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ASSESSING AND ENHANCING SUPPLY CHAIN RESILIENCE FOR SMEs

Examiner: Professor Jukka Hallikas

ABSTRACT

Lappeenranta-Lahti University of Technology (LUT)
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Assessing and Enhancing Supply Chain Resilience for SMEs

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The aim of this master's thesis is to evaluate the level of SMEs' preparedness towards unprecedented volatility in their supply chains and further help them come up with a framework they can use to predict, recover and learn from these unexpected events.
SMEs contribute significantly to different economies worldwide. This is evident as they contribute a big part of countries' GDPs by providing a source of livelihood to millions of people. SMEs are the most susceptible to volatilities with statistics showing that most never last because of their limited access to capital, technology among other causes. This paper therefore reviews SMEs' supply chains with an aim of helping them maintain a high level of performance and development.

This research uses qualitative research methods to collect data. Interviews with four carefully selected respondents from Kenya and Finland were the primary data sources of data to get the perspectives of people responsible in making supply chain resilience measures. The theory used for the research was based on available academic literature on supply chain resilience and Small and Medium sized enterprises.
A thorough review of the results suggests that Small and Medium sized enterprises need to adopt a supply chain resilience framework to cushion them against unexpected events that may affect their supply chains.

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Tampere 09/05/2021

Edward Ameyo Makutwa

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LIST OF SYMBOLS AND ABBREVIATIONS

€	Euro
COVID19	Coronavirus disease 2019
GDP	Gross Domestic Product
Ksh	Kenya Shilling
MSME	MICRO, SMALL AND MEDIUM-SIZE ENTERPRISES
SCRes	Supply Chain Resilience
SMEs	Small and Medium-Sized Enterprises

1 INTRODUCTION

Small and Medium-Sized Enterprises (SMEs) have proven over time to have a significant role both economically and socially in the modern economy; subsequently attracting attention because of their innovativeness.
As an example, in the Finnish economy, they have created jobs for over 150,399 individuals between the years 2001 and 2018. 87,156 of these jobs were created in companies with less than 50 people under their payroll. (Yrittäjät, 2020.)
To further showcase the impact of SMEs on a country's economy, Yrittäjät (2020) also presents that SMEs generate more than half (58.1%) of the 434 billion euros in turnover for Finnish companies, representing more than 40% of the country's GDP.

Today's business world, however, represents an environment where SMEs are often faced with unprecedented and turbulent events that work to slow down the progress of their supply chains. To counter this, recent supply chain management research has been geared towards fathoming the basic notion of it, helping to make decisions on where to back resources to ensure resilience. This thus guarantees that supply Chains respond in time whenever they are faced with potential high-cost disruptions.

In their broad analysis of Supply Chain Resilience (SCRes), Kamalahmadi et al (2015) discovered that of all the publications of firms' resilience, only about 7% of the research projects investigate the topic of resilience for SMEs. According to Thun et al. (2004), SMEs are more prone to disruptions on their supply chains as compared to bigger firms with some reasons including insufficient resources, or a lack of preparedness to disruption in their supply chains etc.
Research on manufacturing supply chains has been the focus of previous research on SCRes. This further showcases an underrepresentation of SME SCRes with reason being that SMEs mainly come from service supply chains. Some of these Services including finance, healthcare and telecommunications which are important to human existence.

The objective of this work, therefore, is to have a look at and enhance Supply Chain resilience for SMEs to help them develop and eventually have a system that can help them stay put in a world full of unprecedented volatility.

1.1 Background

This research is conceived at a time when the whole world is grappled in trying to control COVID19. The virus has seen many supply chains exposed and pushed to the edge of survival as governments across the world put everything on lockdown to slow down the spread of the mentioned virus.

At the height of the COVID19 pandemic, China as an example which accounts for 17% of the global GDP (Gross Domestic Product) had a turbulent disruption to its economy. This was consequently felt across the rest of the world as the country harbours major manufacturing and logistics hubs giving supply chains a hard time to find alternatives for products that China is globally a dominant supplier. (Bloomberg, 2020)

Across the world, SMEs took the biggest hit with direct negative impacts being viewed in increased unemployment, a decline in exports and sluggish growth in the services and manufacturing sectors. as most of them depend on direct contact with customers and who were keeping away because of the partial lockdowns as a precaution from the virus.
The virus represents a vivid example of anomalous occurrences that supply chains across the world face each day and thus necessitating businesses to invest in being ready and flexible to handle the effects volatilities that present themselves to their value chains.
The value that a consistent and well-functioning SME Supply chain provides is required to ensure a well-functioning business system that keeps its end customers are satisfied.
Supply Chain resilience presents itself as a solution that SMEs can adopt in a world full of uncertainties to ensure they can cope with any volatility that they may face.

Imran et al. (2017) define supply chain resilience 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 structure and function.”

Different stakeholders should be engaged to ensure that SMEs maintain their stature in the markets. One notable stakeholder is governments getting involved to provide financial

packages, grants and relaxation in payments of bills that are geared to rescue SMEs whenever disruptions take place. The strategic contribution that SMEs play in economies gives this research project more significance to ensure the resilience of their supply chains.

Shuai et al. (2011), write that creating a resilient supply chain implies that companies will easily rebound from a disruptive event, returning to normalcy or improving their operational efficiency. position. If leveraged, this can be an advantage over a competitor with a slower reaction to a disruption.
Despite SMEs being of major significance to economies, there exists limited research on their resilience necessitating this study even more.

1.2 Research questions, objectives, and limitations

The significant aftermath of disturbances on a business and its supply chain makes it inevitable for them to build resilience (Carvalho et al. 2012c). This thesis is guided by the main objective of coming up with a structure from which SMEs can use to enhance their Supply Chain resilience with an intended contribution of ensuring that they can survive unprecedented events in their business.

SCRes describes the malleable function that a supply chain engages for the purpose of preparing for unprecedented events thus responding to disruption and recovery ensuring a continuous flow of its activities at the highest level of interconnectedness and systemic and functional control. (Imran *et al*., 2017).

To address the objective of this study, the main research question below was proposed:

- *How can SMEs improve their Supply Chain resilience to increase survivability in a volatile market?*

To lay out extensive support and enhance the understanding of the research question formulated, the following sub-questions were drawn up:

RQ1. What Supply Chain resilience measures are available to SMEs?

RQ2. How can SMEs adopt Supply Chain resilience measures to their operations?

RQ3. What is the impact of adopting Supply Chain resilience measures for SMEs?

1.3 Research methodology & data collection plan

This study includes two major parts: theoretical and empirical parts. The first section features an elaborate literature review on the topics of Supply Chain Resilience and Small and Medium Sized Enterprises. The section includes peer-reviewed journals, articles and electronic publications to generate new insights, give more validity and perspective to the research in an efficient way.

The second section features the empirical parts of the study. This section employs qualitative research methods to compliment the theoretical part bringing authenticity, reliability and objectivity to the project. Interviews were organised with different individuals representing different industries giving a proper representation of the SME sector.

1.4 Conceptual framework

This research project's conceptual framework is showcased below (figure 1). The graph contains the main constructs concerning the reaction chain that an SME's supply chain may go through in response to volatility in its environment.

The framework developed for this research project includes detection and activation features that have the purpose of conceptualising resilience during turbulent periods in a SMEs' market and showcases the relationships between SMEs Supply Chain resilience and other business strategy concepts.

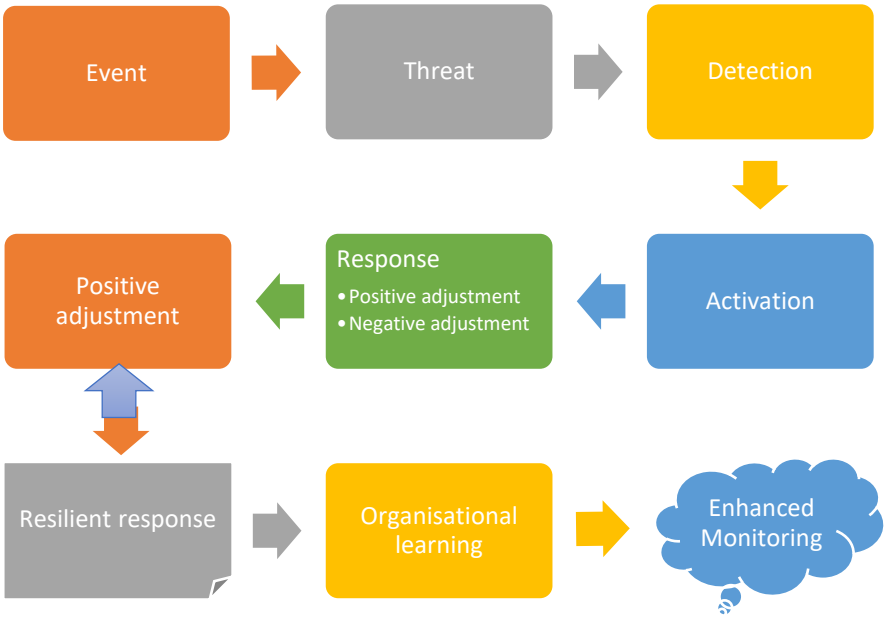

Figure 1. Conceptual framework of the research.

1.5 Structure of the study

The research is divided into 6 main chapters with the main outline being split into three parts: theoretical, empirical and results.
The first three chapters in the theoretical part introduce the research question at hand with further illustration on Supply Chain Resilience and a description of SMEs summing it up.

The research's second section which features the fifth chapter consists of the empirical part. The chapter showcases the methodology and data collection plan that was adopted for the research. The chapter also showcases the validity of the data collection and analysis method used. The section finally looks at the current Supply Chain resilience status of the firms in focus.

The last section includes the results of the research project. The research questions are answered then after, a presentation of the research's limitations is outlined. Proposals for further future research and the managerial implications are later presented in this section. The (figure 2) below illustrates a flow summary of the structure as described above.

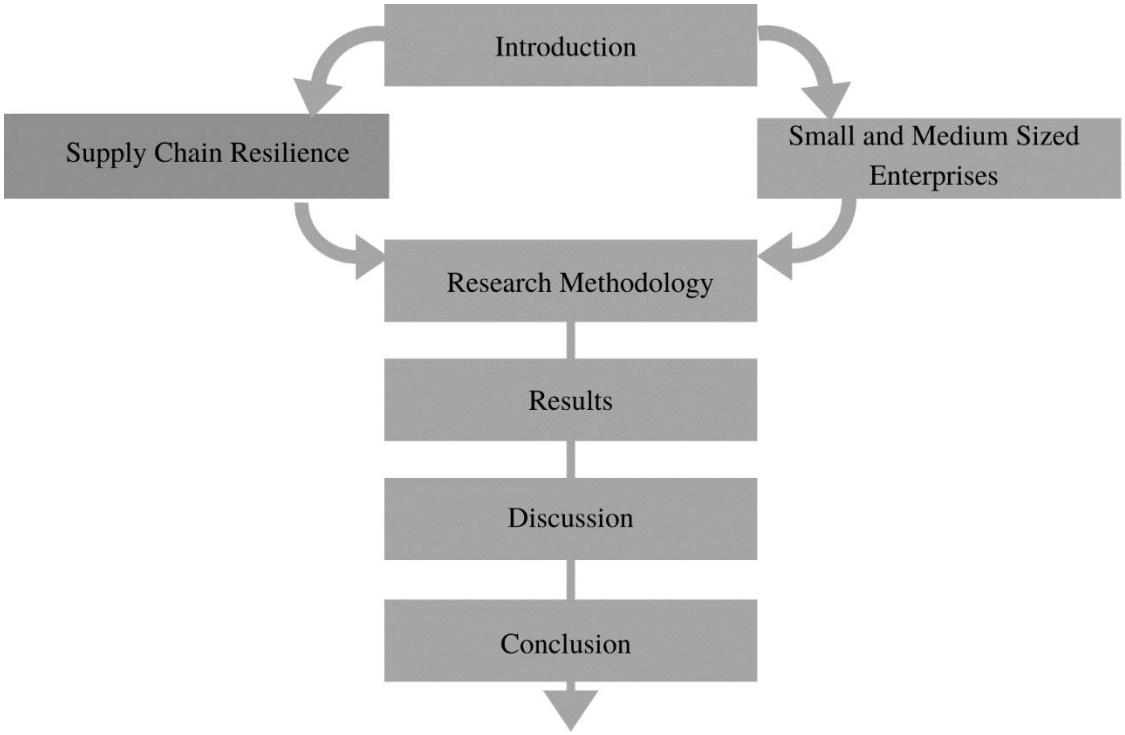

Figure 2: Thesis structure.

2 SUPPLY CHAIN RESILIENCE

To help support the theme of this work, I decided to venture deep into the topic of SCRes.
In recent history, there have been frequent and unprecedented events that have inhibited firms' abilities to progress in their business. Some of these events; both internal and external, have encouraged scholars and institutions to research on ways to mitigate the potential effects of future disruptions by creating resilient supply chains.
The concept of SCRes has been under research by these authors and researchers from different disciplines that found relevance to it. Different authors have come up with several definitions that they found fit to properly define the topic in their articles as documented in table 1.

As mentioned before, some of these events are external to the firms including for example COVID19 and some man made like terrorism. Firms have adopted such means as lean initiatives that reduce costs, improve coordination while on the contrary may leave supply chains with no reserve capacity for emergencies thus leaving them vulnerable to disruption. This has given more weight to researchers and firms to investigate ways in which they can leverage their internal capabilities to ensure they are ready for future volatilities. These capabilities have been thus moulded to form resilience as a concept.

Despite the existence of a wide array of definitions into the topic, this research picks one by Ponomorov and Holocomb (2009) that is more relevant to it. They describe SCRes as "the adaptive capability of a supply chain to prepare in the event of unprecedented events thus responding to the disruptions and consequently recover from the same by maintaining continuity of operations at the level of connectedness and control over structure and function desired by the parties involved." (Ponomorov and Holocomb, 2009, p.131)

The definition puts forward three steps that SCRes firms maintain to guarantee resilience in their daily functioning, and they are described below.

1. *Anticipation*: Persons concerned, in this case supply chain managers should have the ability to forecast disturbances and ready their supply chains for precedented and unprecedented switch in their surroundings. A complete understanding of the disruptions must be done and the possibility of their happening reduced.

2. *Resistance*. Once a predicted or otherwise unpredicted disruption is discovered in a supply chain, the capacity to resist and effectively get it under control in adequate time plays a key role to ensure that daily operations continue smoothly. An ideally prepared supply chain can control disruptions in this stage.
3. *Recovery and responses*. In a situation where a disruption has the potential to adversely affect the supply chain, having successful countermeasures within reach and at the disposal of supply chain administrators is crucial to mitigating the disruption's impact on the entire chain. A well and timely response besides having the capability to shift the firm to its pre-susceptibility condition should be able to move forward from the disruption and be able to reinstitute the firm's position to an elevated form that can eventually result in improved competitive advantages (Kamalahmadi and Parast, 2016). Coutu (2002) states that, the response should be able to restore the company to its earlier status while at the same level ensure the firm's position is regained to its preceding state and simultaneously learn to be able to respond to future disruptions.

Hamel and Välikangas (2003) also add to this by stating that responses should be based on innovation, flexibility, engineering, organization, and supply chains.

The significant impacts that increased globalization, just-in-time approaches, increased outsourcing, higher rates of innovation, global disease pandemics, shorter life cycles of products, among other unspecified and undefined factors brought forward to firms make it inevitable for Supply chain resilience policies to help them counter the turbulent disruptions to their supply chains.

Taking a human's perspective, Dean Becker, the Managing Director of Adaptive Learning systems is quoted saying that "More than Education, more than experience, more than training, an individual's level of resilience will give the final say on who will succeed and who will fall" (Coutu, 2002). As a reference, the statement goes a long way to help argue the fact that resilience must be infused into the subsystem of a firm's own culture to ensure longevity.

A big number of trials have been made to evaluate the basic concept of resilience in a lot of other capacities. This chapter is intended to define the concept of SCRes with wide

explanations to different concepts that constitute resilience to help SMEs define the same and help them understand the applicability of the same to their structures.
In the next sub-chapter, I look at how Supply chains can operationalize these resilience dimensions through the principles that currently exist to ensure competitiveness.

2.1 Supply Chain Resilience Principles

This chapter looks at several articles that define the principles of SCRes.
In their broad article on Building a resilient supply chain, Christopher and Peck (2004), define principles that help define the concept of SCRes. These concepts include *Supply Chain reengineering, Collaboration, agility, and SCRes Management culture*.

These principles are showcased in figure 3 below and the arrows in the figure illustrate the connections that exist within the concepts of SCRes.
The later section of this chapter showcases the principles, variables and their relationships to bring forward a better view of the same.

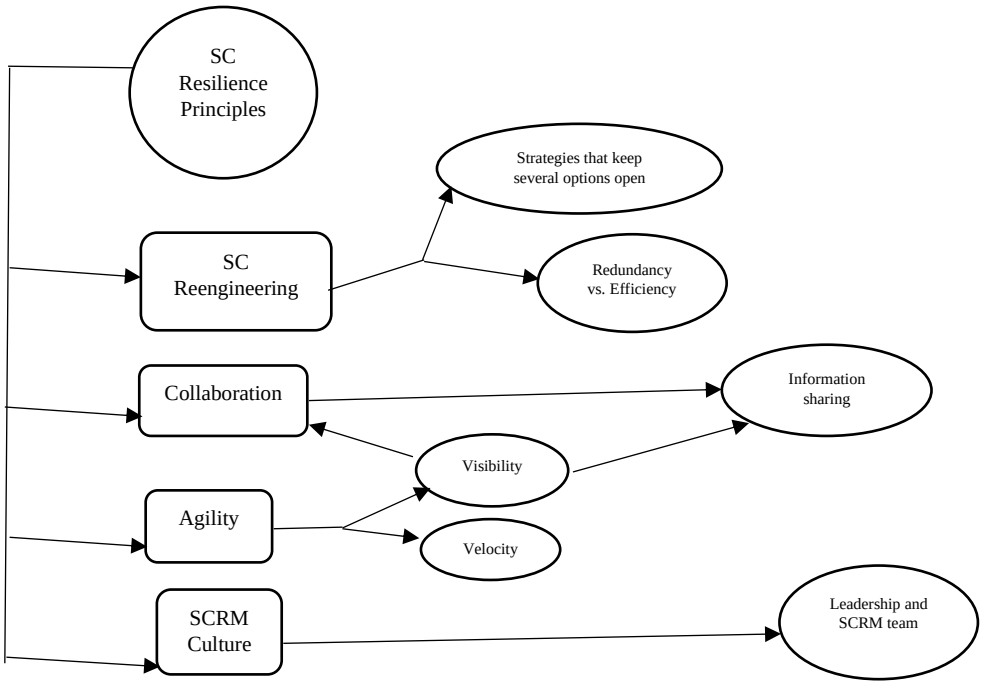

Figure 3. Supply chain principles (Christopher and Peck, 2004)

2.1.1 Supply chain re-engineering

Supply chains have a main objective of ensuring that costs are optimized, and end customers are satisfied. Regarding the potential risks that supply chains may face, the need to integrate SCRes measures into the functioning has over time become a necessity (Wilding, 2013). With that being mentioned, Traditional supply chains must be restructured to integrate resiliency into their core fabric.

In their article, Christopher and Peck (2004) give more emphasis on three factors that guide Supply chain re-engineering. These factors include.

1. Understanding of the Supply Chain.
2. Development of a supply base strategy which prioritises risk understanding of suppliers.
3. Designing principles for SCRes that relies on strategic evaluation of the trade-off that should happen from redundancy to efficiency and vice versa.

Kamalahmadi and Parast (2016) on SCRes also discuss flexibility and redundancy as basic components of supply chain reengineering.

Flexibility is further described as the availability of supply chains to be able to move to another predefined position to respond to atypical situations in a better way and consequently adjust to changes that happen in a supply chain. (Lee, 2004)

Some of the ways that supply chains can be flexible include having a flexible capacity, flexible transportation systems, flexible production facilities and versatile labour agreements. (Tang, 2006 a; Colicchia et al., 2010 Tomlin, 2006; Yang and Yang, 2010;).

Kamalahmadi and Parast (2016) also talk about creating redundancy across a supply chain as a way of achieving resiliency. Some redundancies measures could include, having a safety stock, substitute suppliers for products etc (Sheffi, 2005; Tang, 2006 a; Tomlin, 2006; Sodhi and Lee, 2007; Knemeyer et al., 2009).

Depending on the resources at the disposal of different firms, they themselves can plan before deciding whether to choose redundancy or flexibility in their resilience efforts.

Uriciuoli et al. (2014) in their report, also add to the topic by stating that flexible contracts, safety stock, rerouting, flexibility in design or capacity and multiple suppliers are some common approaches used in the energy industry.

In designing resilient supply chain concepts, density, complexity, and nodes are some of the important features when designing resilient supply chains. Craighead et al (2007) describe Density as the spacing of nodes geographically in a supply chain while complexity as the number of nodes and material flows either forward, backward or within a certain tier in a supply chain. Node on the other hand stands for the significance of a defined node in a supply chain. In essence a disturbance on a single node in a supply chain, builds up to interruption across the entire supply chain in a situation where resilience does not exist.
Taking into consideration two supply chain disruption alleviation functions i.e., *warning and recovery*, the earlier mentioned supply chain features i.e., density, complexity and node reinforce the intensity of a disturbance, while simultaneously mitigating the capabilities to abate the effects brought about by design characteristics and thus lessen disruption severity.

In their article, Blackhurst et al. (2011) brought to light the fact that SCRes is inversely related to density and complexity. With the quantity of nodes increasing, supply chains consequently become more complex and susceptible to disturbance. In contrast, suppliers located in areas with more risks and clustered geographically heighten the risk of causing a disturbance in the supply chain.
Scale is also one characteristic of supply base complexity that can be used to help the connection between supply visibility for both resilience and strength as identified by Brandon-Jones et al. (2014). In their article, Brandon-Jones et al. (2014) identify organization in supply chains eventually coming up with the notion that investment is necessary for each function to increase SCRes. An enterprise's failure to control supply chain disturbance is repeatedly a consequence of a lack of understanding of a firm's own supply network; in their article, Brandon-Jones et al. (2014) suggest that a network perspective be used to examine SCRes.
In their study on the effects of global sourcing, Blackhurst et al. (2005) discovered that redesigning supply chains with a reference to resilience needed an understanding of the trade-off that needs to happen between flexibility and costs in supply chains globally.

Dynamic supply chain models must also be properly understood in order to apply the dynamic essence of disruptions to design models.

An absence of an organized supply network system for risk and mitigation system is one failure that Christopher et al. (2011) found in most firms in their article. Their report gives a view that global sourcing and supply chain network reengineering is a popular way that can help reduce global sourcing risks.

Winston (2014) adds that for firms to be resilient, they need to change their approach in the following ways.

1. Vision: revaluate their vision and embrace an innovation geared strategy with a long-term mindset.
2. Values: they must revise their valuation ways to give an account for undefined costs and benefits.
3. Partners: Forge new partnerships to ensure attainment of goals beyond the grasp of single firms.

2.1.2 Supply chain collaboration

Collaboration as defined by Petit et al., (2016) is the ability to work hand in hand with other firms for the common benefits of all. Faisal et al. (2006) make a more practical definition by stating that collaboration is the "glue that holds supply chain organizations in a crisis together."

Supply chains cover the whole group of partners from suppliers to customers meaning that they gain from and face barriers together as a business unit.

According to Bagchi et al., (2005), increased use of web-based technology, as well as increased competition in the global economy, has increased the need for supply chains to collaborate.

Risk management for highly interconnected supply chains therefore must have increased collaboration and partnership among its entities to ensure proper examination and monitoring of their business processes.

The key objective of supply chain collaboration is thus to improve the efficiency of organization among participating firms both upstream and downstream, with an emphasis on the supply chain's interface of operations. (Gumboh and Gichira, 2015). Sheffi (2001)

also adds that the need to collaborate and further improve risk management in supply chains is brought about mainly by the fact that lead times are increasing.
The collaborating firms have a mutual target of ensuring that goods and services reach their customers at an optimal cost. This further enables the partners in a supply chain to smoothen their processes by getting rid of waste, synchronising their functions and upgrading their communication to adequately serve the supply chain (Simatupang 2005; Cao et al., 2010.)

Wieland and Wallenburg (2013) in their research on the effects of relational competencies on supply chain resilience, discovered that cooperative and communicative relationships have a positive impact on resilience, while integration has no influence.
Supply chain collaboration essentially happens when the partners share information at will, work side by side to resolve common problems, come up with mutual plans and manage risks as a team (Simatupang and Sridharan, 2005: Fantazy, 2010.)
In their article, Scholten and Schilder (2015) displayed how certain activities that boosted collaboration e.g., sharing of information, boost supply chain resilience had positive influence on flexibility, velocity, and visibility across the supply chain.
Given the fact that cooperation is emphasized as a critical component of supply chain resilience, Christopher et al. (2011) and Wilding (2013) in their articles, reveal that many enterprises still do not consider investment in collaboration as being important even with the fact that collaboration has been documented as being of benefit to them.

Kamalahmadi and Parast (2016) further mention Inter-firm trust and Information sharing as elements mainly needed when building cooperative relationships between involved firms. The two elements are further illustrated below.

- ***Trust***

Faisal et al (2007) write that as in any formal relationship, trust ensures cooperation and collaboration inside a supply chain's partners. Sinha et al. (2004) also add to this by stating that a lack of trust is the main factor that exposes supply chains to vulnerability.

- ***Information sharing as a driver for collaboration.***

On building cooperative relationships between firms Christopher and Peck (2004) state that the primary goal of collaborative working, and risk reduction should be the creation of a group of supply chain players that involves the rapid exchange of knowledge among supply chain players.

Every member in a supply chain stands to gain from collaboration only if there is efficient and effective passing of information according to Mandal (2012).

In their article, Wicher and Lenort (2012) state that collaboration can be enhanced by creating trusted networks, sharing of data and information among the members that help in forecasting and planning future mutual plans. They also stress the importance of knowledge sharing both before and after a supply chain interruption. Investing resources in knowledge exchange for stakeholders is also important for detecting possible supply chain weaknesses (Melnyk et al., 2014).

- ***Information sharing as a driver of resiliency.***

As illustrated below, some papers regarding knowledge sharing found it to be a separate engine of SCRes.

Soni et al. (2014) provided some food for thought by listing ten enablers that can help increase SCRes. Visibility, knowledge sharing, and collaboration were all considered separate drivers among the enablers listed. They also considered internal and external information sharing as causal factors in larger firms' resilience.

Blackhurst et al. (2011) revealed that six of the interviewed companies put a greater focus on the need for organized communication tools to better counter disturbances by knowledge exchange in their broad study of various individual enterprises. In their study, they stated that all the firms put more emphasis on the need to come up with supplier relationship management programs to counter supply risk.

Barriers to Supply chain collaboration by SMEs.

Different regions across the world face different sets of barriers in their path to ensuring supply chain collaboration. These barriers deprive their ability to expand to new business levels and markets. These barriers are caused by a wide array of reasons including,

globalization, technology, liberalization of organizations, institutional changes etc. (Gumboh and Gichira 2015).

SMEs face such challenges as high competition with other SMEs and with other bigger firms, the inability to source for skilled labour, inadequate finance etc hence facing even more barriers to their business (Gumboh and Gichira 2015).

Gumbo and Gichira (2015) also state that SMEs are usually started and run by persons who may not have the capacity to manage the businesses in its entirety. These pioneers may have limited skills for example sales, product development, but lack other key skills that bring about the need for partners to bridge the gap.

Some of the factors that hinder a supply chain's ability to exploit cooperation include:

I. Lack of credit

Gumbo and Gichira state that SMEs may lack the access to credit line which further affects their ability to acquire new technology. In exceptions when credit is available, SMEs more often have a limit on their lending conditions forcing entrepreneurs to self-finance or borrow money from short term lending facilities.

II. Technology barriers.

The most evident impediment to supply chain collaboration is the lack of investment in proper information systems. This is further in line is caused by the lack of capital that can help them invest in the same.

With lack of proper information systems, SMEs may find it harder to coordinate value-added activities across boundaries both functional and organizational with the lack of information being shared regarding order status, inventory levels, product designs etc. Gumboh and Gichira (2015).

III. Organizational barriers

Organizational units are the main deal breakers for supply chain collaboration to work. Organizational challenges that firms may encounter touch on such issues as performance, availability of clear vision for the firm and potential mutual benefits (Kubickova et al., 2009). Kubickova et al. (2019) also write that some of the organizational challenges include some workplace cultures that do not promote collaboration, a lack of a commitment by the

management to collaboration, and lack of support structures. Barratt (2004) goes on to say that a lack of understanding or a failure to choose the right partners in supply chain management contribute to the failure of supply chain collaboration.

IV. Lack of Effective Metrics

Performance assessments from supply chain partners are included in the metrics. SMEs in a supply chain should be in control of the whole network to ensure shared benefits and savings, which would ultimately lead to increased service quality.

Gumboh and Gichira (2015) write that the lack of a good oversight view over the supply chain eventually leads to difficulty in achieving performance that guarantee improvements subsequently affecting the quality of collaboration.

V. Security and safety

The protection of a supply chain's entire supply chain is essential to its survival. Companies in a supply chain partnership must therefore invest in adequate security measures to ensure that each partner only does business with well vetted business partners. Addressing potential security with the supply chain members is vital to ensure fostering of the collaboration efforts Gumboh and Gichira (2015).

VI. Relationship barriers

Lambert (2008) states that power play between partners can deprive relationships between partners. Relationships are related to the interactions between partners and require the collaborating firms to have trust, good partner fits and previous experience.

The experience that collaborating partners handle while collaborating will define the form of their future relationship.

VII. Alignment barriers

Barriers often originate from inconsistent goals, objectives and poor measurement practices. A lack of synchronised goals by the managers of collaborating firms lead to them making selfish opposing decisions that go a long way in depriving collaboration. Naslund et al. (2008).

Despite the myriad barriers, SMEs have a lot to gain from supply chain collaboration as the benefits go a long way to ensure better communication across the network and therefore a

more efficient way of doing business. Better communication also means that they can collaborate better in strengthening their supply chain network and collectively handle disasters together.

2.1.3 Agility

Wieland and Wallenberg (2013) define agility as "the ability of a supply chain to rapidly respond to change by adapting its initial stable configuration". They further state two dimensions that resilience features: The proactive dimension that covers robustness of resilience and the reactive dimension which covers the agility part of resilience directly linking it to disturbances and emergencies.

To highlight the importance of agility Soni et al. (2014) in their definition of the 14 facilitators of SCRes, ranked agility as the highest ranking it above collaboration and risk management culture.

Further on agility, the sub chapter below seeks to showcase a number of dimensions that help enhance agility as described by different authors.

I. Visibility

Visibility is defined as "The identity, location and status of entities transiting the supply chain, captured in timely messages about events, along with the planned and actual dates of these events" (Francis, 2008.pg., 2008).

Christopher and Peck, (2004) defined visibility as the knowledge of the status of operating assets and the environment. Supply chain visibility is achieved through direct collaboration between customers and suppliers, and it is a result of a broad investment in information sharing.

Visibility has been further illustrated using the following perspectives.

- ***Visibility as a driver for agility.***

Data et al. (2007) in their effort to improve resilience, used agent-based modelling of complex distribution systems. They further came up with the results that showed that integrating sensors at several parts in a supply chain and subsequently monitoring them often is an important factor for agility in turn improving resiliency.

Wieland and Wallenburg (2013) stated that visibility makes it possible for decision makers to know about changes in a supply chain making it a necessity in response to disruptions. In their hypothesis, they came up with the conclusion that communication and cooperation within the firms improves agility because of enhanced the visibility of functions and network operations.

Azadeh et al. (2014) in their study on the best policy in bringing the resilient factors into a supply chain transportation system with fuzzy parameters, report that redundancy and visibility beside other factors of resilience are important to ensuring visibility. The further difference in the outputs that they found out after putting the visibility policy in place plays a major role and they further recommended supply chains to be reengineered with the visibility characteristic in consideration.

- ***Visibility as a driver for resilience***

While visibility is widely regarded as a catalyst for resilience, it is distinct from agility.

(Carvalho and Cruz-Machado, 2011) in their study on how to efficiently control the effects of disturbances, gave the thought to visibility being a significant element in the disruption discovery stage. On account of the interviews, they conducted with managers from a varied number of companies, they observed that managers put more emphasis on visibility as being a significant factor in mitigating the effects of volatile disruptions to their supply chains.

In their case study, Blackhurst et al. (2011) talk about having visibility as a prerequisite for every supply chain. They also highlight the importance of having monitoring systems in their supply chains that would help them make strategic decisions helping reduce the effects brought about by disruptions.

Jüttner and Maklan (2011) discovered in a multiple case study that members of a supply chain who share risks and expertise across the supply chain work to increase overall visibility, demonstrating the importance of visibility in improving supply chain resilience.

II. Velocity

Prater et al. (2001) state that the concept of speed is deep-rooted in agility. They further introduce velocity as a concept that assimilates speed and time into agility.

Velocity is a chieved by taking a certain distance over time.

In an event that involves risk, velocity dictates the loss that is incurred per unit of time (Jüttner and Maklan, 2011.)

SCRes, according to Barroso et al. (2011), can be accomplished by reconstructing the supply chain to minimize the effect of extreme accidents and failures by increasing the pace at which supply chains recover.

Jüttner and Maklan (2011) in their article discovered that velocity had a direct impact on a firms' returns giving support to their flexibility by increasing the pace to the adaptive capability to their supply systems. system's adaptability. As opposed to flexibility, however, velocity prioritizes productivity over the efficiency of the supply chain's response and recovery.

For a faster velocity in a supply chain, Christopher and Peck (2004) suggest three foundations.

1. Using streamlined processes means doing activities in parallel rather than in series, and e based as opposed to paper based.
2. Eliminating non-value-added time, which means reducing the time for activities that do not add value from the customers' perspective, and lastly.
3. Reduction in bound lead times, which means being able to respond rapidly and cope with short term changes.

Lead time reduction is also a main factor in resilience and the resilience performance of a supply chain drastically changes whenever the lead time changes (Kamalahmadi and Parast, 2016; Spiegler et al. 2012).

Carvalho and Cruz-Machado (2011) emphasize working towards reducing of production and transportation lead times to ensure improved agility and Supply chain resilience.

In their research, Jüttner and Maklan (2011) found that providing redundant resources increases supply chain velocity by reducing lead times.

Wieland and Wallenburg (2013) discovered that communication and collaboration have major positive effects on supply chain agility by improving velocity and visibility in their analysis of the effects of relational competencies on agility. According to Carvalho et al. (2011), the usage of agility and resilient steps is primarily linked to improved supplier velocity and pace, as well as improved supplier responsiveness to unprecedented changes in their environments.

Some more benefits of supply chain collaboration include, cost reduction, demand planning, improved product quality, economies of scale in production and better risk management (Chopra and Mendhl, 2001). Information technology which has eased sharing of information is the driver of collaboration as supply chain partners can share information on markets, demand and supply within no time, reduced inventory levels, improved customer services because of reduced lead times etc. (Gumboh and Gichira, 2015; Rowland, 2008; McLaren et al., 2000).

2.1.4 Supply Chain Resilience Culture

Organizations should ideally embrace an SCRM culture to create an organization that is resilient. The focus on organizational culture has been addressed as a necessary factor for the successful implementation of a varied number of management practices. As an example, A culture for Total Quality Management is a way in which organizations reorganize to ensure quality in their process (Christopher and Peck, 2004.)

Moore and Manring (2009) state that the main contrast between a working and an ineffective response to disturbance in the supply chain is the organizational culture. High profile firms like Toyota have been effective at designing an inborn culture of flexibility.
Mandal (2012) in their study, illustrated that a working culture that incorporates risk management should be deeply rooted in the firm's and their corresponding partner's supply chain.
The subchapters below illustrate Leadership and innovation aspects that help define SCRes organizational culture.

- ***Leadership***

Changes in an organization needs to come from the top. Christopher and Peck (2004) affirmed that during a cultural change at the organizational level, the support and commitment of leadership is key. Wilding (2013) also noted that putting in place a risk management culture needs the leadership to go over the firm's policies and practices with an aim of assessing the effect on the company's supply chain before establishing a cultural change.

- ***Innovation***

Innovation is an important aspect for an organisation's survival and continuous growth in the long run as it defines how the business remodels and adjusts to changes in its environment. (Alvarez- Gonzalez, 2007).

Innovation only works when there is a set of common goals gathered around an understanding of innovation. Sharifrad and Atael (2012), discovered that an organization's level of innovativeness is directly related to the learning and participatory decision-making habits it decides to follow.

Even though innovation has been referred to as a crucial factor in a company's long-term survival and growth, the role of innovation in boosting a company's resilience has not been adequately considered.

In their broad analysis of the relationship between organizational resilience ability, product innovation, and firm efficiency, Akgün and Keskin (2014) found a direct correlation between organizational resilience-capacity variables and an enterprise's product innovativeness, with product innovativeness mediating the relationship between a firm's resilience and its performance.

2.1.5 Supply Chain Resilience measurement

In this section, I seek to investigate different publications that have sought to assess the measurement of resilience.

Carvalho and Cruz Machado (2011) expressed their views on this and presented that Supply Chain resilience can only be measured after a disturbance has already occurred. This however leaves the question of, in what way can Supply Chain Resilience be measured? lingering.

The two gave thought to diversity, cohesion, and diversity as the main drivers of supply chain resilience. They afterwards propose a Supply chain resilience index and a Supply chain Resilience indicator.

The *ScRes Index* is a function of diversity, adaptability, and cohesion while *ScRes Indicator* is a function of the amount of change the system can undergo and the degree of self-organization.

By using the index and indicator, it is possible to measure the Supply chain resilience: The ScRes Index will give way to evaluating the Supply Chain resilience capabilities and the

Supply Chain Resilience Indicator will give way to measuring the system reaction to any disturbances.

Falasca et al. (2008) attempted to establish a quantitative method focused on three dimensions for evaluating supply chain sensitivity to disasters in their paper (density, complexity and nodes critically). They claimed that density can be determined by dividing the number of nodes by the average inter-node distance. Complexity can be measured as a function of the total number of nodes plus the total number of forward, backward, or within-tier flows in the supply chain. Finally, a node's criticality can be determined by combining its relative importance and the amount of non-redundant inbound and outbound flows from the same node. They devised a simulation model for assessing supply chain resilience.

The three propositions relating supply chain architecture characteristics and the two propositions relating supply chain mitigation capabilities to the magnitude of a supply chain disruption are depicted in Figure 6 below.

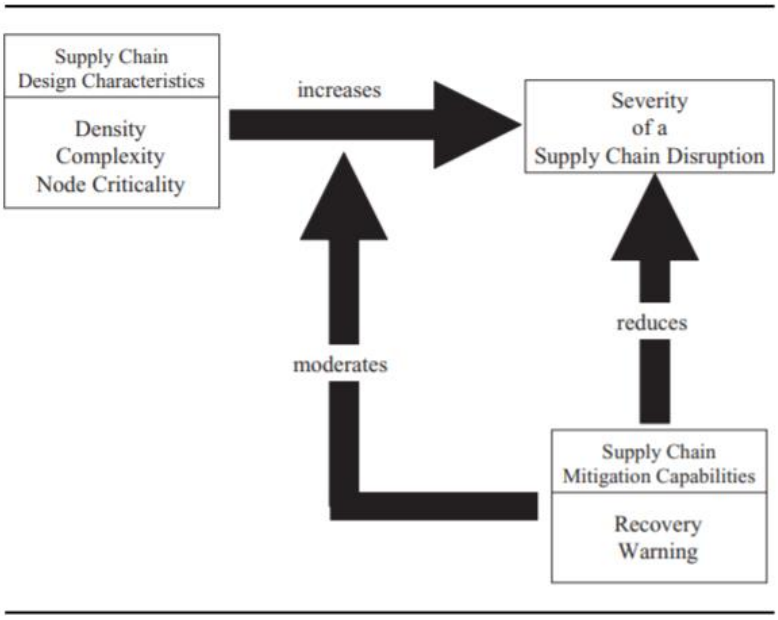

Figure 4. supply chain propositions and supply chain mitigation capabilities. (Craighead et al. 2007)

Craighead et al. (2007) give a further example to this effect of a fire breaking out inside a plant that houses sophisticated, complicated, and expensive manufacturing processes and

equipment and that provides critical parts to many customers (i.e., as relevant to this case the plant is a critical node).

A fire that spreads quickly in such an environment would have the devastating effect of slowing down critical parts downstream. However, a warning system and in this case a fire alarm that detects a pile of papers smoking when the fire is still in the starting face would be in the capacity to give quick notification and to draw attention to this danger. If such a fire detection system were tied to the recovery capability in this case the sprinkler system, a warning alarm could as well activate the sprinkler system automatically and more immediately extinguish the fire before it spreads into a hard-to-control inferno. These warning and recovery capabilities would therefore come in handy in preventing the fire from spreading quickly, burning the plant to the ground, and disrupting the flow of critical materials to the numerous customers downstream.

3 SMALL AND MEDIUM-SIZED ENTERPRISES

3.1 Definition

Small and Medium Sized enterprises (SMEs) have different definitions across the world. The definition is based entirely on the number of people that an SME employs, the firm's balance sheet total and its turnover as illustrated next.

In Kenya, an SME is defined as an organization that employs between 10 and 99 people, with an average annual turnover of between Ksh 500,000 (approximately € 3,700) and Ksh 50 million (approximately € 37,000) while in the European Union, SMEs are firms that employ less than 250 employees and have an annual turnover not exceeding 50 million euros or an annual balance sheet that does not exceed 43 million euros (European Commission, 2015; Wairimu, 2015). Figure 7 and 8 below illustrates the European definition of SMEs.

The definition of SMEs is important as in today's complex business environment, they often have close financial, operational or governance relationships with other firms. Definition with consideration to an enterprise's geographical region is therefore important to help SMEs identify themselves to different stakeholders that regulate them and can support them in whenever needed. These stakeholders can be financial institutions or government support services (European Commission, 2015).

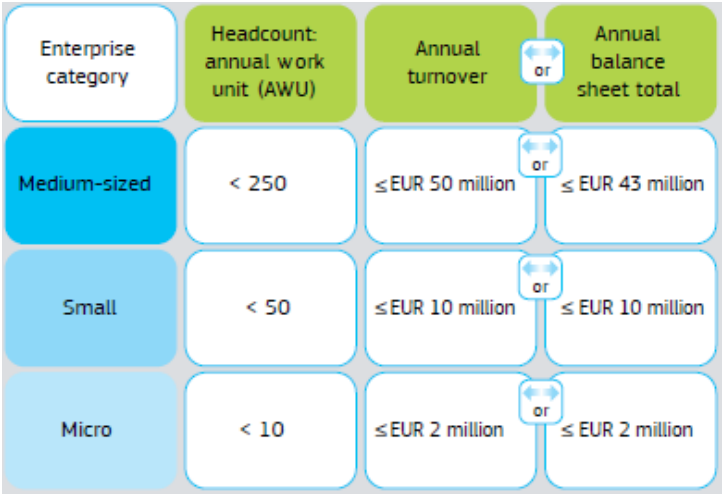

Figure 5. European definition of MSMEs (European Commission, 2015)

In essence, there exists two types of SMEs: the small traditional enterprise that most times lack a long-term strategy, has a small marketplace, with a process of making goods being inherited from one generation to the next, and the modern SME that makes use of high technology, are in a continuous search for new markets and by competitiveness, are in search on how to maximize the efficiency of their activities. (Neagy,2016)

Traditional SMEs are founded usually on the skills and talent of their founders which goes a long way in manifesting the amount of involvement that the founders put in in the overall result of their performance. The leaders of the enterprises involved are entrepreneurs who put their ideas and resources on the line to make their firms function. (Văduva, 2004).

3.2 Role of SMEs

SMEs are a major contributor to all modern economies around the world.

To highlight the role of SMEs to the European Union, the immediate former President of the European commission Jean-Claude Juncker is quoted saying that, “Jobs, growth and investment will only return to Europe if we create the right regulatory environment and promote a climate of entrepreneurship and job creation. We must not stifle innovation and competitiveness with too prescriptive and too detailed regulations, particularly when it comes to small and medium-sized enterprises (SMEs). SMEs are the backbone of our economy, creating more than 85 % of new jobs in Europe and we have to free them from burdensome regulation.” (European Commission, 2015).

SMEs play an important role in the European community. They stimulate the economy as they boost job creation, economic growth and ensure social stability and with the importance they present in promoting innovation and boosting the entrepreneurial spirit, they are a major focus of European policy.

Yrittäjät (2020) gives an insight into SMEs role in the Finnish economy by stating that SMEs have created jobs for over 150,399 individuals between the years 2001 and 2018. 87,156 of these jobs were created in companies with less than 50 people under their payroll.

Yrittäjät (2020) brings more perspective to this by stating that SMEs generate more than half (58%) of the 434 billion euros in turnover for Finnish companies giving an account of more

than 40% of the country's economy thus showing the strategic interest that the Finnish economy benefits from their existence.

Adeyeyeon (2016) adds that SMEs account for 80% of job openings in Africa, building a new middle class and accelerating demand for new goods and services. The Asian economic downturn has heightened the need for a new growth model that enhances SMEs' market and economic prospects with the goal of growing national competitiveness and social welfare. SMEs, according to Adayeyeon (2016), produce a lot of jobs. contributing directly to GDPs, aid industrial growth, meet local service demand, innovate, and provide large corporations with inputs and services in these societies.

3.3 Barriers and threats to SMEs growth

SMEs face a myriad number of challenges that impede their existence in the ever-volatile business environments that they exist.
According to Naegy, 2016, the statistical risk that affects SMEs vary as an example; in developing countries, 20% of new SMEs last less than a year, 20% last two years, and 50% do not last more than five years, leaving just 10% of SMEs with a chance of surviving more than five years. Some of the challenges affecting SMEs are highlighted below.

3.3.1 Structural barriers

SMEs are often faced with several structural barriers. Some of the structural barriers that affect SMEs include a lack of administrative and technological knowledge, labor market rigidities, and a scant view of opportunities available to them towards international expansion (European Commission, 2015)
Regarding SMEs relative scarcity of capital, it is essential for them to take advantage of SME support programmes available to them. A proper SME definition is therefore essential in all markets to ensure that the right firms benefit from these support programmes.
When leveraged, these structural barriers can however be used to the advantage of SMEs as with the reality that they are run by their owners directly, there is less bureaucracy in decision making. This is however dependant on the managerial abilities of the manager. This fact

therefore illustrates the high flexibility that exists in these firms for future development and expansion.

3.3.2 Market failures

SMEs are often faced by market failures that hinder their existence in the business environments that they operate. SMEs more than often lack capital to Invest in research and development. on new technology or a deficit of resources to invest in environmental regulations (European Commission, 2015).

3.3.3 Lack of information on public programmes and policies

In her analysis of MSMEs as suppliers to Extractives Industry Wairimu (2015) states that SMEs are disadvantaged by the lack of public access to policy and program information that are geared towards helping them. This Small and medium-sized businesses (SMEs) have a shortage of knowledge which deprives them of the ability to access development programmes.

3.3.4 Weak or absent associations

Lastly, industry associations are vital to the prosperity of SMEs as they are in a union, they collectively have a bargaining voice and negotiating power. In her article, Wairimu (2015) highlights that most industries have a union with such capabilities, but SMEs are not fully engaged with them limiting their ability to benefit from them.

Small and medium-sized businesses play an important part both economic and social in the environments that they operate. SMEs are also equally vulnerable to the uncertainty of their direct and indirect environment, the next chapter seeks to showcase a number of Supply chain resilience theories that exist in a bid to come up with a framework that SMEs can use to better predict, react and learn from these uncertainties.

4 RESEARCH DESIGN AND METHODS

This chapter seeks to expound on the research methodology used for this thesis project. The first chapter will go through the research design to help answer the research question created. The second chapter will go through the data collection methods used and the reason that led to these decisions explained further.

The third chapter comes to complement the data collection done by analysing the SMEs to gain insightful information for the study. The quality and trustworthiness control of the data used is also discussed in this chapter.

4.1 Research context/case description

This case study's main objective is to come up with a framework from which SMEs can use to enhance their Supply Chain resilience with an intended end contribution of ensuring that they can survive unprecedented events in their business environment.

The case study was chosen with regards to the contribution that SMEs have on economies the world over. The case was conducted in a time when economies around the world are directly being affected by Covid-19 which is in many ways an unprecedented event to different industry players in different sectors.

As SMEs represent different business sectors imaginable, this case study's framework was defined to only a limited amount of representatives from different industries due to the resources and challenges brought forward by the current pandemic limiting the chances of meeting even more interviewees.

Quantitative research methods which may include different forms of surveys, interviews, online polls, etc have an aim of generating numerical data that can be used to identify patterns, attitudes and behaviours. The data points derived from quantitative research methods are utilised by businesses as an example to conclude a previously predefined hypothesis. Some situations allow for further testing for a hypothesis if needed. For this study and to find the relations that exist between different aspects of the study and answer the research questions, a qualitative multiple case study was conducted.

Directly opposite to quantitative research methods, qualitative research aims to summarize the research data and create new insights based on the data (Eskola & Suoranta, 1998). According to Hirsjärvi et al. (2004), qualitative research is useful in discovering and gaining a deeper understanding of some real-life phenomenon like the underlying reasons, opinions, and motivations for certain actions. Qualitative research is also used to give proper insights to an existing problem which can eventually be converted into possible hypotheses for prospective quantitative research in later times.

This research aims to check on the current situation on preparedness and to come up with a framework from which SMEs' can boost their supply chain resilience to ensure that they stay afloat in case any uncertainty happens to their supply chain. This goes a long way in justifying the need for using the qualitative research method as an appropriate method for the empirical part of the study.

This data uses both Primary and secondary data sources. Primary data was considered to give an up-to-date perspective on the different aspects being investigated while secondary data was used to give the perspective of industry peer-reviewed articles and reviews complementing the primary data sources and increasing the reliability and validity of the work. More on the data collection methods used are highlighted in the chapter succeeding this one.

4.2 Data collection methods

This section seeks to showcase the different methods used in this research to collect data that directly aims to support the research question by giving full insight into it.

The first chapter goes through the semi-structured in-depth interview as a data collection method while the second chapter goes through the sampling process undertaken in choosing the respondents. The last sub-chapter goes through the interview process and interview guide.

4.2.1 Individual Structured in-depth interviews

To get the best perspective of the issue at hand, I saw it best to directly contact the individuals involved in the supply chain process at the different firms. This was done to help them come up with a framework that would help them improve Supply Chain Resilience to get their direct opinions and contribution on the matter at hand. Some advantages that personal interviews bring forward as a qualitative data collection method include:

i. It is perfectly suited to explore attitudes, values, beliefs and motives (Richardson et al. 1965, Smith, 1975)
ii. It allows evaluating of the validity of the respondent's answers by observing all non-verbal indicators which are useful when sensitive matters are under discussion (Gordon 1975)
iii. It makes it possible to compare different aspects by making sure that all the questions open are answered by all the respondents (Bailey 1987)
iv. Whenever the respondent is unable to answer a question, they can get some help to format the question or some sort of assistance (Bailey 1987)

4.2.2 Interviewee Selection

To get data for the research, it was needed to get suitable respondents to provide the same. With the fact that SMEs represent firms from a wide number of industries, it was essential to get the perspective of individuals from different backgrounds. Patton (2001), states that this method of sampling is widely used in qualitative research to identify and select information-rich respondents that directly increase the relevance of the topic at hand.

Notwithstanding those qualitative research publications involve small samples, the choice of sample size is a major factor as it determines the level to which the researcher can make the types of generalizations (Onwuegbuzie & Leech, 2005b). A common misappropriation about sampling in qualitative research is that numbers are not a vital factor in the formulation of a sampling strategy as noted by Sandelowski (1995 pg. 179). Therefore, sample sizes

should be an optimum number; not too big to extract rich data and not too small to achieve data saturation (Sandelowski, 1995).

To get a good number of research results for the project, a parallel sampling design was chosen. Schwandt writes that when qualitative research designs that focus on multiple cases are used, the researcher has a major goal of comparing the selected cases. In such cases, a cross-analysis is the best option for use. Even though there exist several different types of sampling designs, I decided to use stratified and criterion sampling designs which I deemed useful to my case in point.

To find the right type of respondents, I used criterion sampling. This type of sampling design method involves selecting worthy respondents that satisfy a set of predetermined criteria needed for the research. In this case, my criteria were SMEs (Patton 2002).

The second sampling design method was stratified. A stratified sampling design is a sampling technique that requires dividing the population into smaller groups or in this case into context strata to complete the sampling process. The strata are determined based on some identical characteristics in the population data. After the division, the researcher involved selects the sample proportionally to give a good and complete impression of the population. It is mostly purposed by researchers to get conclusions from different strata. In this case, I chose several SMEs that represent different industries to get a big perspective big enough to understand the topic at hand.

After an intensive networking and robust sampling process, I ended up with 5 respondents who I considered relevant to my research.

Table 2. Overview of respondents

Respondent	**Industry**	**Role**	**Number of employees**	**City, Country**	**Interview duration**
R_1	Hospitality Industry	Manager	65	Tampere, Finland	00.47

R_2	Manufacturing	Operations Manager	50	Nairobi, Kenya	01:00
R_3	Transportation	Logistics manager	85	Mombasa, Kenya	01:10
R_4	E-commerce	Delivery manager	12	Tampere, Finland	00:40

4.2.3 Interview process and guide

The interviews were conducted virtually in October 2020 complying with the current safe distancing recommendation regarding the Covid-19 Virus situation. All the respondents interviewed were living and working either in Finland or Kenya with each having different roles across the different firms and different industries involved.

All the interviews were conducted following the predetermined interview questions and the interviewer rephrased the questions whenever the respondent had a difficult time comprehending a question or needed more information on the topic before responding. Follow up questions were also asked by the interviewer depending on the different situations during the interview.

As stated by Oltmann 2016, the biggest factor in the context of an interviewer is financial costs and time. Notably, face-to-face interviews which are useful in capturing nonverbal elements of the interview can involve a substantial amount of time and finances about the need to travel from one place to another. The safety of the interviewers is on most occasions overlooked while conducting face-to-face interviews. Wilson 2012 notes that some researchers state that the safety of the interviewer may be compromised in the context of face-to-face interviewer depending on the location and time that the meeting is being held. In the case of the period when the interviews were being held, a direct safety concern was the Coronavirus which necessitated the use of different measures to get the data required to protect the interviewer and the interviewees.

Over-the-phone interviews substantially reduce these barriers according to Oltmann 2016. However, different people have different liking to telephone interviews as they may cause

discomfort (Chapple, 1999; Glogowska et al., 2011; Sturges & Hanrahan, 2004; Trier-Bieniek, 2012; Vogl, 2013). Luckily also with the advancement of technology, over the internet platforms were also considered as options for interviews. Depending on the convenience that each respondent preferred, the interviews were conducted across different platforms including telephone, Zoom and WhatsApp video calls.

All the interviews were conducted in English which is one of the native languages of the interviewer, however not all the respondents listed English as their native language. Their ability to speak and understand English was however not under question as they could honestly and fully communicate and express themselves in the language. To get even more personal responses from the interview, the role of the interviewer was kept as neutral and objective as possible (Paul, 2008).

After getting permission from the interviewees, the interviews were recorded, and the results were later transcribed to make sure that no information was lost or overlooked in the process. Note-taking was also done during the interview which is highly recommended by many qualitative researchers besides audio recording. A negative aspect to note-taking however is that it may be obtrusive and distracting to the respondent in the face-to-face interview situations (Knox & Burkard, 2009). In telephone interview situations, however, interviewers can freely take notes even though as Stephens (2007) states, can be tricky if the interviewer is simultaneously listening and at the same time trying to jot down the responses.

4.3 Interview guide

To ensure that the interviews remained on course in terms of getting the aimed results and relevant responses from the interviewees, a proper guide was followed. In this case, the interview guide followed a set of predetermined questions that helped give a general direction to the interview and thus avoid going off-topic.

The main research question was to find out *How SMEs improve their Supply Chain resilience to increase survivability in a volatile market*. An in-depth interview method was used since the approach is well suited for probing more information and question and answer clarification from both sides in the exploration of views and respondents' opinions about

complex and sensitive issues, providing room for probing more information and question and answer clarification (Barriball, 1993). The wording and sequence of all the questions in a standardized interview are the same for all the respondents to make it clear that any differences in the answers arise from the respondents rather than the interviewer (Gordon, 1975).

Hutchinson & Skodol et al., (1992) also give some weight to semi-structured interviews by stating that this way of conducting interviews gives the interviewers choice in the wording of each question depending on how they understood the prior question. Probing as a technique is useful to the respondents in many ways as it; allows clarifying interesting and relevant issues that the respondents may have according to Hutchinson et al., (1992). Nay-Brock (1984) also state that probing, semi-structured interviews allow for the exploration of sensitive issues. Austin (1981) on the other hand says that semi-structured interviews give way for a complete disclosure of information. Semi-structured interviews allow the interviewer to explore and clarify inconsistencies in respondents' responses according. With the fact that some questions arise from memory, Smith (1992) states that Semi-structured interviews come in handy in such situations.

Patton (1990) also weighs in on probing by stating that this style in semi-structured interviews allows creating a good rapport between the two parties and hence reduce the risk of getting socially desirable answers. These answers according to Bailey (1987) may be more complex regarding the respondents' and interviewers' differences in the sense of age, gender, ethnicity, or education.

The style employed in the interviews also allowed the interviewees to add some more information to the topic that the interviewees had not thought of but would give a big contribution to the theme.

4.4 Data analysis methods

With consent from the respondents, the interviewer used his phone to audio record the conversations and after each of the interviews were transcribed on paper. The researcher then took the liberty to thoroughly scrutinize the transcripts to find common trends and

responses in the responses and noted the differences to ensure that the full picture for the topic under research. These trends were then color-coded as suggested by Patton (2002) with each separate colour representing a category and were transferred to a separate file for more analysis.

Patton (2002) suggests discarding the texts from the separate categories that are found to be unrelated to the research at hand or would be too revealing of the interviewee's identity. After the colour coding, the categories were then studied, and a proper comparison was done. Similar categories were then brought together into larger abstracts with the process being repeated a few times as suggested by Spiggle (1994). The following chapters portray the results of the thorough re-reading of the transcripts and sorting of the categories regarding the responses gotten from the interviews.

4.4.1 Quality of the research

This research project did not use any statistical means to achieve the research findings. On the contrary, the data analysis method used is interpretive which means that there may exist disparity in how people interpret the results hence concluding to be a hard thing to come by. Pratab (2018) states that making sure that the quality and trustworthiness of qualitative research becomes an uphill task. In the case of this thesis, the researcher took some precautionary measures, however, to ensure that the integrity of the project remains at the highest level.

As a first step, the researcher has provided a proper description of the environment and context under which the research was done. This goes a long way in showing the reader all the information that they would need when considering the applicability of the results. As a bonus, all the data, methods and decisions taken have been duly showcased to give the possibility of the study being repeated within a different set of circumstances as recommended by Lincoln & Guba (1985).

To ensure full transparency in the research, the researcher audio-recorded and later transcribed all the interviews and explained the interview guide, the creation process and the analysis method used. Later, to increase credibility, a copy of the transcript was sent to the

corresponding respondents to give a thought on the same and clarify whether there exist any misunderstandings.

Also, the researcher used criterion and stratified methods of sampling for respondents hence ensuring the satisfaction of the data required to make sure they get the information required from a diverse collection of organisations, industries roles of the participants and the type of participants.

Lastly, to ensure the trustworthiness of the results, the findings reported include direct quotes from the interviews and the analysis procedures employed to avoid judgmental bias.

5 FINDINGS

This chapter contains the results of the research further helping to analyse the practical example use of the Supply Chain Resilience principles by the firms. The subsequent sub chapters also highlight different elements that the firms have taken to enhance their resilience efforts. The findings of the research consequently help to answer the report's questions 1-3 and thus make a good assessment of SMEs' Supply Chain resilience.

5.1 Supply Chain Reengineering

In the interviews conducted, Supply Chain reengineering was a reoccurring step that the firms had taken in their supply chains to help them mitigate different scenarios. With the fact that the respondents come from different industries, it also meant that they had different backgrounds and thus their Supply chain reengineering efforts were varied. Below are some of the aspects of Supply chain re-engineering as mentioned by the respondents.

5.1.1 Flexibility

Lead time and cost as variables, were observed to be big defining factors when considering the potential suppliers in all the cases. With this mentioned, all the respondents seemed to prefer having a flexible sourcing scheme to ensure that any short on the suppliers' ability to deliver was duly taken care of. In all the interviews, the respondents mentioned some ways to which they used flexibility as a measure to ensure that their Supply Chain disruption is duly mitigated in good time. To get a better perspective, the following are some of the findings from the interviews.

On flexibility, Respondent 1 acknowledged the impact of different seasons on the nature of their business. Labour is also a significant cost on their balance sheet and thus flexible labour arrangements with their non-core employees who make up 85% of their staff was a way in which they ensured varying seasons did not affect their labour cost budget.

Respondent 2 also weighed in on this by stating that they have a network of partners to whom they outsource their transportation needs. This ensures that they always have a transport supplier offering the best market price. With seasons also largely affecting their business, owning their own fleet means maintaining their fleet during their low season which translates to unnecessary costs. This further enables them to specialize on production quality which in the end is good for business.

The second respondent also adds that due to the seasons, flexibility allows them to process different fruits along the same line when their main product runs out at the nearby farms.

5.1.2 Redundancy

Redundancy was also a major factor that all the enterprises considered as a way of reengineering their supply chain in their operations. Even though in most cases it required more resources, investment in redundancy across the firms was highly recommended as a supply chain resilience measure. The findings below give a better perspective of the respondent's thoughts on the same.

Respondent 1 states that their main supplier does their delivery round once a week and thus giving them a dilemma whenever the mentioned supplier messes up an order or such force majeure. Redundancy allows them to find the same product from a different wholeseller at less convenience and less profit margins after selling in order to satisfy their customers. Respondent also suggests ideally having half a stock as a minimum in their storage as a way to ensure product availability in the case of the inevitable. The downside of this however is the heavy investment involved.

Respondent 4 also gives a thought to the downside of overstocking by stating that the risk of ending up with deadstock is the biggest downside of overstocking which sometimes leads to spoilt goods or them having to sell them at a lower price.

5.2 Collaboration

A review of the interview data shows that all the respondents acknowledged the need for collaboration as an effort that they can use to optimize their operation. Sharing of the information gathered in their supply chain would go a long way to ensure better preparedness and an overall improved business environment if there is knowledge of what is happening at all ends.

Despite this acknowledgement, only R_1 gave an example of how they collaborated with their suppliers. He states that when their suppliers want to launch a product, they consider giving them to them at a discount which allows them to market it as a campaign helping raise awareness while at the same time ensuring a profit for the respondent.

The other respondents however did not have any direct channel to which they collaborated or as an example shared their sales data upstream or downstream to help either of the parties optimise their operation. R2 gives a perspective on this by stating that the only possible place their suppliers can get sales numbers is by checking the amount of orders over time.

5.3 Agility

In the interviews conducted, the respondents gave weight on the importance of agility in their supply chains as a supply chain resilience measure. Some of the proactive elements that the firms went ahead to undertake include a change in their global sourcing strategy by example, nearshoring as illustrated below.

Respondent 2 states that they face a varied number of problems and with distance, different modes of transport at play, it is even harder for them to get products in those circumstance. They mention that they have in a lot of occasions had to buy their supplies from vendors close home as a way to leverage the risk of an unpredictable supply chain. They also mention that the bureaucracy at their border customs unit makes even more uninviting leading them to mostly consider local suppliers.

To help improve their Supply chain agility, the respondents also mentioned acquiring business certifications with their industry governing bodies. These business certifications while being required by the law in all the occasions, helped ensure that there was due compliance with the varied industries and improved the credibility of the different systems that exist. Agility of firms is important as the funds are usually used in research by the governing bodies to ensure better sensitizations in the industry and eventually as a recovery measure. Some of the benefits observed included collective bargaining possibilities to ensure reduction of barriers in business and provision of recovery funds on some occasions.

As an agility measure, Respondent 3 spoke of doing biannual training programs for their drivers to ensure they had current skills to solve the ever-evolving industry problems. This was a bid to ensure a seamless working environment and more consistent deliveries.

Respondent 3 talked of organising technical retreats annually as a way to educate their technical staff on the industry best practices which goes a long way to ensure efficiency and consequently the agility.

Financial institutions also come in handy to help enhance the agility of SMEs as R4 states. They mention that in tough times with an example in the last year, they received a reprieve as their banking service provider announced flexible payment plans aimed at SMEs as a way to ensure they survived the negative effects of the economy.

5.4 Supply Chain Resilience Culture

Based on the data acquired from the interviews, a previous adaptation of some form of Supply Chain resilience Culture was observed. A SCRes culture was key to ensuring that a long-term view of the supply chain was at the centre of all decisions made in their firms. This is better illustrated in the examples below.

5.4.1 Leadership

As a Supply Chain Resilience culture aspect, leadership was one of the ways that all the firms considered as a measure to help them ensure supply chain resilience.

Respondent 2 states that their leadership is at the backbone of their firm's operations and their managers have a direct role of ensuring resilience exists across their firm. In the job's description, there exists a clause for the managers to ensure they understand the firm's change patterns in the business environment giving proper guidance on adaptability and ensuring that the firm learns for their future.

In all the cases, the founders of the SMEs were individuals who had some experience in the industry. This provided a good technical advantage at the start.

All the respondents admitted to having a thorough hiring process that ensured all the staff hired and, in this case, leaders were qualified enough to make long term and dynamic decisions to our business and for this case our supply chain.

5.4.2 Innovation

Innovation was a factor that all the respondents agreed to having with an intention of helping them improve resilience. Innovation was a way to help keep up with their competitors and thus stay at the best of their capacity. To help highlight this more the following are some of the responses from the interviews.

Respondent 1 states that innovation in the service sector which they represent is mainly on ideas. On a weekly basis, they have an analysis of the previous week's sales and inhouse successes and lack thereof with an aim of coming up with improved ways of operating. Respondent 3 adds to this by mentioning that they introduces tracking devices on their transport vehicles leading to a significant drop in fuel loss which proved the importance of technology and innovation in enhancing total control of their supply chain. The fourth respondent mentions website optimization as a way to ensure customer experience and help boost their business.

5.5 Supply Chain Resilience Measurement

SCRes measurement was a visible aspect in all the interviews conducted. Even though not directly mentioned, each of the respondents mentioned an aspect in their supply chain that indicated to supply chain measurement.

Some of the opinions on Supply chain measurement are highlighted below.

The first respondent gives a thought on their sales and visitor numbers as a way in which they measure and try to predict the future and make appropriate adjustments to their supply chain.

Table 3 below showcases a summary of the findings from the interviews conducted with the respondents regarding the Supply Chain resilience Principles.

Table 3. Interview Findings.

	Respondent 1	**Respondent 2**	**Respondent 3**	**Respondent 4**
Supply Chain Reengineering	- Flexible Labour arrangements. - Flexible Sourcing - Leasing agreements - Redundant suppliers - Safety stock	- Flexible Sourcing - Flexible Transportation - Flexible Labour arrangements. - Flexible payment systems.	- Subcontracting - Flexible labour agreements -flexible sourcing - flexible manufacturing capacity - flexible transportation. - Rerouting	- Leasing of warehouses
Collaboration	- In marketing for their suppliers - Demand forecasting	- Demand forecasting -	- Demand forecasting	- Risk sharing
Agility	- Business Certifications - Tax payments - Trainings	- Nearshoring - Business Certifications	- Near shoring - Business Certifications	- Nearshoring - Business Certifications

	- Feedback - Financial holidays with lending institutions - Industry law compliance - Responding to customer needs	- Tax payments - Trainings - Feedback - Payment agreements with lending institutions - Responding to customer needs	- Tax payments - Trainings - Feedback - Payment agreements with lending institutions - Responding to competition strategies	- Tax payments - Trainings - Feedback - Payment agreements with lending institutions - Responding to competitor strategies. - Responding to customer needs
Supply Chain Resilience Culture	- Hiring of knowledgeable staff. - Use of technology in payment systems - Resilient management practices - Risk management practices.	- Resilient management practices - Risk management practices.	- Use of technology - Tracking of transport vehicles - Risk management practices.	- Use of technology to optimise services. - Risk management practices.
Drivers of SCRes	- Cost Optimization - Customer satisfaction - Reduced Leadtime - Demand planning - Better risk management - Reduced inventory levels - Flexibility - Velocity - Visibility	- Cost Optimization - Customer satisfaction - Reduced Leadtime - Demand planning - Improved product quality - Economies of scale in production - Reduced inventory levels	- Cost Optimization - Customer satisfaction - Reduced Leadtime - Demand planning - Economies of scale in production	- Economies of scale in production - Reduced inventory levels - Reduced Leadtime
Barriers of SCRes	- Cost - Lack of credit - Technology - Organizational challenges	- Cost - Lack of credit - Technology - Lack of metrics	- Organizational challenges - Lack of adequate security and safety within the supply	- Cost - Organizational challenges - Alignment

	- Lack of metrics - Alignment barriers.		chain - Alignment barriers.	barriers. - Lack of credit

6 DISCUSSION

In order to answer the research questions, this chapter seeks to bring together the information gathered from the literature and interviews. From the evidence as showcased in the discussion below, it is clear that there exists some form of ScRes in the firms however varied and inconsistent. The SCRes Principles as proposed by Christopher and Peck (2014) further help guide the discussion.

6.1 Supply Chain Reengineering

Supply chains have a main purpose of ensuring that their costs are optimized, and their customers are satisfied. Resilience in many ways helps firms and, in this case, SMEs ensure that these objectives are achieved. Conventional supply chains therefore need to be redesigned to include resilience into their functioning (Wilding, 2013).
From the interviews conducted, the respondents mention lead time and cost as the important defining factors when choosing partners to have in a supply chain. This therefore makes it a necessity for managers in a position to reengineer their supply chains do so in a way that ensures that lead time is reduced to the least and cost is minimized.

Several factors according to Christopher and Peck (2004) are important when reengineering supply chains and they include: Supply chain understanding, risk awareness of suppliers, and a proper assessment of the trade-offs that need to be considered between costs and flexibility in global supply chains before any decision is reached.

Kamalahmadi and Parast (2016) discuss flexibility and redundancy as basic components of supply chain reengineering as illustrated next. Flexibility is an important step when reengineering a supply chain as it allows the possibility of building extra or less capacity with an aim of ensuring survival in the event of an unexpected event in an SME's supply chain (Lee, 2004).

Different ways in which firms can increase flexibility include, adopting flexible production facilities, having flexible labour arrangements, flexible capacity, flexible payment systems, flexible sourcing strategies, rerouting etc. (Tang,2006a; Tomlin,2006; Tang and Tomlin,2008.)

Redundancy on the other hand is a component as introduced by Kamalahmadi and Parast (2016) that SMEs can consider when reengineering their supply chain in the path to seeking resilience. Some of the ways in which SMEs can ensure redundancy in their supply chain include having multiple suppliers, overcapacity, having safety stock etc (Sheffi, 2005; Tang,2006a; Tomlin,2006; Sodhi and Lee,2007; Knemeyeretal.,2009)
Flexibility and redundancy, however, come with a high direct and indirect cost attached to it as it involves investing in extra capacity that may not be immediately needed or used.

Supply chain disruption functions include warning and recovery capabilities and Craighead et al. (2007) also mention density, node and complexity as important factors when redesigning a supply chain. These factors help SMEs' supply chains mitigate the effects of disruption on them by enhancing their detection and recovery capabilities. Blackhurst et al. (2011) also adds to this by stating that the more the nodes in a supply chain are, the more complex a supply chain is and the more the likely hood of a disruption. They also add that suppliers located in riskier areas and are clustered geographically would subsequently raise the possibility of disruptions within a supply chain, hence making these factors important when redesigning a supply chain.

Brandon-Jones et al. (2014) point out that supply chain firms should understand their supply networks as a way of managing supply disruptions. In their article, they suggest investment for each structure to increase supply chain resilience.

Finally, on Supply chain reengineering, Winston (2014) states that firms should change their strategies in the following ways. Rethink their vision embracing innovation and having a long-term mindset, redefine their valuation methods with an aim of giving an account for unpriced costs and benefits and firms should look for partners to achieve goals as a supply chain.

6.2 Collaboration

Supply chain collaboration is featured as the second principle that SMEs can adopt to enhance their supply chain resilience.
In their definition, Faisal et al. (2006) state that collaboration is the glue that holds supply chain organizations in a crisis together."
With the fact that supply chains compete against supply chains, vulnerability becomes a phenomenon that runs through the whole network (Christopher and Peck, 2004). Risk management across supply chains that are highly interconnected must have a high level of collaboration and partnership among its members to ensure that there is proper examination across the supply chain.

Two elements that are essential when building cooperative relationships between different firms include Inter-firm trust and information sharing (Kalahmadi and Parast, 2016).
In his study on mutual trusting behaviours, Panomarov (2009) states that a big percentage of mutual trusting behaviours consequently can cause improved resilience in buyer-supplier relationships. He also states that a longer collaborative relationship has a direct influence on the strength that exists between mutual trusting behaviours.
Faisal et al. (2007) adds to this by stating that trust helps firms cement their cooperation and collaboration in the organization itself and across the supply chain with its partners.

The second element when building cooperative relationships is Information sharing.
Information sharing can be used as a driver for collaboration and as a driver of resilience in firms.
The development of a supply chain community should be the highest priority for collaborative working and risk reduction that has swift interchange of information among the members of the supply chain (Christopher and Peck, 2004). Wicher and Lenort (2012) also state that the collaboration and relationships within members of a supply chain can be enhanced by data and information sharing, building trusted networks, forecasting and planning.

On using information sharing to improve resiliency, Blackhurst et al. (2011) in their article, encourage firms to have a predefined communication protocol to efficiently counter the effects of disruptions.

Some of the ways in which firms can enhance supply chain collaboration with their firms include, creating cooperative, joint training programs contracts all in a bid to increase flexibility, velocity and visibility through the whole supply chain.

Some of the benefits of supply chain collaboration include, cost reduction, demand planning, improved product quality, economies of scale in production and better risk management. (Chopra and Mendhl, 2001).

Information technology which has eased sharing of information is the driver of collaboration as supply chain partners can share information on markets, demand and supply within no time, reduced inventory levels, improved customer services because of reduced lead times etc. (Gumboh and Gichira, 2015; Rowland, 2008; McLaren et al., 2000).

Some of the barriers to supply chain collaboration include lack of credit; limiting the financial capability for SMEs in their path to ensuring resilience, technology barriers as on most occasions with the lack of capital, they do not invest in technology that ensures efficiency and consequently resilience.
Organizational challenges are also barriers which result from partners' own lack of management commitment to collaboration. Lack of metrics is a barrier that results in a lack of visibility across the supply chain which then eventually leads to hardship in achieving performance improvements. Lack of adequate security and safety within the supply chain as different partners invest different amounts in security hence increasing vulnerability to system hacks among other security issues consequently affecting the whole network and relationship barriers among the partners and finally alignment barriers which feature inconsistent goals, objectives and poor measurement practices within the collaborating firms.

With the stated analysis on the benefits and barriers, Christopher et al. (2011) state that many companies do not consider investment in collaboration as an important step to resilience.

This is also evidenced by the fact that none of the respondents have a collaboration framework with any of their suppliers.

6.3 Agility

The third supply chain principle discussed is agility. Agility refers to a supply chain's ability to react quickly to change by adjusting its initial configuration status and moving to a different position (Wieland and Wallenburg, 2013). The two further state resilience has two dimensions i.e., the proactive dimension ideally covering the robustness and the reactive dimension which covers the agility further showing that in the event of disturbances or emergencies, agility and responsiveness of a supply chain are related.

Some of the proactive ways in which the respondents worked to increase their supply chain resilience include, vertical integration which involves either buying other firms in the supply chain or collaborating with them, acquiring business certifications in order to involve the authorities in research and lobbying to enhance resilience, training and development across the supply chain etc.

Some of the reactive ways mentioned by some of the respondents include, responding to different customer needs, responding to competitors' strategies on different sectors, multi sourcing, public-private collaboration etc. all in a bid to ensure resilience in the supply chain in case of a disruption or emergency.

Christopher and Peck (2004) gave a thought to visibility and velocity as dimensions of agility.
The ability to see the state of a company's operating assets and the surrounding world is known as visibility, achieved by close collaboration with a firm's suppliers and customers and it is a result of investment in information sharing (Christopher and Peck, 2004).

The second dimension is velocity and as Christopher and Peck (2004) suggest, it equals distance over time. Jüttner and Maklan (2011) state that the loss that occurs per unit of time in a risk event is determined by velocity.

Jüttner and Maklan (2011) further state that velocity had a positive effect on the firm's sales goals, contributing to their versatility by increasing the adaptability of the supply chain.

Christopher and Peck (2004) suggested three formations for a better supply chain velocity: using simplified methods, which means performing activities in parallel rather than in series and e-based rather than paper-based, removing non-value-added time, which means reducing time for activities that do not add value from the customers' viewpoint, and finally, reducing bound lead times meaning being able to respond rapidly and cope with short term changes.

As observed from the respondents, Leadtime is a main factor affecting their supply chain choices and as Spiegler et al. (2012) the resilience performance of a supply chain drastically changes whenever the lead time changes.
Reduced production and transportation lead times are emphasized by Carvalho and Cruz-Machado (2011) as activities that increase resilience and dependence, with Jüttner and Maklan (2011) adding that redundant supply chain resources fix the velocity of the entire supply chain by reducing lead times.

6.4 Supply Chain Resilience Culture

The fourth Supply Chain principle as proposed by Christopher and Peck (2004) is SCRes. After assessing their supply chain, their firm’s emphasis on having an organizational culture as a management practice that seeks to create a resilient organisation. Soni et al. (2014) state that a culture of risk management is an important enabler to resilience beside agility and visibility.

Different literature on organizational culture regarding resilience present two aspects: Leadership and innovation.
On leadership, Christopher and Peck (2004) state that in the process of cultural change at the organizational level, the support and commitment of leadership. All the respondents agreed to this as they believed the leadership while having an oversight role on decisions, were at the best position to initiate an organizational culture change to enhance resilience.

Innovation plays a crucial role in how an organization adapts and reacts to changes in their climate, and innovation is a significant defining factor for an enterprise's long-term strategy (Viljande and Gonzalez, 2007). According to Akgün and Keskin (2014), there is a clear correlation between organizational resilience and a firm's product innovativeness, with product innovativeness mediating the relationship between a firm’s resilience and its performance.

6.5 Small and Medium Sized Enterprises.

Small and Medium sized enterprises are an important part of economies around the world. SMEs represent a vibrant type of economies that have proven to be important and too significant to be ignored.

Some of the benefits that SMEs present include the fact that they generate income for millions working in them, provide a source of goods and services, drive competition and innovation, initiate new business techniques, products, and services, foster an enterprising culture, boost industrialisation, improve the social wellbeing of individuals running and working under these enterprises (Yrittäjät 2020).
Some of the characteristics that SMEs possess include, ease of entry and exit, have a limited access to formal credit, small scale nature of activities, require less capital and equipment to start and run, use labour intensive technology, use a low level of organization with a limited access to organized markets etc., further showcasing the role that they play in enhancing the entrepreneurial spirit in the economies that they exist in.

SMEs, however, face a myriad number of Supply chain challenges including, weak or absent associations, structural barriers, market failures, and a lack of awareness on public programmes and initiatives which threaten their existence (European Commission, 2015; Wairimu 2015).
Supply chain resilience would however come a long way to ensure that they leverage these challenges and ensure they survive for longer and be able to grow to newer heights.

7 CONCLUSION

The objective of this research project was to investigate the current supply chain resilience capabilities of SMEs with an aim of enhancing the same and come up with a system that helps them anticipate, resist and eventually recover from volatilities that face their supply chains.

The findings of the research show a great deal of ways in which SMEs have adapted to ensure that they are cushioned against volatilities. The findings, however, shows that there exists a lacking in some Supply chain resilience respects which has made them vulnerable to volatilities.

The research question for this research is *How can SMEs improve their Supply Chain resilience to increase survivability in a volatile market?* with the following sub questions.

RQ1. What Supply Chain resilience measures are available to SMEs?
RQ2. How can SMEs adopt Supply Chain resilience measures to their operations?
RQ3. What is the impact of adopting Supply Chain resilience measures for SMEs?
These sub questions help provide extensive support and enhance the understanding of the main research question.

As the focus of this research, Small and Medium Sized enterprises represent businesses that are dynamic and that play a significant role both economic and social to the modern society. These types of businesses are important to economies as they are a source of employment, boost the entrepreneurial abilities of the people working in them, and increase innovation in the societies they represent. SMEs' ability to develop and assimilate new technology and techniques into their functions proves their importance to the future economies.

As Naegy (2016) states in their article however, SMEs in different parts of the world are faced with a varied number of negative stimuli that affect their existence with about 50% of them failing within the first 5 years of their existence. Several varied reasons including organizational barriers, lack of credit, weak or absent associations, market failures, structural barriers etc contribute to some of these negative factors that affect SMEs.

SCRes on the other hand is a business concept that seeks to ensure supply chains adapt, resist and recover whenever they are faced with unexpected events that affect their normal operations.

SCRes is necessitated by the fact that the world of business is affected by increased globalization, just in time concepts, global disease pandemics etc which adversely affect the progress that supply chains aim to achieve.

Christopher (1992) states that present day businesses have shifted from individual firms competing against each other to supply chains competing against other supply chains in the race to satisfy the end customer and eventually increase the competitive advantage.

This research project therefore presents a complete framework that Small and Medium sized enterprises can use to incorporate resilience into their supply chains with an aim of ensuring that they are ready for and learn from unprecedented volatilities in their environments.

7.1 Theoretical contribution

This research has taken a review of current Supply chain resilience practices and made them relevant to Small and Medium Sized Enterprises which previously has been under researched. Through the Supply chain Resilience Principles, SMEs can adopt these practices and further increase flexibility, form redundancies, collaborate further and boost their agility capabilities in their supply chains. The empirical study conducted on 4 different firms in two different countries at different levels of development gives a suitable contribution to understanding SME Supply Chain resilience in the context of firms in those contexts.

7.2 Managerial Implications

The results that this study has achieved gives a framework for SMEs to consider while building a supply chain resilience plan side by side with their partners. The factors facilitating and possible barriers that they may face at each level in the Supply Chain

resilience building process are also highlighted hence ensuring sustainability and overall competitiveness.

7.3 Limitations and suggestions for further research

The first limitation comes from the data collection part of the study. With the fact that in depth interviews were used to collect data for the research, there might be biases made by the interviewer or during the interpretation. Honesty and lack of understanding during the interview on the part of the respondent are also valid limitation concerns for the research.
The second limitation comes from the fact that SMEs interviewed represent firms from a varied number of sectors, this research is limited in the sense that it was not able to get the perspectives of more industries. This may limit the applicability of the supply chain resilience measures proposed.
The last limitation is that the respondents only represent Finland and Kenya. This makes it harder to generalize the supply chain resilience steps as other regions in the world are not duly represented.

Future research on the topic of SMEs supply chain resilience can be done to research on industry specific and geographical specific assessment and enhancement of SME Supply Chain Resilience.

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9 APPENDICES

9.1 Appendix 1: Interview request letter

Hello,

My name is Edward Makutwa, an MSc Supply Management student at Lappeenranta University of Technology. I am in the final stages of my master's studies and am now doing my thesis research project bringing me to the reason as to why I am writing this email.

I am writing a thesis titled "**ASSESSING AND ENHANCING SUPPLY CHAIN RESILIENCE FOR SMEs"** and would be interested to hear on ways in which your firm has been affected, recovered, and learnt from different volatilities that may have affected your supply chain.

The interview will take place in about forty-five minutes so I would ask you to please reserve the same on your schedule. I have a set of prewritten questions to help guide the interview and the interview depending on your preference can take place on either WhatsApp call, Zoom or teams.

I would be glad if you are able to grant me an interview and please feel free to contact me directly through this **email** or through my personal phone number **0xxxxxx** if you have any questions or concerns.

Best regards
Edward Makutwa.

9.2 Appendix 2: Proposed interview questions

1. Please give a brief description of your supply chain design and general flow of information and materials.
2. What kind of disruptions do you face as a company in your supply chain (upstream and downstream)?
3. How and when were these disruptions discovered?
4. What challenges do you face as a company or as a person responsible for implementing a supply chain resilience plan?
5. What kind of mitigation efforts did your organization undertake to reduce the impact of these disruptions?
6. In what ways do you build resilience and make sure that supply chain resilience is maintained in a turbulent business environment?
7. What are the direct benefits or lack thereof of supply chain resilience that you have been able to document?
8. What is the optimum level of investment on supply chain resilience strategies?
9. Do you have any form of predicting indicator for some supply chain disruptions that prompt you to react and thus boost resilience in some way?
10. What information do you share with your suppliers? Do you have any strategic suppliers that you share more information to?

9.3 Appendix 3: Definitions of Supply chain Resilience

Table 1. Definitions of Supply Chain Resilience

Author	Year	Definition
Barroso et al.	2010	SCRes is the supply chain's ability to react to the negative effects caused by disturbances that occur at a given moment in order to maintain the supply chain's objectives.
Brandon-Jones et al.	2014	SCRes is defined as the ability of a system to return to its original state, within an acceptable period of time, after being disturbed.
Carvalho et al.	2011(b)	SCRes is concerned with the system's ability to return to its original state or to a new more desirable one after experiencing a disturbance and avoiding occurrence of failure modes.
Carvalho et al.	2012(b)	SCRes is the ability of the supply chain to cope with unexpected disturbances.
Christopher & Peck	2004	SCRes is the ability of the supply chain to return to its original state or move to a new, more desirable state after being disturbed.
Christopher & Rutherford	2004	Resilience is the ability of a system to return to its original (or desired) state after being disturbed.
Closs & McGarrell	2004	SCRes is the supply chain's ability to withstand and recover from an incident. A resilient supply chain is proactive. anticipating and establishing planned steps to prevent and respond to incidents. Such supply chains quickly rebuild or re-establish alternative means of operations when the subject of an incident.
Datta	2007	SCRes is not only the ability to maintain control over performance variability in the face of disturbance but also a property of being adaptive and capable of sustained response to sudden and significant shifts in the environment in the form of uncertain demands.
Datta et al	2007	Resilience of the supply network is the ability of the production–distribution system to meet each customer demand for each product on time and to quantity.

Erol et al.	2010	Resilience is a response to unexpected or unforeseen changes and disturbances, and an ability to adapt and respond to such changes.
Farasca et al.	2008	SCRes is the ability of a supply chain to reduce the probabilities of a disruption, to reduce the consequences of those disruptions when they occur and to reduce the time to recover normal performance.
Gaonkar & Viswanadham	2007	SCRes is the ability of a supply chain to maintain, resume and restore operations after a disruption.
Guoping & Xinqiu	2010	SCRes is the ability of the supply chain to return to its original or ideal status under emergency risk environment.
Longo & Oren	2008	Resilience is a critical property that, in a context of supply chain change management, allows the supply chain to react to internal/external risks and vulnerabilities, quickly recovering an equilibrium state capable of guaranteeing high performance and efficiency levels.
Pettit et al.	2010	SCRes is the ability to survive, adapt and grow in the face of turbulent change.
Ponis & Koronis	2012	SCRes is the ability to proactively plan and design the supply chain network for anticipating unexpected disruptive (negative events), respond adaptively to disruptions while maintaining control over structure and function and transcending to a post robust state of operations, if possible, a more favourable one than that prior to the event, thus gaining a competitive advantage.
Ponomarov & Holcomb	2009	SCRes is the adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function.
Ponomarov	2012	SCRes is the adaptive capability of a firm's supply chain to prepare for unexpected events, respond to disruptions, and recover from them in a timely manner by maintaining continuity of operations at the desired level of connectedness and control over structure and function.

Rice & Caniato	2003	Resilience in the supply network environment is the ability to react to unexpected disruption and restore normal supply network operations.
Sheffi	2005	Resilience in terms of the corporate world is the ability of the company to bounce back from a large disruption including the speed with which it returns to a normal level of performance.
Shuai et al.	2011	Resilience is defined as the rapid recovery ability to equilibrium after the supply chain is attacked by a disturbance and we use the recovery time to measure the ability.
Xiao et al.	2012	SCRes is the supply chain's ability to return to the original or ideal status after external disruption and includes both the abilities of adaptability to the environment and recovery from the disruption.
Yao & Meurier	2012	Supply resilience is defined as the ability to bounce back from disruptions and to permanently deal with and respond to the changing environment.