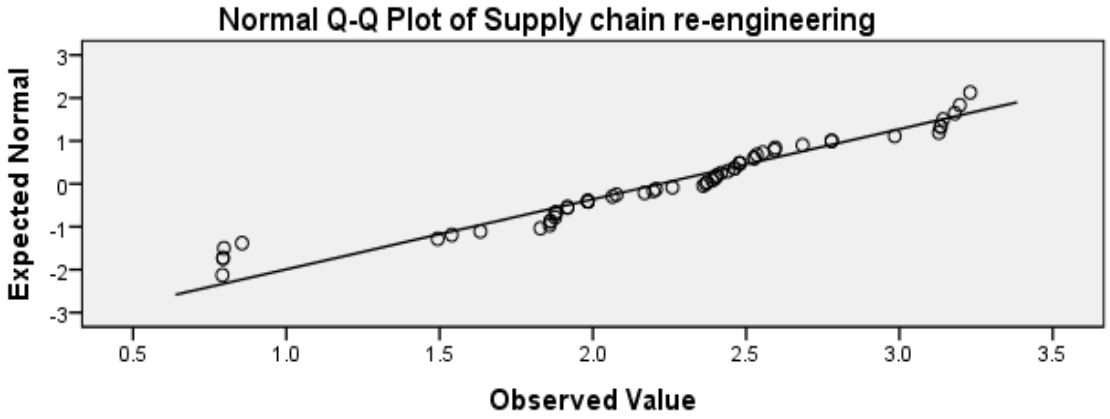

Figure 4.4: Q-Q plot of supply chain re-engineering

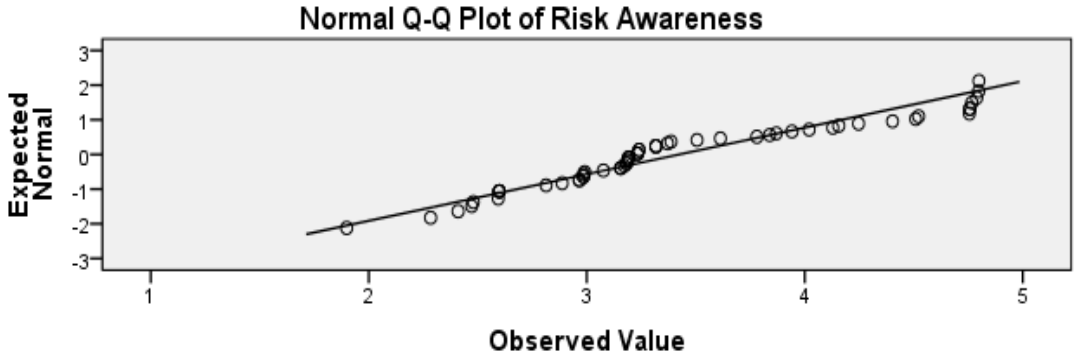

Figure 4.5: Q-Q plot of Risk awareness

4.6.3 Confirmatory Measurement Model

The first stage involved confirmatory factor analysis (CFA) that evaluates the measurement model on multiple criteria such as internal reliability, convergent, and discriminant validity. Prior to this was the exploratory factor analysis (EFA) whose key steps included the computation of factor loading matrix, communalities and principal components analysis (PCA).

a) Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) is used when you have a large set of variables that you want to describe in simpler terms and you have no *a priori* ideas about which variables will cluster together (Tabachnick & Fidell, 2013). Exploratory Factor Analysis is normally done at the early stages of research in order to identify the variables that cluster together (Bordens & Abbot, 2014) and it provides the researcher with information about the number of factors that best represents the data (Hair, Black & Babin, 2010).

Before conducting EFA, two statistical tests were performed to check suitability of data for structure detection, that is, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy indicates the proportion of variance in your variables that might be

caused by underlying factors, whereby high values (close to 1.0) generally indicate that a factor analysis may be useful with your data (Pallant, 2010).

Bartlett's Test of Sphericity tests the hypothesis that one‟s correlation matrix is an identity matrix, which would indicate that the variables are unrelated and therefore unsuitable for structure detection. Small values ($p < 0.05$) of the significance level indicate that a factor analysis may be useful with one‟s data. Table 4.26 indicates the results of the test for suitability of structure detection. It is evident that KMO value is 0.796 which is close to 1. This means factor analysis is suitable. With $p < 0.05$ in the Bartlett's Test of Sphericity, this is an indication of suitability of data for structure detection.

Table 4.26: Results of the test for Suitability of Structure Detection

KMO Measure of Sampling Adequacy	**Bartlett's Test of Sphericity**	
0.796	Approx. Chi-Square	430.530
	df	91
	Sig.	***0.000***

b) Pattern matrix

A pattern matrix, shown in Table 4.27, is a matrix containing the coefficients or "loadings" used to express the item in terms of the factors, that is, interpretation of factors (Rummel, 1970). The more the factors, the lower the pattern coefficients as a rule since there will be more common contributions to variance explained. Rummel further asserts that the pattern matrix loadings are zero when a variable is not involved in a

pattern and close to 1.0 when a variable is almost perfectly related to a factor pattern. In this study, the pattern matrix coefficients ranged from 0.584 to 0.916 thus showing variables are almost perfectly related to a factor pattern.

Table 4.27: Loadings and Cross-Loadings for the Measurement Model

Items	Strategic sourcing	Risk Awareness	Flexibility	Supply chain resilience	Supply chain Re-engineering
SS9	.857				
SS4	.830				
SS2	.818				
RA1		.916			
RA7		.847			
RA9		.738			
F8			.893		
F6			.859		
F7			.698		
BSCR3				.891	
BSCR1				.875	
BSCR8				.584	
SCR5					.828
SCR6					.817

Extraction Method: Principal Component Analysis.

Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 7 iterations.

c) Communalities

Communality values to measure the variability of each observed variable that could be explained by the extracted factors were checked (Field, 2009). A low value for communality, for instance, less than 0.3, could indicate that the variable does not fit well with other variables in its component, and it is undesirable (Pallant, 2010). Initial communalities are, for correlation analyses, the proportion of variance accounted for in each variable by the rest of the variables. Extraction communalities, on the other hand,

as shown in Table 4.28 are estimates of the variance in each variable accounted for by the factors in the factor solution. The extraction communalities for this solution are all greater than 0.647 and are acceptable as this means that the variables fitted well with other variables in their factor (Pallant, 2010).

Table 4.28: Communalities

Constructs	Items	Initial	Extraction
	BSCR1	1.000	.818
	BSCR3	1.000	.775
Supply chain resilience	BSCR8	1.000	.698
	F6	1.000	.874
	F7	1.000	.792
Flexibility	F8	1.000	.861
	RA1	1.000	.811
	RA7	1.000	.857
Risk Awareness	RA9	1.000	.647
	SCR5	1.000	.739
Supply chain Re-engineering	SCR6	1.000	.832
	SS2	1.000	.767
	SS4	1.000	.843
Strategic sourcing	SS9	1.000	.718

Extraction Method: Principal Component Analysis.

d) Principal Component Analysis

The goal of Principal Components Analysis (PCA) is to extract maximum variance from the data set with each component (Tabachnick & Fidell, 2013). Based Kaiser's criterion, five factors, out of a total 14 factors, were imputed. Amongst themselves, they were able to explain 78.8% of the total variance in the data. The five factors in the initial solution have eigenvalues greater than 1.08, with the threshold being eigenvalue greater or equal to 1.0 (Hair, Black, & Babin, 2010). The fewer the variables explaining more of the variability in the original variables, the better it is in ensuring that there is no redundant information (Hair et al., 2010). The result is shown in Table 4.29.

Table 4.29: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	4.598	32.845	32.845	4.598	32.845	32.845	3.020
2	2.012	14.369	47.214	2.012	14.369	47.214	2.840
3	1.896	13.544	60.757	1.896	13.544	60.757	2.820
4	1.446	10.328	71.085	1.446	10.328	71.085	2.687
5	1.080	7.715	78.800	1.080	7.715	**78.800**	2.528
6	.625	4.466	83.266				
7	.552	3.941	87.207				
8	.444	3.172	90.379				
9	.379	2.705	93.084				
10	.316	2.260	95.344				
11	.221	1.580	96.923				
12	.194	1.383	98.306				
13	.155	1.105	99.411				
14	.082	.589	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

e) Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA), a statistical technique used to verify the factor structure of a set of observed variables, allows the researcher to test the hypothesis that a relationship between observed variables and their underlying latent constructs exists as indicated in Figure 4.7.

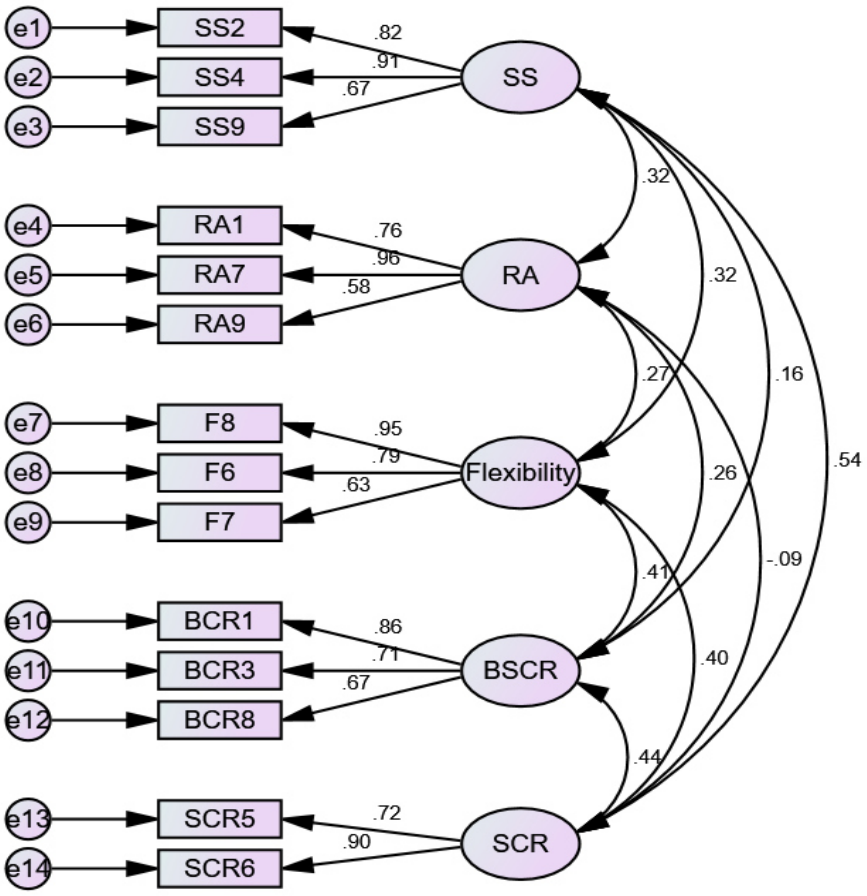

Figure 4.6: Confirmatory factor analysis measurement model

f) Convergent validity

Both convergent and discriminant validity are considered subcategories or subtypes of construct validity (Bahl & Wali, 2014). They work together such that if evidence for both convergent and discriminant validity can be demonstrated, then by definition there is evidence for construct validity. The convergent validity is the degree to which a set of variables converge in measuring the concept on construct and is confirmed using the items reliability, composite reliability and average variance extracted (Hair *et al*., 2010). If all the items are significantly important in measuring their constructs, composite reliability values are at least 0.7 and the average variance extracted (AVE) are at least 0.5 then the convergent validity can be confidently confirmed (Hair *et al*., 2010). Referring to Table 4.30, the composite reliability value of all the constructs exceeded the cut-off value of 0.7 and all the values of average variance extracted (AVEs) are more than 0.5. Thus, one can confirm that the measurement, outer, model possesses an adequate level of convergent validity.

Table 4.30: Convergent validity

Variables	Composite Reliability (CR)	Average Variance Extracted (AVE)
Supply chain resilience	0.796	0.569
Strategic sourcing	0.848	0.654
Risk Awareness	0.820	0.612
Flexibility	0.840	0.643
Supply chain Re-engineering	0.799	0.668

g) Discriminant validity

To establish discriminant validity, one needs to show that measures that should not be related are, in reality, not related. In correlation matrix illustrated in Table 4.31, the diagonal elements in bold are the square root of the average variance extracted (AVE) of all the latent constructs. The discriminant validity is assumed if the diagonal elements (in bold) are higher than other off-diagonal elements in their rows and columns (Compeau, Higgins, & Huff, 1999), hence demonstrating discriminant validity.

Table 4.31: Discriminant validity

Constructs	Supply chain resilience	Strategic sourcing	Risk Awareness	Flexibility	Supply chain Re-engineering	Average Variance Extracted (AVE)
Supply chain resilience	**0.754**					0.569
Strategic sourcing	0.160	**0.809**				0.654
Risk Awareness	0.258	0.321	**0.782**			0.612
Flexibility	0.406	0.319	0.266	**0.802**		0.643
Supply chain Re-engineering	0.443	0.543	-0.089	0.402	**0.817**	0.668

h) Chi-square goodness-of-fit test

Chi-square goodness of fit test was used to determine whether the model provided adequate fit for the data. Different fit statistical tests were used to assess whether overall models were acceptable and if acceptable, the researchers establish whether specific paths were significant Hu & Bentler, 1999). The criterion for acceptance of chi-square index ranges from less than 2 to less than 5 (Marsh, *et al*., 2011).

Other fit statistics were used to examine the fits since the chi-square goodness of fit statistics is overly sensitive to sample size (Schumacker & Lomax, 2004). Table 4.32 shows a Chi-Square statistics of 259.840 with an associated probability value of 0.000 which is greater than 0.05.

Table 4.32: Chi-square goodness of fit-test

Chi-square value	df	P-value
259.840	114	.000

4.6.4 Confirmatory Structural Model and Hypothesis Testing of the Study Variables

The second stage involved latent variables structural equation modeling (SEM) to test the hypothesized relationships and to fit the structural model. Structural equation modeling (SEM) is a very general, chiefly linear, chiefly cross-sectional statistical modeling technique (Schumacker & Lomax, 1996). Factor analysis, path analysis and regression all represent special cases of SEM. Structural equation modeling is largely a confirmatory, rather than exploratory, technique, and SEM software is typically used for performing confirmatory factor analysis (Jackson, Gillaspy & Purc-Stephenson, 2009).

In this study, SEM was used to test hypotheses and to fit the theoretical model. Each model variable was tested for outliers and normality on variables aspects. This was an exploratory data analysis (EDA) for understanding the structure of the variable before further data analyses undertaking. This helped in applying the appropriate analytical data analyses techniques to avoid crucial violations of key assumptions in consequent modeling processes. This was followed by model fit testing.

In structural equation modeling, the fit indices establish whether, overall, the model is acceptable, and if acceptable, researchers then establish whether specific paths are significant (Moss, 2009). Scholars such as Marsh, Balla, and Hau (1996), recommend that individuals utilize a range of fit indices. Yet others posit that although χ^2 is the traditional measure used in assessing overall model fit, it tends to be unreliable when sample sizes larger than 200 are used, and so alternative fit indexes could be used as

there is no agreement on the best single approach for evaluating model fits (Schumacker & Lomax, 2004). This study, apart from picking on five of the most widely respected and reported fit indices (Hooper *et al*., 2008), also considered the two types of fit statistics that are commonly used, that is, absolute fit indices and incremental fit indices (Hair *et al*., 2010). For absolute fit indices, the study picked on Goodness-of-Fit Index, and Root-Mean-Square Error of Approximation, and for incremental fit indices, Adjusted Goodness-of-Fit Index, Normed Fit Index and Comparative Fit Index. This study also examined their interpretive value in assessing model fit.

The Comparative Fit Index (CFI), one of the most popularly reported fit indices due to being one of the measures least effected by sample size, takes into account a sample size that performs well even when sample size is small (Tabachnick & Fidell, 2013). This index assumes that all latent variables are uncorrelated, that is, independent model and compares the sample covariance matrix with this independent model (Kline, 2005). The values for this statistic range between 0.0 and 1.0 with values closer to 1.0 indicating good fit. Indeed, a value of CFI greater than or equal to 0.95 is presently recognized as indicative of good fit (Hu & Bentler, 1999).

Goodness-of-Fit Index (GFI) is used to measure the amount of variance and covariance in the observed correlation matrix that is predicted by the model-implied correlation matrix. Values between 0.90 and 1.0 are indicated acceptable (Arbuckle & Wothke, 1999). Adjusted Goodness-of-Fit Index (AGFI) corrects the GFI, which is affected by the number of indicators of each latent variable. Values for the AGFI also range between 0 and 1.0 and it is generally accepted that values of 0.90 or greater indicate well-fitting models.

Root-Mean-Square Error of Approximation (RMSEA) assesses how poorly the model fits the data by considering the error of approximation, which concerns the lack of fit of the researcher's model to the population covariance matrix. Values up to 0.08 indicate reasonable fit to the data. If the samples are large, values of less than 0.10 are also acceptable (Byrne, 2001).

Hypothesis testing 1:

Influence of strategic sourcing on supply chain resilience manufacturing firms

The first specific objective of this study was to determine the influence of strategic sourcing on supply chain resilience in manufacturing firms in Kenya. Normality test on the factors produced Skewness values between -1 and +1. The outliers were tested for each of the observations, with observations farthest from the centroid, Mahalanobis distance, being taken into consideration. There were no outliers detected because the values obtained in testing the model fit indices were within the thresholds as shown in Table 4.33.

Table 4.33: Confirmatory factor analysis model fits of strategic sourcing

Model	CFI	GFI	AGFI	NFI	RMSEA
Default model	.978	0.944	0.924	0.924	0.079
Saturated model	1	1		1	
Independent model	0.000	0.561	0.385	0.00	0.384

Model Fit Indices for the Influence of strategic sourcing on supply chain resilience in manufacturing firms in Kenya showed that the Comparative Fit Index (CFI) value was 0.978 which is closer to 1.0 indicating good fit. Certainly, a value of CFI greater than or equal to 0.95 is presently recognized as indicative of good fit (Hu & Bentler, 1999). Goodness-of-Fit Index (GFI) had a value of 0.944 which is acceptable. Adjusted Goodness-of-Fit Index (AGFI) with a value of 0.924 and it was generally accepted because any values of 0.90 or greater indicate well-fitting models. Root-Mean-Square Error of Approximation (RMSEA) had a value of 0.079 which less than 0.08 thus indicating reasonable fit to the data and accepted (Byrne, 2001).

The hypothesis to test for this specific objective was:

> **H_1:** Strategic sourcing has a positive significant influence on supply chain resilience in manufacturing firms in Kenya.

Further, the study found out that there was a positive (regression weight=0.264) relationship between strategic sourcing and supply chain resilience in manufacturing firms. The regression weight for strategic sourcing was positive and significant with a t-value=2.02 (p-value<0.001) as shown in Table 4.34.

Table 4.34: Regression weight of strategic sourcing

			Unstandardized Estimate	standardised Estimate	S.E.	T-value	P-value
PM	<---	SS	0.313	0.264	0.154	2.027	0.047
SS2	<---	SS	1	0.807			
SS4	<---	SS	1.196	0.934	0.195	6.142	***
SS9	<---	SS	0.629	0.661	0.119	5.271	***
BSCR1	<---	BSCR	1	0.906			

BSCR3	<---	BSCR	0.785	0.705	0.180	4.370	***
BSCR8	<---	BSCR	0.499	0.629	0.122	4.101	***

N=59*p<0.1, **p<0.05; ***p<0.001 (two tailed)

This implies that for every 1 unit increase in strategic sourcing, performance of manufacturing firms in Kenya is predicted to increase by 0.264 units and therefore $H_1$is accepted. Therefore, strategic sourcing creates supply chain resilience of manufacturing firms in Kenya and managers should have sourcing strategy to assist them in designing and managing supply networks in line with the organizational performance objectives in order to create resilience. The finding of this study concurred with the study of Carla *et al*. (2014) who noted that strategic sourcing activities like collaboration, supplier relationships, supplier selection and supplier base had positive influence in achieving supply chain resilience in manufacturing firms. By managing them properly, managers would be able to develop good relationships with suppliers' and hence beneficial way to make strategic and effective decisions. Christopher and Peck (2004) found out that the fundamental principle of supply chain collaboration is the exchange of information and application of shared knowledge across the chain to decrease uncertainty.

A high level of collaboration work across the supply chains can significantly help to mitigate risk and thus creating supply chain resilience. Strategic sourcing can help the supply chain design (or supply chain configuration or even re-engineering) to reduce complexity and enhance the alignment of the flows throughout the supply chain (Carla *et al*., 2014).

a) Hypothesis testing 2:

Influence of supply chain re-engineering on supply chain resilienceof firms

The second specific objective of this study was to examine the influence of supply chain re-engineering on supply chain resilience in manufacturing firms in Kenya. Normality

test on the factors produced Skewness values between -1 and +1. The outliers were tested for each of the observations, with observations farthest from the centroid, Mahalanobis distance, being taken into consideration. There were no outliers detected because the values obtained in testing the model fit indices were within the thresholds as shown in Table 4.35.

Table 4.35: Confirmatory factor analysis model fits of supply chain re-engineering

Model	CFI	GFI	AGFI	NFI	RMSEA
Default model	.980	0.962	0.956	0.942	0.061
Saturated model	1	1		1	
Independent model	0	0.570	0.355	0.00	0.394

Model Fit Indices for the influence of supply chain re-engineering on supply chain resilience in manufacturing firms in Kenya. The Comparative Fit Index (CFI) value is 0.980 which is closer to 1.0 indicating good fit. Certainly, a value of CFI greater than or equal to 0.95 is presently recognized as indicative of good fit (Hu & Bentler, 1999). Goodness-of-Fit Index (GFI) had a value of 0.962 which is acceptable. Adjusted Goodness-of-Fit Index (AGFI) with a value of 0.956 and it is generally accepted because any values of 0.90 or greater indicate well-fitting models. Root-Mean-Square Error of Approximation (RMSEA) had a value of 0.061 which less than 0.08 thus indicating reasonable fit to the data and accepted (Byrne, 2001).

The hypothesis to test for this specific objective was:

> **H_2:** Supply chain re-engineering has a positive significant influence on supply chain resilience in manufacturing firms in Kenya.

In addition, the study found out that there was a positive (regression weight=0.445) relationship between supply chain re-engineering and supply chain resilience in manufacturing firms. The regression weight for supply chain re-engineering was positive and significant with a t-value=2.693 (p-value<0.001) as shown in Table 4.36.

Table 4.36: Regression Weights of Supply Chain Re-Engineering

			Unstandardized Estimate	standardised Estimate	S.E.	T-value	P-value
BSCR	<---	SCR	0.674	0.445	0.20	2.63	0.07
BSCR1	<---	BSCR	1	0.883			
BSCR3	<---	BSCR	0.812	0.710	0.10	4.72	***
BSCR8	<---	BSCR	0.531	0.653	0.18	4.44	***
SCR5	<---	SCR	1	0.757			
SCR6	<---	SCR	1.310	0.860	0.42	2.97	0.03

N=59*p<0.1, **p<0.05; ***p<0.001 (two tailed)

This implies that for every 1 unit increase in supply chain re-engineering, supply chain resilience in manufacturing firms in Kenya is predicted to increase by 0.445 units and hence $H_2$is accepted. Thus, supply chain re-engineering creates supply chain resilience in the manufacturing firms and managers should understand and have knowledge of supply chain processes to conceptualize, design and implement in order to improve resilience of firms. The finding of this study was in harmony with the study of Scholten, Scott and Fynes (2014) who noted that re-engineering capabilities had a positive influence in mitigating risk and hence building supply chain resilience of firms.

Re-engineering of supply chain channels during emergency enables processes that help to get aid to people or products to consumers effectively and efficiently while avoiding duplication efforts. This would help firms to establish processes enabling a network where resources and complementary skills can be used in the most effective and efficient way. Christopher and Peck (2004) found that building a resilient supply chain is essential and it requires top management support and risk awareness throughout the supply network. Supply chain re-engineering should be designed to optimize resilience.

It is a fundamental pre requisite for improved supply chain resilience in an understanding of the network that connects the business to its suppliers and suppliers and its downstream customers. Mapping tools can be used to assist in identifying bottlenecks items and critical paths e.g long lead-times, single sourcing and linkages where visibility is poor.

Ponomarov and Holcomb (2009) noted that supply chain re-engineering influence supply chain resilience of manufacturing firms positively and thus, resilience must be built into a supply chain in advance of a disturbance and incorporate readiness to enable an efficient and effective response. Robust supply chain strategies should be enhanced to prevent major disruptions. This can be achieved by adapting the chain's initial stable configuration and understanding of the network of all supply chain members to be aligned in the event of a disruption occurring (Tang, 2006; Wieland & Wallenburg, 2012; Juttner & Maklan, 2011; Christopher & Peck, 2004; Ponomarov & Holcomb, 2009).

b) Hypothesis testing 3:

Influence of operational flexibility on supply chain resilience in firms.

The third specific objective of this study was to establish the influence of operational flexibility on supply chain resilience in manufacturing firms in Kenya. Normality test on the factors produced Skewness values between -1 and +1. The outliers were tested for each of the observations, with observations farthest from the centroid, Mahalanobis distance, being taken into consideration. There were no outliers detected because the values obtained in testing the model fit indices were within the thresholds as shown in Table 4.37.

Table 4.37: Confirmatory factor analysis model fits of operational flexibility

Model	CFI	GFI	AGFI	NFI	RMSEA
Default model	.989	0.952	0.975	0.936	0.056
Saturated model	1	1		1	
Independent model	0.000	0.529	0.340	0.000	0.389

Model Fit Indices for the influence of operational flexibility on supply chain resilience in manufacturing firms in Kenya as the Comparative Fit Index (CFI) value is 0.989 which is closer to 1.0 indicating good fit. Certainly, a value of CFI greater than or equal to 0.95 is presently recognized as indicative of good fit (Hu & Bentler, 1999). Goodness-of-Fit Index (GFI) had a value of 0.952 which is acceptable. Adjusted Goodness-of-Fit Index (AGFI) with a value of 0.975 and it is generally accepted because any values of 0.90 or greater indicate well-fitting models. Root-Mean-Square Error of Approximation (RMSEA) had a value of 0.056 which less than 0.08 thus indicating reasonable fit to the data and accepted (Byrne, 2001).

The hypothesis to test for this specific objective was:

> **H_3:**Operational flexibility has a positive significant influence on supply chain resilience in manufacturing firms in Kenya.

Further, the study found out that there was a positive (regression weight=0.388) relationship between operational flexibility and supply chain resilience of manufacturing firms. The regression weight for flexibility was positive and significant with a t-value=2.705 (p-value<0.001) as shown in Table 4.38.

Table 4.38: Regression Weights of operational flexibility

			Unstandardized Estimate	standardised Estimate	S.E.	T-value	P-value
BSCR	<---	Flexibility	0.33	0.388	0.122	2.705	0.007

F8	<---	Flexibility	1	1.007			
F6	<---	Flexibility	0.572	0.75	0.1	5.749	***
F7	<---	Flexibility	0.521	0.598	0.114	4.568	***
BSCR1	<---	BSCR	1	0.891			
BSCR3	<---	BSCR	0.819	0.724	0.171	4.79	***
BSCR8	<---	BSCR	0.503	0.625	0.116	4.325	***

N=59*p<0.1, **p<0.05; ***p<0.001 (two tailed)

This implies that for every 1 unit increase in operational flexibility, supply chain resilience of manufacturing firms in Kenya is predicted to increase by 0.388 units and hence $H_3$is accepted. Therefore, flexibility creates supply chain resilience in the manufacturing firms in Kenya. Manufacturing firms in Kenya should have the ability to adapt to changing requirements of its environment and stakeholders shortest time possible. The finding of this study was in agreement with the findings of the studies reviewed in the literature. Christopher and Holweg (2011) asserted that operational flexibility creates supply chain resilience by enhancing prompt adaptability during turbulence. Jüttner and Maklan (2011) noted that sourcing flexibility can be considered a key enabler to resilience owing to the ability to shift cost-effective supply sources by choosing the cheapest source or strengthening the companies' bargaining power in price negotiations with their suppliers. Product flexibility enables a rapid change in product design by providing a range of products which will respond effectively in case of an immediate change (Yi *et al.*, 2011).

However, flexibility in order fulfillment will enable firms to quickly ramp up production to meet surge demand without carrying large amounts of excess capacity which is extremely profitable when facing unpredictable or seasonable demand (Pettit *et al.*, 2010). Also, backup capacity of the enablers of production, utilities such as electricity, water and communication are important in creating supply chain resilience of firms.

c) Hypothesis testing 4:

Influence of risk awareness on supply chain resilience in firms.

The fourth specific objective of this study was to analyse the influence of risk awareness on supply chain resilience in manufacturing firms in Kenya. Normality test on the factors produced Skewness values between -1 and +1. The outliers were tested for each of the observations, with observations farthest from the centroid, Mahalanobis distance, being taken into consideration. There were no outliers detected because the values obtained in testing the model fit indices were within the thresholds as shown in Table 4.39.

Table 4.39: Confirmatory factor analysis model fits of risk awareness

Model	CFI	GFI	AGFI	NFI	RMSEA
Default model	.995	0.948	0.902	0.959	0.037
Saturated model	1	1		1	
Independent model	0	0.371	0.327	0	0.437

Model Fit Indices for the influence of risk awareness on supply chain resilience in manufacturing firms in Kenya. The Comparative Fit Index (CFI) value is 0.995 which is closer to 1.0 indicating good fit. Certainly, a value of CFI greater than or equal to 0.95 is presently recognized as indicative of good fit (Hu & Bentler, 1999). Goodness-of-Fit Index (GFI) had a value of 0.948 which is acceptable. Adjusted Goodness-of-Fit Index

(AGFI) with a value of 0.902 and it is generally accepted because any values of 0.90 or greater indicate well-fitting models. Root-Mean-Square Error of Approximation (RMSEA) had a value of 0.037 which less than 0.08 thus indicating reasonable fit to the data and accepted (Byrne, 2001).

The hypothesis to test for this specific objective was:

> **H_4:** Risk awareness has a positive significant influence on supply chain resilience in manufacturing firms in Kenya.

Further, the study found out that there was a positive (regression weight=0.438) relationship between risk awareness and supply chain resilience of manufacturing firms. The regression weight for flexibility was positive and significant with a t-value=2.725 (p-value<0.001) as shown in Table 4.40.

Table 4.40: Regression Weights of risk awareness

			Unstandardized Estimate	standardized Estimate	S.E.	T-value	P-Value
BSCR	<---	RA	0.693	0.438	0.254	2.725	0.006
RA1	<---	RA	1	0.831			
RA7	<---	RA	0.947	0.836	0.179	5.299	***
RA9	<---	RA	0.717	0.612	0.164	4.381	***
BSCR1	<---	BSCR	1	0.865			
BSCR3	<---	BSCR	0.805	0.691	0.185	4.346	***
BSCR8	<---	BSCR	0.529	0.64	0.128	4.143	***

N=59*p<0.1, **p<0.05; ***p<0.001 (two tailed)

This implies that for every 1 unit increase in risk awareness, supply chain resilience of manufacturing firms in Kenya is predicted to increase by 0.438 units and hence $H_4$is accepted. Hence, risk awareness creates supply chain resilience in the manufacturing firms in Kenya. Managers of manufacturing firms in Kenya should make risk awareness as a formal part of decision making in order to understand and prevent common risks that could occur within operations to create resilience. The finding of this study concurred with the study of Jüttner and Maklan (2011) which stated, that monitoring supply risks had a positive impact on the supply chain visibility and resilience.

Therefore, to be resilient organizations need to develop appropriate management policies and actions that assess risk continuously and coordinate the efforts of their supply network (Kleindorfer & Saad, 2005). Supply chain partners must share a common understandings and awareness of the risks that could occur within their operations (Faisal *et al*., 2006). The capacity to learn from past disruptions to develop better preparedness for future events is a principal property of resilience (Ponomarov & Holcomb, 2009).

Consequently, leading companies provide training to employees, suppliers and customers about security and supply network risks raising awareness and reinforcing the importance of supply chain resilience (Blackhurst *et al*., 2011; Rice & Caniato, 2003).

4.6.5 Overall Structural model

Model Fit Indices for the enhancers for supply chain resilience on the performance of manufacturing firms in Kenya withthe Comparative Fit Index (CFI) value is 0.906 which is closer to 1.0 indicating good fit. Certainly, a value of CFI greater than or equal to 0.95 is presently recognized as indicative of good fit (Hu & Bentler, 1999). Goodness-of-Fit Index (GFI) had a value of 0.912 which is acceptable. Adjusted Goodness-of-Fit Index (AGFI) with a value of 0.932 and it is generally accepted because any values of 0.90 or greater indicate well-fitting models.

Root-Mean-Square Error of Approximation (RMSEA) had a value of 0.071 which less than 0.08 thus indicating reasonable fit to the data and accepted (Byrne, 2001). Thus, the fit statistics in Table 4.41 showed acceptable fit threshold levels, suggesting a good fit between the hypothesized model and the data.

Table 4.41: Model fit indices for CFA structural model

Model	CFI	GFI	AGFI	RMSEA
Default model	0.906	.912	.932	.071
Saturated model	1.000	1.000		
Independence model	0.000	.420	.331	.270

An overall structural equation model encompassing the measurement models and structural model was established by extending the hypothesized relationships among the latent variables, depicted graphically with straight one-headed arrows as shown in Figure 4.7

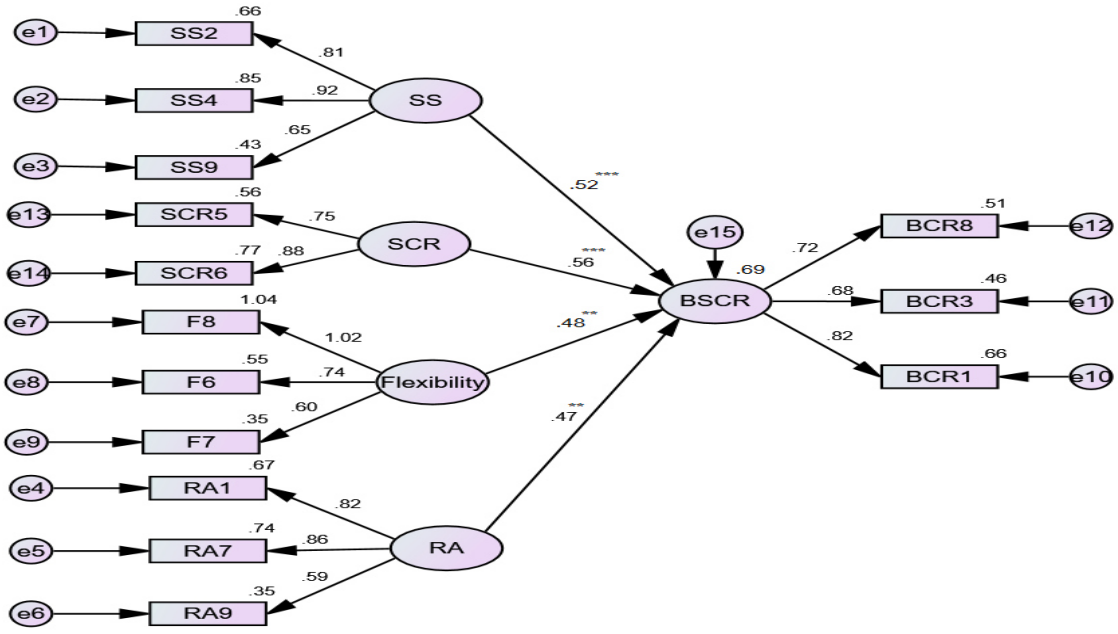

Figure 4.7: Structural Equation of Overall Model

In the hypothesized relationships, supply chain resilience was set as the dependent variable or endogenous latent variable. Four independent latent variables, that is, strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness were set as exogenous variables. The hypothesized structural equation model was tested using the maximum likelihood method and evaluated on the same fit criteria used in assessing the measurement models. All the regression weights for the variables were significant at (p-value<0.001). Further, the study found out that there was a positive relationship among strategic sourcing, supply chain re-engineering, operational flexibility, risk awareness and performance of manufacturing firms as shown in Table 4.42.

Table 4.42: Regression Weights of all independent and dependent variables

			Unstandardized Estimate	standardised Estimate	S.E.	T-value	P-value
BSCR	<---	SS	0.650	0.516	0.163	3.994	***
BSCR	<---	SCR	0.777	0.556	0.219	3.546	***
BSCR	<---	Flexibility	0.578	0.486	0.166	3.476	0.001
BSCR	<---	RA	0.725	0.471	0.221	3.282	0.001
SS2	<---	SS	1	0.81			
SS4	<---	SS	1.166	0.922	0.197	5.92	***
SS9	<---	SS	0.612	0.654	0.121	5.063	***
RA1	<---	RA	1	0.816			
RA7	<---	RA	0.994	0.862	0.181	5.505	***
RA9	<---	RA	0.71	0.595	0.165	4.308	***
F8	<---	Flexibility	1	1.017			
F6	<---	Flexibility	0.562	0.745	0.108	5.186	***
F7	<---	Flexibility	0.514	0.595	0.122	4.228	***
BCR1	<---	BSCR	1	0.815			
BCR3	<---	BSCR	0.831	0.676	0.176	4.726	***
BCR8	<---	BSCR	0.626	0.716	0.126	4.98	***
SCR5	<---	SCR	1	0.75			
SCR6	<---	SCR	1.347	0.876	0.342	3.943	***

N=59*p<0.1, **p<0.05; ***p<0.001 (two tailed)

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter provides a summary of the major findings of this study and also sets to draw conclusions and make recommendations for practice and suggestions for further research based on the results of this study.

5.2 Summary

The overall objective of this study was to investigate enhancers for supply chain resilience in manufacturing firms in Kenya. In particular the study sought to determine the influence of strategic sourcing on supply chain resilience in manufacturing firms in Kenya, to examine the influence of supply chain re-engineering on supply chain resilience in manufacturing, to establish the influence of operational flexibility on supply chain resilience in manufacturing firms in Kenya and to analyze the influence of risk awareness on supply chain resilience in manufacturing firms in Kenya.

5.2.1 Influence of Strategic Sourcing on Supply Chain Resilience

Strategic sourcing is a way of designing and managing supply networks in line with the organizations operational and performance objectives. In this study strategic sourcing was measured using collaborations; supplier base and criteria used in selecting suppliers. The study established that manufacturing firms in Kenya collaborate frequently with their key supply chain partners through the following platforms: sharing of information, synchronizing of decisions, aligning of incentives in a form of co-developing systems, sharing costs, risks and benefits, share resources and constant communication.

Also, it was determined that manufacturing firms in Kenya maintained smaller supplier base as an easy way of managing suppliers. Similarly, it was noted that manufacturing firms in Kenya had adopted multiple sourcing in order to create reliable delivery. Likewise, it was established that manufacturing firms in Kenya had various criteria of selecting suppliers and they included financial strength, quality of products, past performance, capacity production requirements and technology.

Moreover, the study found out that there was a positive significant linear relationship between strategic sourcing and supply chain resilience in manufacturing firms in Kenya. The study implied that there was a strong relationship between strategic sourcing and performance of manufacturing firms in Kenya. Thus, strategic sourcing through collaborating with key suppliers, maintaining manageable supply base and better criteria for selecting suppliers can create supply chain resilience in manufacturing firms in Kenya.

5.2.2 Influence of Supply Chain Re-Engineering on Supply Chain Resilience

Supply chain re-engineering is an act of conceptualization, design, implementation and operational of supply chains through supply chain knowledge understanding and supply strategy. In this study supply chain re-engineering was operationalized using supply chain knowledge, supply chain design and supply strategy. The study found that that manufacturing firms in Kenya used prior knowledge acquired in identifying high supply chain risk. However, few manufacturing firms in Kenya used mapping tools to identify bottlenecks and critical path in supply chain. Further, the study established that regarding to supply base strategy, manufacturing firms in Kenya adopted pro-active strategy of supplier developments such as working closely with their suppliers. But few manufacturing firms Kenya used risk awareness as key criteria for selecting suppliers.

Likewise, majority of manufacturing firms Kenya disagreed use single sourcing by product in order to keep alternative source of supply available and use single sourcing for multiple sites or branch outlets to gain advantages of single sourcing. Nevertheless, it was noted that manufacturing firms in Kenya chose supply chain strategies that kept lowest cost and reduced impact in disruptions. Similarly, it was established that manufacturing firms in Kenya maintained stakeholders to understand supply chain structures, but few manufacturing firms in Kenya trade-off between efficiency and redundancy stock.

In addition, the result showed that supply chain re-engineering had a positive significant linear relationship with the performance of manufacturing firms in Kenya using Pearson correlation coefficient. The study indicated that there was a positive correlation between supply chain re-engineering and supply chain resilience. Therefore, supply chain re-engineering creates supply chain resilience in manufacturing firms.

5.2.3 Influence of Operational Flexibility on Supply Chain Resilience

Operational flexibility is the ability of an organization to adapt to the changing requirements of its environment and stakeholders with minimum time and effort. In this study, flexibility was measured using the following indicators: production capacity, sourcing and order fulfilling. In regard to production capacity, it was established that manufacturing firms in Kenya had reliable back-up utilities such as electricity and water. Also, it was found that manufacturing firms in Kenya maintained access to duplicate or redundant facilities and equipment. Besides that, manufacturing firms in Kenya had significant excess capacity of materials, equipment and labour to quickly boost output if needed. Likewise, in regard to sourcing, it was found out that manufacturing firms in Kenya had alternative source of key inputs. But few manufacturing firms in Kenya who can easily modify to change specifications, qualities and terms of supply contracts.

In matters to do with order fulfillment, it was found out that manufacturing firms in Kenya can quickly increase capacity of storage and distribution services to satisfy their customers and few manufacturing firms in Kenya delayed final production of finished goods until close to the time that customers place orders. Likewise, few manufacturing firms in Kenya can quickly change the routing and mode of transportation for outbound shipment and reallocating of orders to alternate suppliers.

Further, the study showed that operational flexibility had a positive significant linear relationship with supply chain resilience of manufacturing firms in Kenya. This relationship was established by use of Pearson correlation coefficient and the study showed that there was a fairly positive relationship between operational flexibility and performance of manufacturing firms in Kenya. Hence, operational flexibility creates supply chain resilience resulting in high performance of the manufacturing firms in Kenya.

5.2.4 Influence of Risk Awareness on Supply Chain Resilience

Risk awareness is the process of making supply chain risk assessment a formal part of decision making process at every level. The study measured flexibility using the following indicators: assessment of risks, sharing risks with partners and training stakeholders. On risk assessment, the study established that manufacturing firms in Kenya frequently monitored supply risks such as quality and outsourcing risk, developed appropriate management policies to access risks and manufacturing firms in Kenya had continuity plans addressing major supply chains risks. On issues of sharing risks with partners, the study noted that manufacturing firms shared common understandings of risks with their partners, manufacturing firms in Kenya had capacity to learn from past disruptions to be prepared and manufacturing firms in Kenya employed a team which was dedicated to supply risk management.

Similarly on issues of training, the study showed that manufacturing firms in Kenya provided training of employees, suppliers and customers about security of risks, manufacturing firms in Kenya trained stakeholders to understand supply chain structures and manufacturing firms in Kenya had the ability to correct forecasted demand (customers, demand).

Moreover, risk awareness had a positive significant linear relationship with performance of manufacturing firms in Kenya. This relationship was established using Pearson correlation coefficient and the study indicated that there was a fairly positive relationship between risk awareness and performance of manufacturing firms in Kenya. Thus, risk awareness creates supply chain resilience in manufacturing firms.

5.3 Conclusion

From the study findings, it could be concluded that strategic sourcing had a positive significant influence on supply chain resilience in manufacturing firms. The study showed that there was a strong relationship between strategic sourcing and supply chain resilience of manufacturing firms and hence it could be concluded that if strategic sourcing is embraced by management of manufacturing firms, it would built supply chain resilience of firms in Kenya.

Also, based on the results of this study, it could be concluded that manufacturing firms in Kenya collaborate frequently with their key supply chain partners through the various platforms like sharing of information, synchronizing of decisions, aligning of incentives in a form of co-developing systems, sharing costs, risks and benefits, sharing of resources and constant communication. Likewise, it could be concluded that manufacturing firms in Kenya had adopted multiple sourcing in order to create reliable delivery and various criteria of selecting suppliers like financial strength, quality of products, past performance, capacity production requirements and technology.

Therefore, collaborations, supplier base and supplier selection forms the integral part of strategic sourcing and if well executed in the manufacturing firms in Kenya, it would create supply chain resilience of firms.

Regarding to supply chain re-engineering, it could be concluded that supply chain re-engineering had a positive significant linear relationship with the performance of manufacturing firms in Kenya using Pearson correlation coefficient. The study found out that supply chain re-engineering if adopted could increase supply chain resilience thereby increasing performance of the manufacturing firms in Kenya. Basing on the indicators used to measure supply chain re-engineering, from the findings it could be concluded that manufacturing firms in Kenya had acquired prior knowledge in identifying high supply chain risk, maintained stakeholders to understand supply chain structures, chose supply chain strategies that kept lowest cost and reduced impact in disruptions but lacked mapping tools to identify bottlenecks and critical path in supply chain which is key element in supply chain re-engineering. Besides that, manufacturing firms in Kenya lacked risk awareness as key criteria for selecting suppliers, trade-off between efficiency and redundancy stock and use of single sourcing by product in order to keep alternative source of supply available.

However, on the issue of operational flexibility, it could be concluded that operational flexibility had a positive significant linear relationship with the performance of manufacturing firms in Kenya. This relationship was established by Pearson correlation coefficient. The study revealed that there was a fairly positive relationship between flexibility and supply chain resilience of manufacturing firms.

Thus, operational flexibility would enable manufacturing firms to adapt to the changing requirements of its environment and stakeholders with minimum time and effort if adopted. From the study findings, it could be concluded that manufacturing firms in

Kenya had reliable production flexibility capacity of back-up utilities such as electricity and water, maintained access to duplicate or redundant facilities and equipment, significant excess capacity of materials, equipment and labour to quickly boost output if needed and alternative source of key inputs. In the issues of order fulfillment, it could be concluded that manufacturing firms in Kenya could quickly increase capacity of storage and distribution services to satisfy their customers and few.

However, few manufacturing firms in Kenya could delay final production of finished goods until close to the time that customers place orders and could quickly change the routing and mode of transportation for outbound shipment and reallocating of orders to alternate suppliers. Therefore, the study concludes that operational flexibility can create supply chain resilience in the manufacturing firms.

Lastly, it could be concludes that risk awareness had a positive significant linear relationship with the performance of manufacturing firms in Kenya. This relationship was established using Pearson correlation coefficient. The study inferred that there was a fairly positive relationship between risk awareness and the performance of manufacturing firms in Kenya. Therefore, if risk awareness is made a formal part of making decisions at every stage, manufacturing firms in Kenya could increase supply chain resilience and then translating to high performance. Also, the study concludes that manufacturing firms in Kenya frequently monitored supply risks such as quality and outsourcing risk, developed appropriate management policies to access risks and continuity plans addressing major supply chains risks.

It could also be concludes that manufacturing firms in Kenya shared common understandings of risks with their partners, employed a team which was dedicated to supply risk management and provided training of employees, suppliers and customers about security of risks as a way of risk awareness in manufacturing firms.

Based on the study findings, it also be concluded that manufacturing firms in Kenya train stakeholders to understand supply chain structures and had the ability to correct forecasted demand (customers, demand). Thus, the study concludes that risk awareness can create supply chain resilience of firms.

5.4 Recommendations

The study made the following recommendations:

5.4.1 Managerial Recommendations to the Manufacturing Firms

The study established that strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness influence positively the performance of manufacturing firms in Kenya. Therefore, the study recommends it would be appropriate for management to adopt strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness as a way of creating supply chain resilience in order to increase performance of manufacturing firms. These enhancers are important for creating the resilience capability within the manufacturing firms in Kenya or along their supply chains to overcome critical disruptions as well as daily outages to increase performance of firms. Thus, the study recommends particularly to the management to be proactive in developing resilience in their organizations as preventive measure against disruptions which cause massive losses when they occur in the firms.

Also, the study recommends for the management of the manufacturing firms in Kenya to adopt the supply chain resilience conceptual framework which has been developed and translated theory into practical guidance for managers. This conceptual framework provides specific enhancers for creating supply chain resilience in manufacturing firms' and approaches that develop the adaptive capabilities to prepare for, respond to and recover from a disruption. This framework would allow management of manufacturing firms in Kenya to direct and prioritize resources accordingly and reduce the vulnerability of the supply chain for unforeseeable events in the manufacturing firms.

In addition, the study recommends that it would be appropriate for management to adopt strategic sourcing approach when procuring strategic or critical items as strategic sourcing would create supply chain resilience in the manufacturing firms which in turn increase the performance of firms. Strategic sourcing can be achieved through collaborating frequently with their key supply chain partners in matters to do with sharing of information, synchronizing of decisions and aligning of incentives. Likewise, the study recommends for managers in the manufacturing firms to adopt multiple sourcing in order to create reliable delivery to the manufacturing firms.

Based on the study findings, it was noted that supply chain re-engineering had a positive influence on the performance of manufacturing firms in Kenya. But some manufacturing firms in Kenya lacked mapping tools to identify bottlenecks and critical path in supply chain and risk awareness as key criteria for selecting suppliers, trade-off between efficiency and redundancy stock. Therefore, the study recommends that it would be appropriate for management of manufacturing firms in Kenya to embrace supply chain re-engineering as a way of building supply chain resilience of firms.

Similarly, from the findings of the study risk awareness should be made a formal part of decision making at every stage within manufacturing firms as a way of increasing supply chain resilience and eventually high performance of firms. Thus, the study recommends that it would be appropriate for management of manufacturing firms in Kenya to develop and adopt appropriate management policies to access risks and continuity plans to address major supply chains risks. This can be achieved by understanding of risks with their partners, employ a team which is dedicated to supply risk management and provided training of employees, suppliers and customers about security of risks as a way of risk awareness in manufacturing firms.

5.4.2 Recommendations to the Policy Makers

The Government of Kenya considers manufacturing firms in particular a key pillar of its growth strategy. Therefore, the study recommends it would be appropriate for the government to collaborate with manufacturing firms. In particular this study provides and offer descriptive insights on how the interaction between manufacturing firms in Kenya and government/regulatory bodies like Kenya Bureau of standards by constantly sharing vital inform on how come up with policies which would benefits both manufacturing firms and government.

Also, the study recommends to the regulatory body like Kenya Association of Manufacturers to work and collaborate with manufacturing. This can be done through aligning incentives in a form of co-developing systems, sharing costs, risks and benefits, sharing of resources and constant communication with the manufacturing firms. Likewise the study recommends to the government of Kenya to work in harmony with manufacturing firms in areas training of employees, suppliers and customers about security of risks and stakeholders to understand supply chain structures and the ability to correct forecasted demand such as customers, demand. Lastly, manufacturing firms should highlight current pitfalls in regulations like high and double taxation, harmonization of quality standards and security threats like terrorism. This would enable the government to reap 20% of GDP from manufacturing firms in order to achieve Kenya Vision 2030.

5.4.3 Recommendations for Stakeholders

From the study, it was indicated that the environment that business operate is dynamic and keeps on changing. This makes resilience a volatile phenomenon that is difficult to achieve. Thus, the study recommends it would be appropriate for manufacturing firms, community, government and other business enterprises to adopt supply chain resilience as a way of establishing resilient supply chains in the manufacturing for any eventuality.

This can be done by use of enhancers for supply chain resilience since they takes precaution right at the beginning to prevent disruption from occurring and if it occurs, these enhancers can be able to respond and recover any further damage that may be caused and finally continue to grow better than it were. Some of the enhancers have been discussed in the study such as strategic sourcing, supply chain re-engineering, operational flexibility and risk awareness.

5.5 Areas for Further Research

The study was confined to a literature review that only proposes strategic supply chain, supply chain re-engineering, flexibility, risk awareness and the theories that supports these four variables. Thus, empirical work that actually demonstrates the whole of supply chain resilience is beyond the scope of four enhancers identified in the study. Therefore, similar study can be conducted using different enhancers to implement supply chain resilience in manufacturing firms. Similarly, the data was collected from single informant representatives of each participating firms and this may be biased. This study recommends improving the data, a similar research to be conducted from multiple informants groups to come up with a variety of outcomes by creating discussion among supply chain managers with different skill, experience and motivation.

Also, the study was conducted in various manufacturing sectors in Kenya which were classified into 14 subsectors. This study recommends conducting multiple case studies in manufacturing firms from a single sector like automotive industry and technology sector which are embedded in a very uncertainty and dynamic market will be quite interesting. Likewise, the study adopted cross-sectional research design which was limited to point-in-time assessment. Therefore, future research can be conducted using longitudinal so as the research to identify the evolution of resilient strategies across number of years.

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APPENDICES

Appendix i: Letter of Introduction

Date: …….

To …….

Dear Sir/Madam,

RE: COLLECTION OF RESEARCH DATA

I am a student at Jomo Kenyatta University of Agriculture & Technology (JKUAT) pursuing a Ph.D in Supply chain management. I am carrying out a research on "*Enhancers for supply chain resilience in manufacturing firms in Kenya*". I am in the process of gathering relevant data for the purpose of this study. You have been identified as one of the collaborators and a key respondent in this study and I would like to kindly invite you to participate in my PhD research. I therefore write to request for your invaluable assistance towards making this study a success by taking time off your busy schedule to respond to the attached questionnaire.

The information collected and used in the PhD Dissertation will be kept strictly confidential, and you will remain completely anonymous throughout data processing. The final report will be made available to you once all analyses are completed. It will be appreciated if you can fill the questionnaire within the next one week to enable early finalization of the study. I thank you very much in advance for your consideration, time and responses. Thank you

Yours sincerely,

Arani Wycliffe

Appendix ii: Letter of Authorization

Date: …….

To Executive Director

……..

……..

NAIROBI

Dear Sir/Madam,

RE: ACADEMIC RESEARCH DATA: "ENHANCERS FOR SUPPLY CHAIN RESILIENCE IN MANUFACTURING FIRMS IN KENYA"

I am a student at Jomo Kenyatta University of Agriculture & Technology (JKUAT) pursuing a Ph.D in Supply chain management. I am required to undertake a thesis whose title is as indicated above as partial fulfillment for the award of the doctoral degree. I am kindly requesting for your assistance in making my research a success by granting permission to collect relevant data of your organization from your Head of Supply Chain Division. I would like to assure your office that all the data collected will be treated with utmost confidentiality and will be used exclusively for the purposes of this academic research.

I am looking forward to your kind consideration and at the same time wishing your esteemed organization success in all your endeavors.

Yours sincerely,

Arani Wycliffe

Appendix iii: Questionnaire

This questionnaire seeks to investigate the enhancers for supply chain resilience in manufacturing firms in Kenya. In particular, it will involve aspects of strategic sourcing, supply chain re-engineering, flexibility and risk awareness.

Note

(a) All responses will be treated in the strictest confidence

(b) If you would like a copy of the findings please supply name and address for receipt of your copy of the findings.

(c) Alternatively, if you would prefer your responses to remain completely anonymous, put only an email address in the address section. Please tick, (√), using copy & paste, where appropriate.

Name:

Address:

PART A: Organizational Data

Please provide the following information regarding your organization.

1. Company name _____

2. Type of manufacturing sector in which your company falls (tick as appropriate)

a. Metal and Allied [ ]
b. Pharmaceuticals [ ]
c. Textile [ ]
d. Building [ ]
e. Food, Beverage [ ]

f. Chemical [ ]
g. Energy [ ]
h. Plastic [ ]
i. Wood products [ ]
j. Leather [ ]
k. Motor [ ]
l. Paper [ ]
m. Fresh produce [ ]
n. Service consultancy [ ]

3. Ownership of company (tick one)

a. Locally [ ]
b. Foreign [ ]
c. Foreign and local [ ]

4. Markets served (tick)

a. Domestic markets only [ ]
b. Foreign markets only [ ]
c. Domestic and foreign [ ]

5. Number of years the organization has been in operation in Kenya

a. Less than 5 years [ ]
b. 6 to 10 years [ ]
c. 11 to 15 years [ ]
d. 16 to 20 years [ ]
e. More than 2o years [ ]

PART B

Strategic sourcing

Please indicate the extent to which of the following strategic sourcing issues are implemented for supply chain resilience in your firm. Please record your answer by ticking in the spaces provided, by the scale indicator (1=not at all, 2=small extent, 3=moderate, 4=large extent, 5=very large extent)

Strategic sourcing	1	2	3	4	5
Collaborations					
a) We frequently share information with our supply chain partners					
b) We synchronize decisions with our supply chain partners (planning, operations that optimize benefits					
c) We align incentives with our supply chain partners (co-developing systems, sharing costs, risk and benefits)					
d) We share resources with our supply chain partners (leveraging capabilities, resources and assets)					
e) We have collaborative communication with our supply chain partners					
f) We have joint knowledge creation with our partners (better understanding of markets competitors)					
Supplier base					
g) We maintain small supplier base to be able to manage					
h) We have adopted multiple sourcing to create reliable delivery					

Criteria selection of suppliers					
i) We select suppliers basing on financial strength					
j) We select suppliers basing on quality of products they offer					
k) We select suppliers basing on the past performances					
l) We select suppliers basing on the capacity to production requirements					
m) We select suppliers basing on technology adopted by supplier					

Please suggest how strategic sourcing is implemented for building supply chain resilience in the manufacturing firm.

……

……

……..

Supply Chain Re-engineering

Please indicate the extent to which of the following supply chain re-engineering issues are created within your firm in order to build supply chain resilience. Please record your answer by ticking in the spaces provided, by the scale indicator (1=not at all, 2=small extent, 3=moderate, 4=large extent, 5=very large extent)

Supply chain re-engineering	1	2	3	4	5
Supply chain mapping					
a) We use mapping tools knowledge to identify bottlenecks and critical path in supply chain (long lead time)					
b) We use knowledge to identify high supply chain risk (demand, process control & environment)					
Supply base strategy					
c) We adopt pro-active strategy of supplier development(working closely with suppliers)					
d) We use risk awareness as key criteria for selecting suppliers					
e) We use single sourcing by product in order to keep alternative source of supply available					
f) We single source for our multiple sites/branch outlets to gain advantages of single sourcing					
Supply chain design principle					
g) We choose supply chain strategies that keep lowest cost, reduce impact in disruptions					
h) We train stakeholders to understand supply chain structures					
i) We trade-off between efficiency and redundancy stock					

Please suggest how your firm can create effective supply chain re-engineering in order to build supply chain resilience……
……

Operational flexibility

Please indicate the extent to which of the following flexibility issues are implemented within your firm in order to build supply chain resilience. Please record your answer by ticking in the spaces provided, by the scale indicator (1=not at all, 2=small extent, 3=moderate, 4=large extent, 5=very large extent)

Flexibility	1	2	3	4	5
Production capacity					
a) We have reliable back-up utilities (electricity, water)					
b) We maintain access to duplicate or redundant facilities and equipment					
c) We have significant excess capacity of materials, equipment and labour to quickly boost output if needed					
Flexibility sourcing					
d) We have alternative sources of key inputs					
e) Our supply contracts can be easily modified to change specifications, qualities and terms					
Flexibility in order fulfillment					
f) We can quickly increase capacity of storage and distribution services					
g) We currently delay final production of finished goods until close to the time that customers place orders					
h) We can quickly change the routing and mode of transportation for outbound shipment					
i) We can quickly reallocate orders to alternate suppliers					

Please suggest how your firms can employ flexibility measures in order to build supply chain resilience.

……
……
…….

Risk Awareness

Please indicate the extent to which of the following risk awareness issues are handled within the manufacturing firm in order to build supply chain resilience. Please record your answer by ticking in the spaces provided, by the scale indicator (1=not at all, 2=small extent, 3=moderate, 4=large extent, 5=very large extent)

Risk awareness	1	2	3	4	5
Risk assessment of supply chain risks					
a) We frequently monitor supply risks (quality, outsourcing risk)					
b) We develop appropriate management policies to assess risk					
c) We have continuity plans addressing major supply chain risks					
Sharing risks of supply chain risks					
d) We share a common understandings of risk					
e) We have capacity to learn from past disruptions to be prepared					
f) We employ a team which is dedicated to supply risk management					
Training stakeholders on supply chain risks					
g) We provide training to employees, suppliers &customers about security of risks					
h) We train stakeholders to understand supply chain structures					
i) We have the ability to correctly forecast demand (customers, demand)					

Please suggest how your firm can employ effective risk awareness in order to build supply chain resilience

……
……
……..

Supply chain resilience

Please rate supply chain resilience of your company using the following indicators given.Record your answer by ticking in the spaces provided, by the scale indicator (1=not at all, 2=small extent, 3=moderate, 4=large extent, 5=very large extent)

Supply chain resilience	1	2	3	4	5
Customer service					
a) Representatives of our firm communicate effectively with customers					
b) Our firm has strong, long term relationships with customers					
c) Our brands have excellent customer recognition and strong reputation for quality					
d) We respond to customer complaint in time					

Profitability

For each of the following profitability performance measures, please indicate your outcome during the past 5 years

	profitability indicator	**2011**	**2012**	**2013**	**2014**	**2015**
a)	Sales revenue					
b)	Operational cost					
c)	Total assets					

Growth of market share

What % growth in market share would you associate with growth of market for the last three years in your manufacturing firm?

Year	**Growth of market share (%)**				
	Less than 10	10-20	20-30	30-40	More than 40
2013					
2014					
2015					

Appendix iv: List of Manufacturing Firms in Kenya

NO.	NAME	LOCATION
	Food & Beverages	
1	Nairobi Bottlers Ltd	Nairobi
2	East African Breweries Ltd	Nairobi
3	East African Malt Ltd	Nairobi
4	Nestle Foods Kenya Ltd	Nairobi
5	New Kenya Co-operative Creameries Ltd	Nairobi
6	Brookside Diary Ltd	Thika
7	Kenafric Bakery	Ruiru
8	Belat Enterprises	Athi-River
9	Cadbury Kenya Ltd	Nairobi
	Buildings & Construction	
10	Bamburi Cement Ltd	Nairobi
11	Flamingo Tiles (Kenya) Ltd	Nairobi
	Chemical & Allied	
12	Basco Products (K) Ltd	Nairobi
13	Carbacid (CO2) Ltd	Nairobi
14	Cooper K- Brands Ltd	Nairobi
15	Chemicals and Solvents (EA) Ltd	Nairobi
16	Haco Tiger Brands (E.A) Ltd	Nairobi
17	Henkel Kenya Ltd	Nairobi
18	Galaxy Paints & Coating Co. Ltd	Nairobi
	Energy, Electricals & Electronics	
19	Aucma Digital Technology Africa Ltd	Nairobi
20	Daima Energy services Ltd	Nairobi
21	East African Cables Ltd	Nairobi
22	Kenya power Ltd	Nairobi
	Plastics & Rubber	
23	Polythene industries Ltd	Nairobi
24	Kenpoly Manufacturers ltd	Nairobi
25	Kentainers Ltd	Nairobi
26	Elson Plastics of Kenya Ltd	Nairobi
27	General Plastics Ltd	Nairobi

28	Nairobi Plastics Ltd	Nairobi
	Textile & apparels	
29	Kenya Trading (EPZ) ltd	Nairobi
30	Kikoy Co. Ltd	Nairobi
	Wood, Timber & Furniture	
31	Kenya wood Ltd	Nairobi
32	Shamco industries	Nairobi
	Pharmaceuticals & Medical Equipment	
33	Dawa Ltd	Nairobi
34	Glaxo Smithkline Kenya Ltd	Nairobi
	Metal & Allied	
35	Allied East Africa Ltd	Nairobi
36	Apex steel Ltd	Nairobi
37	Corrugated Sheets Ltd	Nairobi
38	East Africa Glassware Mart Ltd	Nairobi
39	General aluminum Fabricators Ltd	Nairobi
	Leather & Footwear	
40	Budget Shoes Ltd	Nairobi
	Motor Vehicle & accessories	
41	General Motor East Africa Ltd	Nairobi
42	Toyota Kenya Ltd	Nairobi
43	Master Fabricators Ltd	Nairobi
	Paper and Board	
44	Carton manufacturers Ltd	Nairobi
45	East African Packaging Industries Ltd	Nairobi
46	Colour Packaging ltd	Nairobi
47	Brand Printers Ltd	Nairobi
48	Bags & Balers Manufacturers (K) Ltd	Nairobi
49	Essential Manufacturing	Nairobi
	Service & consultancy	
50	Access Alliance Ltd	Nairobi
51	Deloitte	Nairobi
52	City Clock (K) Ltd	Nairobi

53	East African development bank	Nairobi
54	Express Kenya Ltd	Nairobi
55	Insight management Consultants Ltd	Nairobi
56	Nokia Siemens Networks Kenya Ltd	Nairobi
57	Techno Brain Ltd	Nairobi
58	Kenya Fire appliances Co. Ltd	Nairobi
	Fresh Produce	
59	Mahee Flowers	Nairobi

Source: Adopted from KAM (2015)

Appendix V: Key Table

Item	Description
SS1	we frequently share information with our supply chain partners
SS2	We synchronise decisions with our supply chain partners (planning ,operations that optimise benefits)
SS3	we align incentives with our supply partners (co-developing systems ,sharing costs , risks and benefits)
SS4	we share resources with our supply partners (leveraging capabilities , resources and assets)
SS5	we have collaborative communication with our supply chain partners
SS6	we have joint knowledge creation with our partners (better understanding of markets competitors)
SS7	we maintain small supplier base to be able to manage
SS8	we have adopted multiple sourcing to create reliable delivery
SS9	we select suppliers basing on the financial strength
SS10	we select suppliers basing on quality of products they offer
SS11	we select suppliers basing on the spat performances
SS12	we select suppliers basing on the capacity to production requirements
SS13	we select suppliers basing on the technology adopted by supplier
SCR1	we use mapping tools knowledge to identify bottlenecks and critical path in supply chain (long lead time)
SCR2	we use knowledge to identify high supply chain risk (demand process control and environment)
SCR3	we adopt pro-active strategy of supplier developments (working closely with suppliers)
SCR4	we use risk awareness as a key criteria for selecting suppliers
SCR5	we use single sourcing by product in order to keep alternative source of supply available
SCR6	we single source for multiple sites / branch outlets to gain advantages of single sourcing

SCR7	we choose supply chain strategies that keep lowest cost , reduce impact in disruptions
SCR8	we maintain stakeholders to understand supply chain structures
SCR9	we trade-off between efficiency and redundancy stock
F1	we have reliable back-up utilities (electricity and water)
F2	we maintain access to duplicate or redundant facilities and equipment
F3	we have significant excess capacity of materials , equipment and labour to quickly boost output if needed
F4	we have alternative source of key inputs
F5	our supply contracts can be easily modified to change specifications , qualities and terms
F6	we can quickly increase capacity of storage and distribution services
F7	we currently delay final production of finished goods until close to the time that customers place orders
F8	we can quickly change the routing and mode of transportation for outbound shipment
F9	we can quickly relocate orders to alternate suppliers
RA1	we frequently monitor supply risks (quality , outsourcing risk)
RA2	we develop appropriate management policies to access risk
RA3	we have continuity plans addressing major supply chains risks
RA4	we share a common understandings of risk
RA5	we have capacity to learn from past disruptions to be prepared
RA6	we employ a team which is dedicated to supply risk management
RA7	we provide training of employees , suppliers and customers about security of risks
RA8	we train stakeholders to understand supply chain structures
RA9	we have the ability to correct forecast demand (customers, demand)
PM1	representatives of our firms communicate effectively with customers
PM2	our firm has strong , long term relationships with customers
PM3	our brands have excellent customer recognition and strong reputation for

	quality
PM4	we respond to customer complaint in time
PM5	we sell our products at high relative margin
PM6	our products command a significant share of the market
PM7	our customers are very loyal to our products
PM8	we have significant financial reserve to cover all potential needs
PM9	our financial portfolio is very diverse
PM10	we insure our facilities , equipment's , goods and personnel

Appendix vi: Multivariate testing of outliers for the dependent variable