ENHANCERS FOR BUILDING SUPPLY CHAIN RESILIENCE IN MANUFACTURING FIRMS IN KENYA

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ABSTRACT

In Kenya, the manufacturing sector is important and it makes a substantial contribution to the country's economic development. But in recent years, the sector's contribution to gross domestic product (GDP) has worsened due to unforeseen disruptions like workers strikes, terrorist activities, draught incidences, volatility in international oil prices and high cost of production. Therefore, the biggest challenge for the manufacturing sector is on how to deal with unexpected disruptions in order to build supply chain resilience. Thus, the general objective of this study is to investigate enhancers for building supply chain resilience in manufacturing firms in Kenya. The study will adopt cross-sectional survey design using both quantitative and qualitative approaches. The target population will be 613 manufacturing firms in Nairobi and its surroundings, who are members of Kenya Association of Manufacturers (KAM). The study will use stratified random sampling to pick a sample size of 62 manufacturing firms which represents 14 industrial sectors in manufacturing firms. Data will be collected using questionnaire. Descriptive statistics will be used aided by Statistical Packages for Social Sciences version 21 to compute percentages of respondents' answers. Inferential statistics using linear regression and correlation analysis will be applied to assist examining relationship between the research variables.

Key Words: *Enhancers, Supply Chain, Resilience*

INTRODUCTION

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: every business activity has an inherent risk of unexpected disturbances that can lead to financial losses and in some cases firm closures (Skipper & Hanna, 2009; Scholten & Fynes 2014). Building supply chain resilience can help to reduce and overcome exposure (vulnerability) to risks through developing strategies that enable the supply chain to recover to its original (or an improved) functional state following a disruption (Juttner & Maklan, 2011).

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, 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).

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 (2004b) 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 (Skipper & Hanna, 2009) 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).

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 draughts experienced in 2010 resulted to reduced availability of raw materials (Kenya Association of Manufacturers, 2012). These unforeseen disruptions are an indication that the Kenya manufacturing firms suffers from 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 fails to address the methodology on how these recommendations should be achieved.

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).

According to 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) recommends 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 recommendations by Tourism Act of 2011 has been fully implemented and do not offer solutions to supply chain disruptions which are unforeseen.

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. These 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.

Overview of 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. Kenya Vision 2030 identifies 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 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.

Statement of the Problem

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 *et al*., 2015). 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). In Kenya, the manufacturing sector is important and it makes a substantial contribution to the country's economic development. According to the Kenya Vision 2030 (Government of Kenya, 2007) the manufacturing sector is expected to play a key role in the growth of the Kenyan economy by contributing 20 percent. The 2008-2012 medium term plans' overall goal of the sector was to increase its contribution to the gross domestic product (GDP) by at least 10 percent per annum (Waiganjo, 2013). The manufacturing sector is currently employing 240, 000 people, which represents 13 percent of total employment with an additional 1.6 million people employed in the informal side of the industry (KAM, 2015).

Despite the accrued benefits from the manufacturing sector in Kenya, they are yet to account 20 percent of the GDP as stipulated in the Kenya Vision 2030 (Bolo & Wainaina, 2011; KAM, 2012; KNBS, 2013; Waiganjo, 2013). The manufacturing sector's contribution to GDP has remained at an average of 10 percent for more than ten years (KNBS, 2015). For example, KAM, (2012); KNBS, (2013) found out that the Kenya 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, uncertainties due to the 2013 general elections, influx of counterfeits and volatility in international oil prices continued to affect the performance of the sector (KNBS, 2015; ROK, 2013). 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, Bello, Jimoh, & Umar, 2011). Furthermore, 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, and to bribery, corruption and other unethical business practices.

Moreover, these unforeseen disruptions are not only affecting manufacturing firms in Kenya but also all businesses globally. For instance, the global business environment has changed and is currently subjected to a multitude of events from a variety of sources, such as natural disasters, social conflicts, economic crises and manufacturing failures (Giunipero *et al*., 2015). In 2013, 75 per cent of companies experienced at least one disruption, of which 21 per cent suffered more than €1 million in costs for a single incident ranging from equipment malfunctions, unforeseen discontinuities in supply and information technology breakdowns to natural hazards and disasters (Business Continuity Institute, 2013). Therefore, the biggest challenges to the manufacturing firms are on how to deal with these unforeseen disruptions.

The role of supply chain resilience in Kenyan manufacturing firms remains unexplored and there is lack of a guiding framework on how manufacturing firms should embrace and build sound supply chain resilience. Majority of the studies on supply chain resilience however, have been carried out in developed countries (Benjamin, Mark, Jerry & Marta, 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.

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 (Benjamin *et al*., 2015; Chika, Bello, Jimoh & Umar, 2011). Thus, 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. To address this gap, this research seeks to investigate enhancers for building supply chain resilience in manufacturing firms in, Kenya.

Objectives of the study

General objective of the study

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

Specific Objectives

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

Research Hypothesis

H01: Strategic sourcing has no influence on building supply chain resilience in manufacturing firms in Kenya.

H02: Supply chain re-engineering has no influence on building supply chain resilience in manufacturing firms in Kenya.

H03: Flexibility has no influence on building supply chain resilience in manufacturing firms in Kenya.

H04: Risk awareness has no influence on building supply chain resilience in manufacturing firms in Kenya.

Scope of the study

The study will only investigate manufacturing firms, which are only located in Nairobi and its surrounding area. Most of the manufacturing firms are located in Nairobi region. Based on the available data, more than 80% of manufacturing firms are located in the Nairobi and its surrounding area (KAM, 2015).

LITERATURE REVIEW

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, several theories and models of supply chain resilience are discussed and how they interact with supply chain management theories and models.

Systems Theory

Organizations are systems that are open and therefore are influenced by and interact with the external environment (Bertalanffy, 1951; Katz & Kahn 1978). Supply chains are composed of nodes that are interconnected to form networks by the physical flow of materials and these networks must be managed properly to ensure smooth flow of materials from suppliers into the manufacturing plant and eventually distribution of finished products to the consumers. Systems theory is an intuitive and widely used theoretical base in supply chain literature (Frankel, Bolumole, Eltantawy, Paulraj & Gundlach, 2008; Manuj & Mentzer, 2008b; Skipper, Craighead, Byrd & Rainer, 2008). As open systems, organizations rely on a steady flow of inputs that originate and are extracted from the environment to sustain their operations. Therefore, manufacturing firms cannot operate in isolation of environmental inputs. Through the environment, organizations are able to draw its inputs in order to process them into finished goods and services.

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 supply chain, 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.

Within the supply chain disruption literature, it has been suggested that all chain members to have an understanding of the network (Christopher & Peck, 2004; Ponis & Koronis, 2012; Ponomarov & Holcomb, 2009) to be aligned in the event of a disruption occurring. 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 will 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 activities within their plants affecting production downstream.

Strategic Contingency Theory

Wren (2005) observes that the 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 (dependent) 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). These influences 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 different.

This theory is important to the Kenyan 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 Kenyan manufacturing firms should implement predefined contingency plans to provide a quick response with appropriate mitigation measures that enable them to recover fast by minimizing the negative disruption consequences. Likewise, they 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 Kenyan manufacturing firms can 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 Kenyan 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).

Strategic Choice Theory

The early empirical studies on the relationship between organizational structure and situational factors such as technology by Blau, Hage and Aiken, Hal, Lawrence, and Lorsch in the United States and Pugh and Woodward in Britain provided material for development of models that helped the Strategic choice theory (SCT) to advance (Child, 1972). According to these models, the goal of the organizations is to achieve high performance standards and increase the efficiency to the limits of economic constraints. In these studies, little attention was paid to situational (contextual) factors for example, environment, technology, and scale of operation and the agency of choice any agent in the organization who has the power to direct the organization, e.g. managers (Child, 1972). Contextual factors are very important if firms are to perform well. For instance, mangers who make sound decisions for their organizations and adopt modern technology, they are likely to become more resilient.

Strategic decisions in organizations have significant effects on organizational outcomes. 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 to this study because managers play an important role in achieving organizational outcomes through their decisions making (Child, 1972). For example, managers in the Kenyan manufacturing firms must 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). Managers of the Kenyan 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 Kenyan 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 of the Kenyan manufacturing firms should be more aware of the current situation of the market, 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.

Complex Adaptive System

The term Complex Adaptive System (CAS) emerged from complexity theory (Nilsson, 2003; Burnes, 2004; Brownlee, 2007) and was initially applied to living systems (Surana *et al*. 2005). Complexity theory focuses on the emergence of order in dynamic and non-linear systems that operate at the edge of chaos (Wycisk, McKelvey, & Hülsmann, 2008). Since physical and social phenomena contain both chaos and order, complex non-linear systems strive to be neither overly stable nor unstable. This is achieved through their order-generating rules, which facilitate transformation and self-organization in order to remain at the edge of chaos amidst environmental changes (Burnes, 2004). A Complex Adaptive System (CAS) is regarded as a special kind of complex system due to the property of adaptation and can exist in unstable, but not completely chaotic environments. For example, manufacturing firms be operates in a volatile environment which changes frequently due to disruptions and yet they need to adopt and survive within the same environment.

Holland (1995) 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. It consists of an interconnected network of multiple entities (or agents) that respond adaptively to changes in both the environment and the system of entities within it (Choi, Dooley, & Rungtusanatham 2001). 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 (Nilsson, 2003). Thus, 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 (e.g. 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.

The process of coevolution in a CAS is also influenced by its non-linearity (Choi, Dooley, & Rungtusanatham, 2001), which together with self-organization and emergence has been considered a core feature of a CAS (McCarthy, 2003, 2004; McCarthy *et al*. 2006). Non-linearity implies that there is an inconsistent relationship between the cause and effect of CAS events (Urry, 2005), such that extreme events may yield disproportionately negative or positive results. Non-linearity 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 (McCarthy *et al*. 2006). 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.

By its nature, a supply chain looks like a CAS (Choi, Dooley, & Rungtusanatham, 2001; Surana *et al*. 2005; Pathak *et al*. 2007; Hearnshaw & Wilson, 2013) since it mirrors the main features of a CAS. Moreover, the property of resilience is one that is inherent to such a CAS. Hence, there appears to be a logical fit between the theoretical reflection of CAS and the study of SCRES. 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: we know, for example, that apparently minor changes in supply chain controls allow for catastrophic events to potentially occur. The most obvious example of this is the bullwhip effect, where a small distortion in the flow of orders downstream can cause a massive impact upstream in the supply chain (Pereira *et al*. 2009). 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 Kenyan 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 collaborate with other manufacturing firms and other stakeholders like suppliers, customers and government in order to be able to create resilience in manufacturing firms in Kenya.

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.

This study will seek to investigate on how strategic sourcing, supply chain re-engineering, flexibility and risk awareness influence supply chain resilience in manufacturing firms. The variables in the conceptual framework were derived from the theories identified and literature from different scholars in this study.

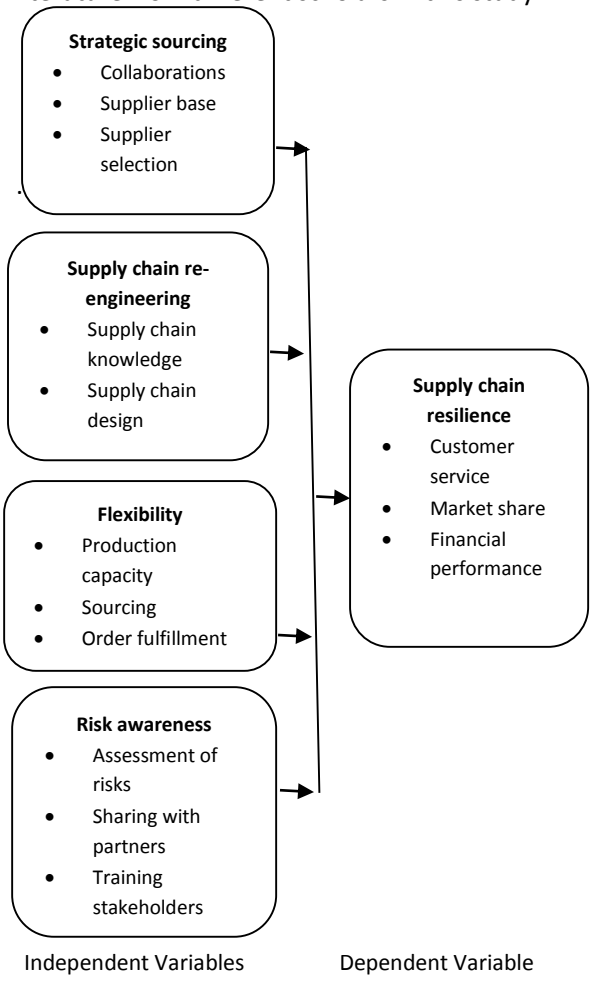

Figure 1: Conceptual framework

Strategic Sourcing

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 a 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, 2006a; Zsidisin and 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. 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). One of the objectives of the study is to determine the influence of strategic sourcing on supply chain resilience in manufacturing firms in Kenya. Thus the following hypothesis is proposed:

H01: Strategic sourcing has no influence on supply chain resilience in manufacturing firms in Kenya.

Supply Chain Re-engineering

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 and 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. From the foregoing discussion, therefore, the following hypothesis will be tested:

H02: Supply chain re-engineering has no influence on supply chain resilience in manufacturing firms in Kenya.

Flexibility

Erol, Sauser, and Mansouri (2010) defined 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 2006b; 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, 2006b). 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). Flexibility also enables resources to be more easily redeployed, including transportation and labour resources (Pettit, Croxton, & Fiksel, 2013). 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.* (2012b) 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 very well-discussed strategy when the topic is uncertain and unexpected events (Sheffi & Rice, 2005; Tang, 2006a). 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). From the following literature, the following hypothesis will be tested:

H03: Flexibility has no influence on supply chain resilience in manufacturing firms in Kenya.

Risk Awareness

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 to raise awareness and reinforce 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. Therefore, the following hypothesis is proposed:

H04: Risk awareness has no influence on supply chain resilience in manufacturing firms in Kenya.

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)

Despite the increase in SCRES publications, few focus on assessing and measuring SCRES. 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 is 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.

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 demonstrate the SCRES magnitude of both the retailer and manufacturer.

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. As shown by Wu *et al.* (2013), a timeline can illustrate the impact before, during and after a disruption to measure SCRES and display how quickly a firm has recovered. Therefore, this study will adopt customer service, market share and financial performance to operationalize SCRES in manufacturing firms.

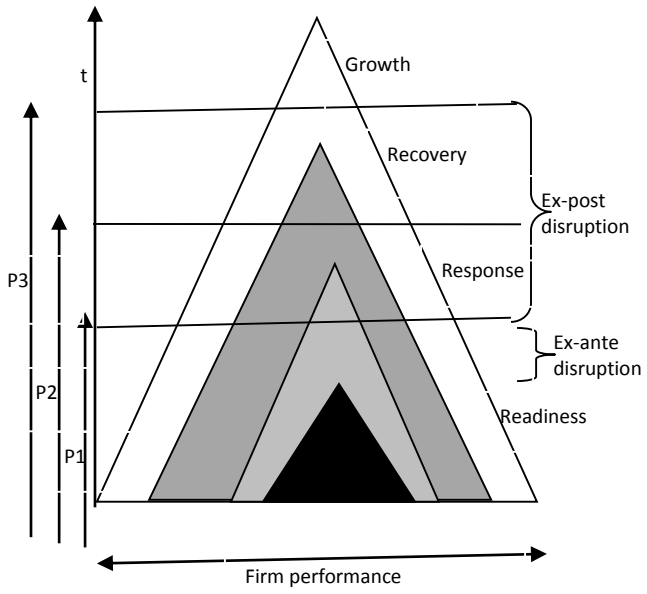

Figure 2.2: Sand cone model; resilience measurement model
Source: Adapted from Giunipero *et al*., (2015)

In order to group and synthesize the SCRES enhancers, the study propose a classification that distinguishes 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 assign proactive actions to the readiness phase while reactive measures embrace 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 in Kenya.

Strategic sourcing which includes: collaboration; supplier relationships; supplier selection and supplier base (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, appropriate supplier selection, using selection criteria that can 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).

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 in company's strategy, such as sourcing flexibility (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). Also firms should increase flexibility in order to adapt to changing requirements within minimum time and effort (Pettit *et al.*, 2013).

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).

Critique of the Existing Literature Relevant to the Study

The four core enhancers discussed above 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 to develop enhancers that build resilience towards threats individually. Scholars has 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).

Research Gaps

The lack of 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 unexplored 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.

RESEARCH METHODOLOGY

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 will adopt 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 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, helps with hypothesis formulation and testing the analysis of the relationship between variables (Kothari, 2004). Therefore, this design will be appropriate for this study which extensively will test 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 will also be 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 will adopt 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).

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 will be all the 613 manufacturing firms in Nairobi. Manufacturing sector 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).

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 will be a list of all the manufacturing firms in the 14 key industrial subsectors of the manufacturing sector in Kenya. These subsectors are: 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 will be obtained from the directory of Kenya Association of Manufacturers and exporter (KAM, 2015) which is a premier representative organization for manufacturing value added industries. It has the mandate of promoting competitive local manufacturing in liberalized markets, representing a cross section of the entire manufacturing sector in Kenya. KAM provides demand-driven-value-added services to facilitate firm-level interventions and continuous improvements aimed at enhancing industry's performance and profitability, with the intention to deepen Kenya's industrial sectors and improve competitiveness.

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 will use 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 is established that there are 14 key industrial subsectors of the 613 manufacturing sector, in addition to service sector and affiliate associations. The manufacturing firms are divided into 14 groups/ strata (Table 3.1), each key subsector forming a stratum. Stratified random sampling technique guarantees that each stratum is represented in the sample and is 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 gives a sample size of 62 respondents. The study therefore will involve 62 manufacturing firms in Nairobi and its surroundings. The researcher will select supply chain managers from each of the firms to participate in the study. Table 3.1 shows how the sample size arrived at.

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**

Table 1: Number for choosing a stratified random sample

Data Collection Instruments

A standardized questionnaire will be 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. 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 is divided into two sections. Part A is the organizational data. Part B will ask the respondents to provide information concerning the major areas of this study. The questionnaire contains both closed and open ended questions. The closed ended questions are aimed at giving precise information which will minimize information bias and facilitate data analysis, while the open ended questions will give 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 will be self-administered to the respondents and two research assistants will be recruited and trained so that they can be able to get quality results. Secondary data will also be collected from published sources such as library, internet and research done by other scholars. The target participants will be supply chain managers who will fill in the questionnaires. These target participants have adequate knowledge about the strategies manufacturing firms are putting in place to create supply chain resilience, considering their crucial role in top management involvement.

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

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 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 will be tested on 10% of the entire sample size, which will translate to six respondents. The questionnaire will be pilot tested on six manufacturing firms that are part of the target

population but not in the sample, and supply chain managers will fill in the questionnaire.

Reliability of Data Collection Instruments

This study will adopt 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 will be adopted because it is more stable than the other methods (Bryman, 2012; Cooper & Schindler, 2011). Internal consistency is 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) will be computed as follows:

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

Validity of Data Collection Instruments

This study will adopt 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).

This study will also adopt 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. Exploratory Factor Analysis (EFA) can be used to validate hypothetical constructs by clustering those indicators or characteristics that appear to correlate highly with each other (Kane, 2006).

Data Processing and Analysis

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 will be 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 21 and Microsoft Excel. Inferential data analysis will be 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. Regression models will be fitted and hypothesis testing carried using multiple regression analysis and standard F tests.

This study will test normality, heteroscedasticity and autocorrelation. Normality is important in knowing the shape of the distribution and helps to predict dependent variables scores (Paul & Zhang, 2009). Heteroscedasticity means a situation in which the variance of the dependent variable varies across the data, as opposed to a situation where Ordinary Least Squares, OLS, makes the assumption that $V(\varepsilon_j)=\sigma^2$for all j, meaning that the variance of the error term is constant (homoscedasticity). Heteroscedasticity complicates analysis because many methods in regression analysis are based on an assumption of equal variance (Park, 2008). Autocorrelation refers to the correlation of a time series with its own past and future values (Box & Jenkins, 1976). The autocorrelation function can be used to detect non-randomness in data and also to identify an appropriate time series model if the data are not random. Autocorrelation is essentially a correlation coefficient, but instead of correlation being between two different variables, the correlation is between two values of the same variable at times X_i and X_{i+k}.

This study will also test for multicollinearity. Multicollinearity is the undesirable situation where the correlations among the independent variables are strong (Martz, 2013). To test for multicollinearity, Variance Inflation Factor (VIF) will be used. 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).

Statistical measurement models

According to Mugenda and Mugenda (2003), linear regression analysis attempts to determine whether a group of variables together predict a given dependent variable and in this way, attempt to increase the accuracy of the estimate. The general linear regression model for this study will be:

$$Y= \beta_0 + \beta_1X_1 + \beta_2X_2 + {}_3X_3 + \beta_4X_4 + \varepsilon$$

Where; Y=Supply chain

β_0=constant

β_i is the coefficient for Xi (i=1, 2,3,4,5)

X_1=strategic sourcing

X_2=supply chain re-engineering

X_3=flexibility

X_4=risk awareness

ε = error term

Measurement of Variables

This study will use the following rating scales, that is, open-ended questions to allow the respondents to add information that might not be 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 will dominate the questionnaire. Chimi and Russel (2009) elucidated 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 will be collected in this study exhibit majority of these features and so the Likert scale will be 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 will be measured by a linear regression model.

Strategic sourcing is the employment of appropriate strategy which carefully considers profit potential and risk factors (Mingu & Xiaobo, 2009). In this study strategic sourcing will be measured by use of collaborations with supply chain partners, supplier base and supplier selections. These measurements are modified and adopted from Scholten and Schilder, (2015).

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 is measured objectively and subjectively by use of supply chain knowledge, supply chain design and supply base strategy. These measurements are modified and adopted from Christopher and Peck (2004b).

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 is 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 is 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, market share and financial performance. These measurements are adopted and modified from Giunipero *et al*., (2015).

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