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An Investigation of Relational Behaviours and Supply Chain Risk Information Sharing: A Mixed Method Study of Firms in Nigeria

by

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Declaration of Authenticity and Author's Rights

This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.

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Some parts of this thesis have been presented in academic event and conferences:

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Dedication

This thesis is dedicated to all life-saving whistle-blowers, dead and alive, from all works of life, and particularly to Dr Li Wenliang, who was among the medical professionals who warned colleagues and others about the Coronavirus (Covid-19) outbreak at Wuhan. His actions based on the relationship with his colleagues reflect on why firms should encourage its employees to build informal relationships which can be leveraged for sharing risk information in supply chains.

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Abstract

Supply chain risk information sharing is one of the proactive strategies for mitigating risks and making supply chains more resilient. The ability to sense threats before they disrupt the supply chain is strengthened by risk information from supply chain partners and other stakeholders who are usually not mandated to share risk information. This study responds to calls (Sheffi and Rice Jr., 2005; Juttner and Maklan, 2011; Johnson, Elliott and Drake, 2013) for advancing the research on supply chain risk management especially in the developing country context which Tukamuhabwa, Stevenson and Busby (2017) argues that the way in which threats are handled may differ.

Antecedents such as trust, relationship length, commitment and reciprocity have been identified as relational enablers in the literature; however, they might not be sufficient or be the only enablers for firms to share supply chain risk information from the onset of a supply chain relationship, especially in the context of Nigeria. Apart from the cultural peculiarities of Nigeria, which affect business practices and relationships, there is on-going insurgency in the North-east and other human-made risk events that disrupt supply chains in the country. Hence, there is the need to carry out research of this kind that investigates how firms in Nigeria mitigate supply chain risk by leveraging on their informal relationships to share and receive risk information.

This thesis addresses this research gap by first focussing on collecting qualitative data through semi-structured interviews from supply chain managers, about the relational behaviours they leverage for supply chain risk information sharing. Data from the interviews were transcribed and coded for thematic analysis. Three propositions relating to relational closeness, relational incentive, and collective prosperity emerged. Subsequently, the result of the qualitative strand was used to develop a survey instrument and was administered to members of the Chartered Institute of Procurement and Supply in Nigeria.

Data for the quantitative strand was collected through an online and self-administered questionnaire. Partial least squares structural equation modelling was used to analyse the quantitative data. The result indicated that relational closeness and collective prosperity have a significant influence on supply chain risk information sharing. However, the result does not find support for the relationship between relational incentive and supply chain risk information sharing. A mixed method discussion was further presented to explain how the quantitative findings generalised the qualitative result.

The originality of this research lies in its attempt to integrate social capital and social network theories with supply chain management literature to create new knowledge of how to mitigate supply chain risk in the Nigerian context. The overall theoretical implication of this study is that it contributes to supply chain management literature by identifying new relational attributes that are vital in enhancing supply chain risk information sharing. Regarding the managerial implication, this research highlights the need to consider investing in social relationships, particularly through relational closeness and collective prosperity as a means of receiving and sharing supply chain risk information in the sample firms.

Although the findings of this study are only generalised to the sample, the findings could be insightful to multinational firms operating or expanding their supply chain to Nigeria on the need to enhance relational closeness and collective prosperity for supply chain risk information sharing. In light of the findings of this study, limitations and areas for future research were outlined.

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1. Introduction

This section presents the motivation and background to the research; which helps in stating the personal reasons why the researcher embarked on this research. Yet, the background to the research starts with a broader explanation of the research; regarding efforts by firms to make their supply chains more resilient to disruption. By providing this wider discussion about the background, it is expected that a better understanding of the research problem can be achieved. The section also presents the research aim, research question, contributions, a brief description of the research methodology and subsequently, the structure of the thesis.

1.1. Research motivation

The motivation for this research came from an interest in businesses – particularly their supply chains - that were affected by the insurgency in North-Eastern Nigeria. I was curious about how businesses in the frontline of insurgent attacks were resilient; particularly, how the supply chains of business in these troubled areas were coping (or otherwise) with the insurgency. The questions that arose from this interest related to how businesses in the troubled areas replenish their stocks and manage their inventory: do businesses receive information about imminent attacks; what type of logistics-related decisions will be made when pre-emptive information about insurgent attacks have been received; and, what if the information was false? These and several related questions kept surfacing when news that roads to towns and villages were cut-off and alternative routes were being used. I believed that such news has real effects on supply chains of businesses in the area and that businesses must be doing something about their supply chains to mitigate the effect. Subsequently, my interest in the risk information received and shared by businesses began to expand beyond North-Eastern Nigeria to other countries and contexts: for example, port strikes in Mombasa, to congestion in the Panama Canal.

One Christmas when I was doing my masters studies and the university was shut, and I had free time; I came across a book by Manuell Castells titled: “The Rise of Network Society”. This book and two more by this author, motivated me to find out how and whether the business in disaster-prone areas, can leverage on the relationships with their social networks in order to receive as well as share risk information to make their supply chains more resilient. I was also interested in understanding the quality of risk information shared by supply chain stakeholders and whether relational ties influenced them.

These concerns about supply chains in North-Eastern Nigeria, and the goal to undertake a research that will make practical and theoretical contributions to supply chains and supply chain management remains the overarching motivation for this research. This allowed for openness in receiving ideas from relevant academics and practitioners (especially in conferences and other academic engagement) that I felt could contribute to the success of the research. Influential in this was accepting the suggestion to adopt a mixed method approach (from EUROMA conference 2018).

In all, the current form of this thesis satisfies the initial curiosity and motivation of the researcher by investigating beyond one particular type of supply chain risk management strategy in one context (insurgency in North-Eastern Nigeria). Instead, extending the research to seek data from supply chain managers and members of the Chartered Institute of Procurement and Supply (CIPS) Nigeria, who are encountering and are managing various types of supply chain risks which may warrant leveraging on their relational assets for risk information.

1.2. Background to the research

Natural disasters such as earthquakes, tsunamis, hurricanes are some of the extreme (non-human caused) risk events, which, despite occurring in a particular area and time, can have severe consequences for supply chains. Yet, politically related risks (mostly human initiated), continue to pose potential threats to supply chains. For instance, a political decision such as a trade war can have direct effects on ordering, stocking, the number of suppliers, location of suppliers and other supply chain activities and decisions. The importance of political risk to supply chains was acknowledged by the Council for Supply Chain Management Professionals (CSCMP) in their Supply Chain Quarterly publication which they identified trade wars as the highest risk supply chains face in 2019 (Larsson and Kamal, 2019). Consequently, supply chain managers, academics, politicians and other decision-makers are concerned about managing political and other risks in order to make their supply chain more resilient (Kim and Spilker, 2019; Soni and Kodali, 2013).

Supply chain risk management involves the identification of potential sources of risk, and implementing appropriate strategies through a coordinated approach among supply chain members to mitigate the risk, and reduce supply chain vulnerability (Jüttner, 2005; Manuj and Mentzer, 2008). Ponomarov and Holcomb (2009) defined supply chain resilience as: "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 and Holcomb, 2009). From both supply chain resilience, and supply chain risk management perspectives, supply chain risk information sharing strengthens the supply chain's ability to identify and mitigate risk (Jüttner, 2005; Manuj and Mentzer, 2008).

Supply chain risk information sharing has been defined as situations where critical and proprietary supply chain risk information are shared by supply chain members (Li, Fan, Lee and Cheng, 2015). As part of supply chain risk management, supply chain risk information sharing supports the goal of identifying potential sources of risk, so that appropriate strategies through a coordinated approach among supply chain members for reducing supply chain vulnerability may be achieved (Jüttner and Maklan, 2011; Manuj & Mentzer, 2008). Although information is one of the items that flow in the supply chain (other are materials and funds), the practice of information sharing in the supply chain is sometimes difficult. For example, whilst arguing for the benefit of information sharing in improving supply chain flexibility,

Stevenson & Spring (2009) observed that it is not a widespread practice, especially among SMEs. Yet, sharing supply chain risk information could be even less unpopular as some risks like environmental-related do not frequently occur in some parts of the world.

In coordinating supply chains to identify and ultimately share risk information, supply chain managers still have to work with the complexities, uncertainties and the various types of supply chain relationships that exist between them and their partners. For instance, some supply chains may be less complex with fewer layers and connections, while other supply chains (for example, automotive or retail) may have several tiers and interconnections. Additionally, some management relationships might be represented by a typical transactional relationship, whilst others may be more collaborative depending upon the nature of what is being supplied (Lambert & Knemeyer, 2004). Within the several challenges of managing the complexities and the primary goal of ensuring the timely and uninterrupted flow of goods, information and funds; are the possibilities that a supply chain trigger event can cause disruption either external of the firm which creates the need to share risk information. This might be difficult in an arms-length relationship where the connection between supply chain partners is strictly formal.

Regardless of the nature of the relationship, and whether risk information sharing has been included within the supply contract or not, the social capital theory argues that where there are informal relationships at the organisational or interpersonal level, there is an increased likelihood to share risk information (Lin, 2001; Nahapiet & Ghoshal, 1998). Risk information in this context is regarded as a resource that an actor has, and will be needed by other supply chain members. From the social capital perspective, actions are required to be taken by organisations to gain access to resources – such as supply chain risk information – that are owned by other actors. As a result, investigating relational behaviours for the purpose of supply chain risk information is proposed as an opportunity for explorative research since risk information sharing is a voluntary act for supply chain members.

1.3. Statement of the problem

The recurrent occurrence of disruptive events continues to highlight the need to share supply chain risk information. According to Agigi, Niemann and Kotzé (2016), the frequency of disruption within supply chains has highlighted the reality to firms, and resulted with the question concerning supply chain disruption; that it is not whether it will occur, but when it will occur, and how prepared is the supply chain. Scholars such as Hendricks and Singhal (2005), Constantino, Gravio, Shaban and Tronci (2013), Jüttner (2005), and, Kleindorfer and Saad (2005), have all identified the need for more research in the area. As a strategy of supply chain resilience and risk management, risk information sharing gives firms the ability to sense new threats which according to Ambulkar, Blackhurst and Grawe (2015) is a capability crucial for its survival. Related to this argument, Sheffi and Rice Jr. (2005) advocated that in order to reduce supply chain disruption and increase resilience, there has to be a culture which allows "maverick" information (sharing vital information through unconventional means) to be heard.

However, Frazier, Maltz, Antia and Rindfleisch (2009) reported that some firms might not be willing to share information that has not been agreed in their contracts, or share information beyond their dyadic ties (Kembro and Selviaridis, 2015). In other words, although a supply chain partner may have information about risks that could have a negative consequence to their partners, they may not share the information because the terms of the contract do not require them to do so. As a result, opportunities to mitigate supply chain disruption may be missed. Additionally, some firms may not be aware of the relational behaviours that would have enabled them to receive risk information about their supply chains, or leverage on social relationships between their partners in order to receive risk information.

Published literature demonstrates that relational antecedents such as trust, relationship length, commitment and reciprocity, are enablers to information sharing (Li, Fan, Lee & Cheng, 2015; Ha, Park & Cho, 2011; Klein & Rai, 2009; Nyaga, Whipple & Lynch, 2010; Wang, Ye & Tan, 2014). However, the context of this published research – which are mostly on collaboration, supply chain performance and demand related risk, differs from the context of this study. Although investigating supply chain risk information sharing in the context of collaboration, supply chain performance and demand related risk is essential, they do not provide the detailed understanding needed when the research is focused primarily on relational behaviours and risk information sharing.

Further, the relational antecedents (trust, relationship length, commitment and reciprocity) identified by past studies might not be sufficient or the only basis for firms to share supply chain risk information from the onset of a supply chain relationship, especially in the context of Nigeria. Additionally, given that most of the studies carried out were quantitative (Li et al., 2015; Ha, Park and Cho, 2011; Klei and Rai, 2009; Nyaga, Whipple and Lynch, 2010; Wang, Ye and Tan, 2014), it is necessary to investigate from supply chain managers perspectives, what relational behaviours are critical for supply chain risk information sharing. The argument is, in a situation where the supply chain concerns are related to risk events such as insurgency, strikes, unfavourable government policies, armed robbery on the highway, communal clashes - that are all common in Nigeria - context-specific relational behaviours are likely to be developed by firms. Furthermore, Tukamuhabwa, Stevenson and Busby (2017) argue "*that the threats faced by firms and supply chains in developing countries, and the way in which these threats are handled, may differ from the developed country context"* and as such, they called for further studies to be conducted in developing countries context.

Kembro and Selviaridis (2015) argued that "in order to capture the contextual information regarding the supply chain studied", minimal control of the observed behaviours is needed to understand the phenomenon under study as it enables collecting rich data from multiple firms (Easton, 2010; Eisenhardt,1989; Ellram, 1996; Yin, 2013). Consequently, in order to understand the broader perspectives and practice of relational behaviours that enhances supply chain risk information sharing, and

responding to the call by Tukamuhabwa et al., (2017) it is important to start by exploring the issue through the lenses of supply chain managers in Nigeria, starting with a qualitative approach.

1.4. Research aim

The aim of this research is to investigate, examine and identify new relational behaviours that enhance supply chain risk information sharing in the Nigerian context. The research reported here proceed as a two-phased mixed exploratory study. The two stages were necessary as it was believed that the relational behaviours that enhance supply chain risk information sharing could be identified through an initial exploratory study conducted to examine relational behaviours that are used by supply chain managers for risk information sharing. In addition, a second phase was considered as it validates the outcome of the exploratory research. In stage one, supply chain managers of five companies where interviewed which resulted in the development of three themes that permitted the operationalisation of relational behaviour constructs for supply chain risk information sharing. The second stage of the study validated the relational behaviours identified by surveying members of the Chartered Institute of Procurement and Supply (CIPS) in Nigeria.

1.5. Research question

Considering the lack of clarity of relational behaviours that enhance supply chain risk information sharing, the following research question is asked in order to provide an opportunity to explore the relational behaviours used by supply chain managers to receive and share risk information, and subsequently examine the extent and prevalence of the relational behaviours identified on supply chain risk information sharing:

- How and to what extent do relational behaviours enhance supply chain risk information sharing?

1.6. Research context

The research context of this study is focussed on the supply chain of firms, particularly those located in Nigeria, a country of an estimated population of 195 million people and over 200 ethnic groups with English as the official language (Worldbank, 2019; BBC, 2020). The population of Nigeria is spread across over 923,768 square kilometres, which necessitates logistics and supply chain practices to promote business activities and create wealth. However, Nigeria is marred by several insecurity challenges from the insurgency in North-Eastern Nigeria to militancy in the South-South region and general kidnapping and armed robbery all over the country which all have an adverse effect to logistics and general freight of goods and people (United Nations News, 2020). The National Bureau for Statistics (NBS) of Nigeria reported that 49% of households in the North East and 23% in North Central Nigeria experience conflict (National Bureau of Statistics, 2020). Similarly, insecurity in Nigeria hinders business activities and discourages foreign and local investors (Okonkwo, Ndubuisi-Okolo and Anagbogu, 2015).

Recently in early 2020, the Borno state Governor (the state worst affected by insurgency) also complained that the security situation is getting worse since 2019 (BBC News Pidgin, 2020).

Within the context of the insecurity in Nigeria, is the scholarship for this research which aims not only to make a knowledge contribution to the field of supply chain management but to investigate relational behaviours that can be leveraged for supply chain risk information sharing for the real benefit of businesses in Nigeria. Although the government of Nigeria is spending millions of dollars as well as partnering with developed countries such as Britain and the United States of America to improve the security situation in the most populous country in Africa (UK Government, 2018), the scholarship and motivation for this research is aimed at researching about behaviours that can help supply chains in Nigeria to mitigate risks through sharing information.

1.7. Contributions of the research

The significant contribution of this thesis is that it identifies and provides empirical evidence of the effect of two previously unknown relational behaviours of closeness and collective prosperity and their effect on supply chain risk information sharing. Other areas where this research stands out based on its significant contribution includes:

- The research is the first empirical study conducted to seek the experience of supply chain managers to identify how relational behaviours enhance supply chain risk information sharing.
- It conducted and presented a systematic literature review that identifies three broad categories of research conducted on relational behaviours and supply chain risk information sharing.
- The thesis adds to the literature in supply chain management by conducting and presenting a literature review that assesses risk information sharing from different perspectives.
- The thesis methodologically adds to the literature by presenting an empirical mixed method finding that builds from qualitative and quantitative studies, which reveals new evidence of how relational behaviours enhance supply chain risk information sharing.
- The research brings new insight to the practice of supply chain management by identifying two new relational assets that management can leverage on for increased supply chain risk information sharing in their supply chains.
- The research brings new insight to practice by providing new influential relational behaviours, which existing and future foreign and multinational firms may consider when operating or expanding their supply chain network to Nigeria.

1.8. Overview of the research process

This research investigated relational behaviours and supply chain risk information sharing. The motivation for the research originated from the increase in supply chain disruptions both in Nigeria and

globally while questioning the role social relationships can play in sharing risk information. Figure 1-1 presents the overall research process undertaken for this thesis.

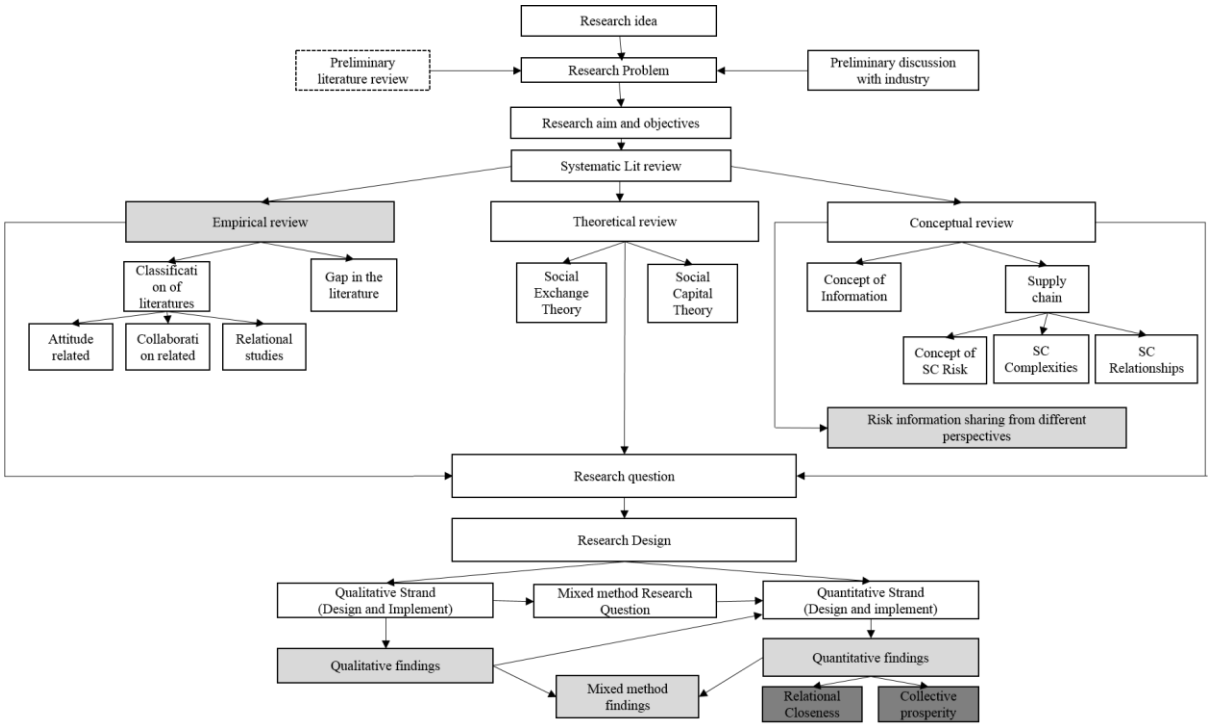

Figure 1-1: Thesis research process

A preliminary discussion with two supply chain experts in Glasgow reiterated the originality of the problem beyond Nigeria, but also from industry perspectives. At the same time, a preliminary literature review was conducted to assess the problem from a theoretical perspective. Both the preliminary discussions and preliminary literature review provided clarity to the research problem to be solved.

After having a clear picture of the research problem from a theoretical and practical standpoint, the research aim and objectives were then clearly defined. Subsequently, a systematic literature review procedure was developed to identify and select relevant literature about the research problem. The literature identified were reviewed with three main goals. Firstly, to identify the gap in the literature and knowledge, i.e. what has and has not been done with regards to the problem identified. Secondly, to use the literature identified to support the research from a theoretical standpoint. Thirdly, in order to use relevant literature to explain the concept of supply chain risk information sharing from a multidimensional perspective. Both the second and third goals of the literature review strategy of this thesis involved cross-referencing additional literature outside the field of supply chain management. As a result, the literature review aspect of this research has systematic; theoretical; empirical; and conceptual which are delivered within Section 2 to Section 5 of the thesis.

The justification for having three layers of the literature review was, firstly, based on the problem – a lack of clarity in terms of whether supply chain managers leverage their social relationships to gain and share risk information, while social capital theory advocates for such practice. As a result, it was necessary to undertake a theoretical review to find a theoretical justification for the problem area. Secondly, since no empirical research within the context of supply chain management as well as Nigeria, it was necessary to design the literature review in such a way that presents a broad discussion of the concept of supply chain risk information sharing.

The outcome from the empirical, theoretical, and conceptual literature provided a basis to formulate the research question that would be addressed within the research. Since most research typically follows an iterative process (Creswell, 2009), the research question for the thesis was developed and asked after understanding the gap in the literature, the theoretical dimension of the problem and an understanding of the conceptual dimensions of supply chain risk information sharing.

Based on the nature of the problem and the research question of the thesis, a mixed method approach was adopted. The mixed method – sequential design – started with qualitative exploratory interviews where supply chain managers from five companies in Nigeria were interviewed. New and useful insights about three previously unknown relational behaviours (in the context of supply chain risk information sharing) that enhance supply chain risk information were found. This address the first aspect of the research question, which asks how does social relationship enhance supply chain risk information (in chapter 8).

Afterwards, propositions were developed from the qualitative strands, which were transformed into hypotheses that were tested. A questionnaire was developed and administered to members of CIPS in Nigeria through the online and self-administered procedure. Quantitative data were analysed using Partial Least Squares Structural Equation Modelling. The quantitative analysis found two out of the three relational behaviours to have statistical significance. This answers the second part of the thesis research question that asked to what extent doe social relationship enhance supply chain risk information sharing (in chapter 9).

Subsequently, a mixed method discussion was conducted to assess how the quantitative results generalised to the qualitative findings. In all, the mixed method discusses the two relational behaviours as they represent the significant contribution of this thesis.

1.9. Structure of the thesis

The remaining sections of the thesis are structured as follows:

Section 2 presents the conceptual literature that discusses the literature surrounding the research and how they were linked to this research. Given the unique nature and complexity of supply chain management, this section provides discussions that assist in understanding supply chain risk information

sharing. The section starts with discussing the concept of information, then the concept of supply chain risk. The section then discusses supply chain network, complexities and relationships. Furthermore, risk information from different perspectives such as computer and cyber risk perspective; disaster and emergency management perspective; the intelligence community perspective; and, creditors and lenders perspective were discussed.

Section 3 follows with the theoretical literature of the theories that underpinned this research. The two main theories that form the foundation of this research – social capital theory and social exchange theory were discussed in detail.

Section 4 provides the related literature of findings reported by past scholars. The section plays a vital role in presenting what has been written by past scholars about social relationship and supply chain risk information sharing. The literature reviewed in this section were identified from the systematic literature review protocol. They were grouped according to literature that studied; the attitude towards information sharing; collaboration and risk information sharing; and, relational studies and risk information sharing. At the end of the related literature review, the gap in the literature was identified and stated.

Section 5 follows with the research methodology, which presents and justifies the methodology used in this research. The section states the philosophical and methodological underpinnings adopted that are reported within this thesis. Also, in this section, the mixed method approach was presented and subsequently, the research design of the research.

Section 6 presents the qualitative research design used for the qualitative strand of this thesis. This section discussed the research ethics, criteria and interview protocol, qualitative data collection, analysis and validation.

Section 7 went further to present the qualitative results and interpretation for this thesis. Included in this section are the background companies and the supply chain risk they face, qualitative findings, discussion of interview results and development of the initial research model. This section addresses the first part (qualitative) of the research question.

Section 8 then provides the quantitative research design used for the quantitative strand of this thesis. The section discusses the instrumentation and questionnaire development, questionnaire design, sampling framework, data preparation approach, management of errors and then strategy for quantitative data analysis.

Section 9 follows by presenting the result of the quantitative strand. In this section, data purification procedure was specified where out-of-range values, missing data, statistical outlier, normality test were assessed. Also, in this section, the sample characteristics, evaluation of PLS-SEM model where hypothetical research model, indicator loadings, assessment of the formative model and structural model

result were presented. The quantitative results were subsequently analysed. This section addresses the second part (quantitative) of the research first question.

Section 10 then presents the discussion which focuses on the mixed method result. Included in the section is a brief discussion of the research methodology and method, the research outcome, discussion of the mixed method results, limitation and areas for future work.

Lastly, section 11 presents the conclusion and recommendation for this thesis. Here, the theoretical contribution and managerial implication are stated.

2. Conceptual literature

The conceptual literature review of this thesis is aimed at explaining the key concepts of this thesis - information sharing and supply chain risk – with the view of bringing clarity to the context of this thesis. Since concepts may transcend beyond a particular discipline (Rowley and Slack, 2004), it is essential to clearly explain how the key concepts of this research (supply chain risk information) is viewed within the context of this thesis and the discipline of supply chain management.

The section starts by explaining the concept of information which is broken down into smaller elements that allow for detailed discussions. Some of the topics discussed, with regards to information, includes the meaning of information sharing, information quality and factors influencing information sharing. Also, the concept of supply chain risk is discussed, highlighting supply chain risk source, supply chain categories, and supply chain risk management. Also, in this section, supply chain risk information sharing was assessed from different perspective together will supply chain complexities and supply chain relationships.

2.1.1. Meaning of information sharing

The concept of information is used in almost every scientific discipline, within its context, and about specific phenomena (Capurro & Hjorland). Information is defined as organised data that has been interpreted and put into meaningful or useful context (Chaffey and & White, 2011; Beynon-Davies, 2009). Yet, "sharing" was defined by Sharratt and Usoro (2003) as a process whereby one party gives a resource to another. Within the context of information, Dawes (1996) defines sharing as an exchange or giving others access to information. It is important to point out that by granting access implies that the sender is in control of the information. Secondly, without contextualising, what is being shared could be data and remain so if it is not meaningful or useful within a specific context. Although in a strict business sense, data sharing is different from information sharing, an event may occur in the future which previous data shared will be meaningful for decision making. Information can take the following forms:

- Structured information
- Unstructured information
- Formal information
- Informal information

Structured information in general terms is "information whose intended meaning is unambiguous and explicitly represented in the structure or format of the data" (Ferrucci and Lally, 2004). Structured information can also be described in terms of a set of instances and a schema, which are tightly coupled (Batini and Scannapieco, 2016). In contrast, information that their intended meaning is only loosely implied by its form is unstructured information. Examples of unstructured information could be "any

sequence of symbols, coded in natural language or any other symbolic language with no semantics induced by an explicit schema" (Batini and Scannapieco, 2016). Although most business organisation usually send structured information to their partners, intelligence agency, in contrast, may send unstructured information to prevent unwanted persons from assessing and interpreting the information. Notwithstanding, the interpretation key (i.e. to re-structure the unstructured information) is sent before or after the main message is sent.

Formal information, based on its sources, is information created and sent under authorised or legal means to an intended user or receiver. However, informal information has no such basis for regularisation or authorisation. Formal sources of information are mostly impersonal, whereas informal sources are often personal. It has been suggested that formal and informal information can be paired synonymously as; informal-personal and formal-impersonal (Kaye, 1995). However, there are cases where personal information can be considered as official information. This can arise when circumstance leading to receiving the information is based on official privileges. In such an instance, the organisation may request that such personal information should be declared. Risk information received from a friend in a partnering company can be demanded by the organisation.

In day-to-day organisational practice, informal information system provides information that is needed for the smooth functioning of the organisation. Corporate formal information is sometimes rigid and short. It is informal information and communication that helps in adding more detail or creating an opportunity for clearer formal information. Further, within an organisation, both formal and informal information is sent to specific people. Even as social media are currently used as a means of sending formal information, options such as private chat or private email are still available for sending informal information. Nevertheless, the qualities of the forms of information, especially informal and unstructured, need to be asses before making a business decision.

2.1.2. Information quality

Information quality in general terms refers to information that its fit for purpose – how well the information supports the user and the decisions made (Chaffey and White, 2011). Quality in the context of information is the entire feature of information to satisfy stated or implied objectives. Beynon-Davis (2009) argued that the quality of information influences the quality of decision making. Thus, information quality can have a severe effect on the efficiency and effectiveness of organisations and businesses (Batini and Scannapieco, 2016). Decisions made from wrong information can have a negative consequence on the financial and operational performance of the organisation. With regards to risk information, organisations can make wrong supply chain decision like expediting or dealing purchase due to the quality of the information received.

Given that information quality is critical to all types of organisations, scholars such as Shamala *et al.*, (2017) have argued for information quality dimensions as a guide for gathering and sending quality

information. Beynon-Davis (2009) identified three dimensions of information quality, namely, content, time and form, as presented in.

Information quality broad dimensions	Information quality sub-dimension
Content Dimension	Accuracy
	Relevance
	Completeness
	Conciseness
	Scope
Time Dimension	Timeliness
	Currency
	Frequency
	Time period
Form Dimension	Clarity
	Detail
	Order
	Presentation
	Media

Table 2-1 Dimensions of information quality adapted from Beynon-Davis (2009)

The content dimension of information quality suggest that information must be accurate -correct; relevant - supports decision making; complete - no missing data; concise - not too detailed; scope - may be internal or external to the organisation and can also be broad or narrow (Beynon-Davis, 2009). In compering content dimension of information quality with informal information, there are bound to be some weaknesses in informal information which reduce its quality.

Nevertheless, informal information may fulfil the time dimension of information quality which requires that information should be timely - available when needed; currency - the information is up to date frequency - supplied at an appropriate regular interval; time period - covers the right period of time (Beynon-Davis, 2009). One of the reasons why informal information may likely be more timely than formal information is because of bureaucratic rules of authorisation which can slow the sharing of information, especially when there are several layers of information authorisation.

The third dimension of information quality is the form dimension, which requires information to be clear - readily interpreted; detailed - can have both summary "dashboard" views and entailed ‘drill-down'; order - the data is sorted in a logical order and can be modified by the user; presentation - tabulation or graphs where necessary; media - can be in hard or soft copy (Beynon-Davis, 2009). Contrary to formal information, informal and unstructured information do not follow the form dimension of information quality. Nevertheless, from the perspective of this study, the call by Sheffi and Rice Jr. (2005) for “maverick information” to be heard suggest the need for timely and accurate information which should first fulfil time and content dimension of information quality. Further, where there is a need for immediate action, it is expected that the emphasis will be to receive the right information at the right time.

2.1.3. Factors influencing information sharing

Information sensitivity is an essential factor to consider when sharing information internally or externally in an organisation. External information sharing usually needs rigours agreements and arrangement compared to internal intra-organisational information sharing. Also, the interest and information need of each stakeholder (internal and external) need to be taken into account (Treku and Wiredu, 2016). Also, Praditya, Janssen and Sulastri (2017) pointed out that twenty-six factors influence information sharing. These factors are broadly categorised into technological factors and organisational factors. The organisational factors include trust, power and involvement, while the technological factor includes compatibility and interoperability, among others.

Further, Jonsson and Myrelid (2016) observed the main factor that influences information sharing are business context, nature of the information, inter-organisational and intra-organisational factors. Also, Kembro, Näslund and Olhager (2017) stress that nine factors must be addressed to enable dyadic information sharing. The factors include: (i) low information quality, (ii) costly and inadequate information systems, (iii) power asymmetry, (iv) lack of governance, (v) lack of trust, (vi) unfair allocation of benefits, (vii) lack of common performance indicators, (viii) lack of common goals, and (ix) confidential information (Kembro and Näslund, 2017). It is important to note that each of the factors listed is related to the form of information shared (formal and informal) as well as the content of the information. For example, in power asymmetry factor influencing information sharing, despite bureaucratic delays to sharing information, a powerful partner in the supply chain can demand timely information. Based on its relevance to this thesis, interpersonal factors and inter-organisational factors are discussed separately in the next subsections of this thesis.

Interpersonal factors and information sharing

Interpersonal relationships transpire mostly between family, friends, relatives, neighbours, community or classmates. At the interpersonal level, the focus is on individual behaviours, approach and channels for information sharing with the people around them (Yang and Maxwell, 2011). Information sharing at the interpersonal level can be a voluntary act to provide information to family, friends, neighbours, community or classmates who have information needs (Yang and Maxwell, 2011). However, there are still elements of power asymmetry influence, as discussed previously in the social exchange theory.

In the interpersonal, an individual can deliberately choose to recall the information needs of other people and share information with them (Yang and Maxwell, 2011). Whilst keeping the information needs of their acquaintances in mind, when a new piece of information is acquired, a link between the new information acquired with the information needs of acquaintances are made. Subsequently, the acquired information will be shared with the target individual(s) that need them, usually through channels such as social media (Hersberger, Rioux. and Cruitt, 2005). Hence, knowing the information needs of people within a person's social network is vital for interpersonal information sharing.

Other reasons why people share information at the interpersonal level, includes developing rapport, educating or raising consciousness, and for mutual awareness (Marshall and Bly, 2004). Hence, the common interests of the individual who share and receive information are mostly highlighted in interpersonal information sharing. As a result, Marshall and Bly (2004) reported that strong social ties and relationships between information givers and receivers are one of the benefits of interpersonal information sharing. The argument surrounding the motive for sharing information at the interpersonal level is supported by the social capital and social theory.

However, Yang and Maxwell (2011) observed that interpersonal information sharing could become more complicated and sometimes difficult when performed within an organisational context. In such an instance, information can be seen as the property of the organisation which must be surrendered. The argument is that individuals are privy to information because of their employment and job roles. Hence, sharing such information to an acquaintance may be restricted.

Intra-organisational factors and information sharing

Intra-organisation information in many organisations is supported by local area networks (LANs) – which although allow workgroups to customise their computing environment, at the same time being part of the same physical, organisational enterprise-wide network (Barua, Ravindran and Whinston, 1997). Although there is interconnectivity in organisations, there are still control and restrictions on each database of the individual decision units or teams. In other words, an organisation unit may allow or restrict access to information to non-unit members or unit members with a lower rank. Information restriction is part of the bureaucratic management approach – one of the factors influencing intra-organisational information sharing shown in figure 4.1 - which emphasises that information flows in organisations are strictly controlled (Yang and Maxwell, 2011).

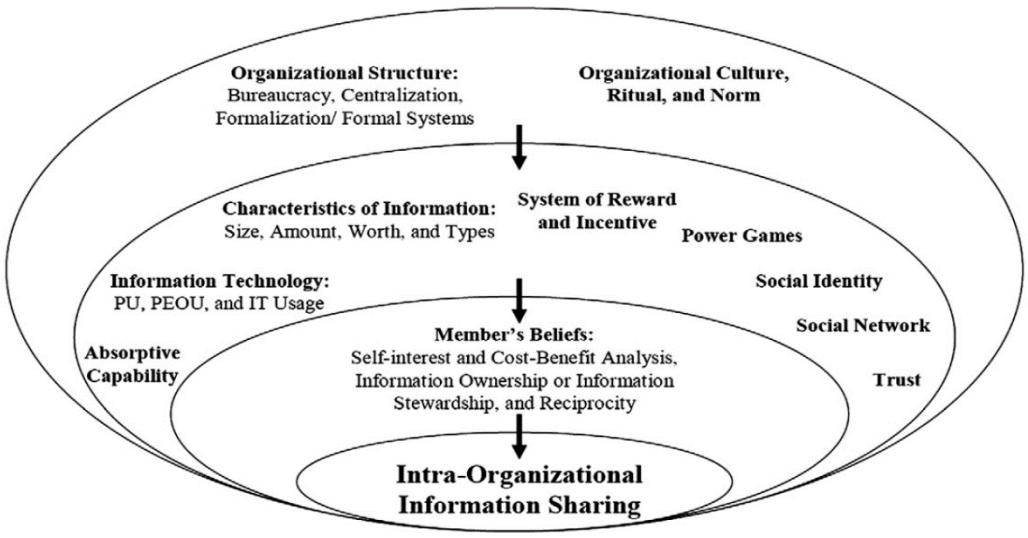

Figure 2-1: Factors influencing intra-organizational information sharing (Yang and Maxwell, 2011)

Yang and Maxwell (2011) explained in the three factors of layers that can influence intra-organisational information sharing in. At the first layer, organisational structure and organisational culture may have a wide range of effect on all organisational activities, including information sharing (Yang and Maxwell, 2011). At the second layer, social identity, social network, a system of reward and incentive, trust and power games are factors that are formed and influenced by organisational culture and organisational structure, and they can influence members' beliefs in intra-organizational information sharing in level three (Yang and Maxwell, 2011). In level three, members self-interest and cost-benefit analysis, reciprocity, stewardship and information ownership are factors that influence information sharing (Yang and Maxwell, 2011). Notwithstanding, factors in level two and three influence member's beliefs. A study by Cress, Kimmerle and Hesse (2006) claim that information sharing presents a social dilemma while Constant et al., (1994) stress that member perception of self-interest can reduce support for information sharing in an organisation

Although information restriction is beneficial in certain situations, Barua, Ravindran & Whinston (1997) observed that restriction in intra-organisational information sharing might create an island of high-quality information. Businesses that adopt a flat organisation structure may try to reduce the gaps between information islands by creating a bridge of teams that share information between functional units. Also, in situations where there is information island in organisations, management can leverage and promote interpersonal relationship to remove the barriers to information sharing.

Inter-organisational factors and information sharing

Organisations, especially those in manufacturing, operate by produce goods and (sometimes) service, which necessitate the exchange of information either during procurement of raw materials or sale of the finished product. With developments and advances in information and communication technology (ICT), the way which information is shared between organisations continues to change, primarily due to concerns of security and confidentiality. Chau, Zeng, Atabakhsh and Chen (2001) argued that it is crucial to design a system that can handle both access authorisation and authentication for the organisations involved in information sharing.

Other factors that affect information sharing relates to internal organisational and management issues. Similar to intra-organisational information sharing, these challenges may include organisational bureaucracy, geographic areas where the organisation is located, differences in culture, differences in operational procedures, competing for interest, a concern of information misuse, leadership trust, incentive and reward as well as the comparison of risk and reward (Yang and Maxwell, 2011). Despite the factors restricting information sharing at the inter-organisational level, from the perspective of this thesis, interpersonal relationships are necessary. Especially where supply chains extend beyond several tiers, which might make it difficult or slow to share risk information. Further, although organisation exist as

an entity which usually needs inter-organisational information sharing, the first step for starting formal inter-organisational information starts with informal inter-personal information sharing.

In the next subsection of this thesis, the discussion will be focussed on supply chain risk and supply chain risk management. Based on the aim of this study, the current discussion from information sharing will be linked to supply chain risk management in order to contextualise the research.

2.2. Concept of supply chain risk

Risk as a concept is used in several business contexts such as supply chain, finance, insurance, decision theory, utility theory, health and safety, and engineering. Scholars have associated this commonality of the concept of risk in various disciplines to the reason why there is a difference in the definition of risk (Wagner & Bode 2006). In the field of supply chain management, some scholars have defined risk similar to the field of finance and classical decision theory, where there are arguments that risk can lead to a positive outcome (Wagner & Bode, 2006; Baird and Thomas, 1990). An example of positive financial risk is gaining from exchange rate translation, while, loss in translation is deemed to be a negative risk. In this regard, researchers from the field of supply chain management like (Jüttner, Peck, & Christopher, 2003) have used this positive notion to defined supply chain risk as disparities in the distribution of supply chain outcomes, their chances and the subjective values which can take various outcomes (Jüttner, Peck, & Christopher, 2003).

Moreover, when supply chain risk is viewed in isolation without 'loss', the positive side of risk could create value for the focal firm. For instance, a firm that decides to change to Just-in-Time inventory could be deemed to have carried out calculated risk. If all things being equal and there is no disruption at any point in time, the firm might benefit from a faster turnaround of stock, fewer wastages and smaller investment which will yield a positive outcome or 'positive supply chain surpluses'.

However, the opportunity side of supply chain risk could be hampered when a risky decision taken has resulted in a loss. Thus, some supply chain risk management scholars will prefer to described supply chain risk as an event-oriented concept that can lead to danger, which needs to be mitigated. The emphasis from this school of thought is focused on the "triggering event" (which is also referred to as disruption, disaster, disturbance, hazard or crisis) that constitute risk (Heckmann, Comes and Nickel, 2015). A triggering event in the context of supply chain risk is an occurrence that can cause disruption. The occurrence could be a fire, a machine breakdown, a strike, a protest, an outcome of an investigation, speculation or a direct or indirect attack that has a negative effect on the performance of the supply chain. Linking the definition of supply chain risk to 'triggering event' is stressed by (Wagner & Bode, 2008) as one of the ways of differentiating the concept of risk in the field of supply chain management from other fields. In the field of supply chain management, managers are not expected to intentionally 'gamble' on risk or take a calculated risk and expect a 'happy disaster'. The argument by (Wagner & Bode, 2008) is consistent with (Manuj & Mentzer, 2008) who interviewed supply chain managers where

the interviewees reported that risk could be viewed as 'anything that keeps you away from perfect outcomes'. As a result, companies usually invest enormous resources and effort in gathering, analysing and assessing information to manage potential triggering-event that could eventually materialise to become a supply chain risk (Heckmann, Comes and Nickel, 2015).

Further, supply chains that have suffered disaster may be inclined with the negative side of risk. Hence, it will be unwise for managers to deliberately put their supply chain at risk in order to make a surplus. Similar to the previous example of a firm changing its inventory policy to Just-in-Time, it would be risky for a company located in the UK that has its suppliers in the EU, to deliberately change its stocking policy to Just-in-Time when the outcome of Brexit's single market policy is yet to be determined. To this end, (Harland et al., 2003) defined supply chain risk as damage, evaluated by its occurrence probability, affecting more than just one company, but with a cause originating within a single company, within the supply chain or in the environment of the supply chain. Also, Tummala and Schoenherr (2011) have conceptualised supply chain risk as "an event that adversely affects supply chain operations and hence its desired performance measures".

From the perspective of this thesis, understanding supply chain risk provides an opportunity for firms to give it the seriousness it deserves and inform their partner whilst expecting a reciprocal behaviour. Hence, supply chain partners that identify a trigger event can quickly assess the likelihood that it will affect their supply chain or their partner's supply chain and the resulting consequence. Although sharing information about trigger event – seen as sharing data or unstructured information – can lead to information overload. However, rather than reject unstructured information, which can deter the sender, establishing a data mining system in the organisation, for risk information sharing can be useful to the organisation.

2.2.1. Supply chain risk source

In designing a supply chain risk management strategy, risk managers need to know the source of the risk and its possible impact on the supply chain. Supply chain risk sources are environmental, organisational and supply chain-related places where disruption could emerge (Jüttner, 2005). The primary sources of supply chain risk as observed by scholars are firm endogenous, exogenous (Trkman, Oliveira, & McCormack, 2016; Pontré et al. 2011) internal and external risk (Cucchiella & Gastaldi, 2006).

Firm endogenous and exogenous risks source

Since supply chains are known to involve interrelationships between several firms, it is, therefore, important to look beyond risks that are firm related. Thus, firms are expected to consider the risk that is inside their organisation is referred to as endogenous risk, and risk that is outside the focal company's as exogenous risk (Trkman & McCormack, 2009). While most endogenous risks might be predictable and quantifiable, exogenous risk in contrast - that is outside the firm's - are even more challenging to

predict and quantified (Pontré, Welter, Malta, Faria and Chernyshova, 2011). For instance, poultry farmers can easily predict foot and mouth disease because to them; it is an endogenous risk. However, a tour operating company would classify the same disease as exogenous even though it can have a negative effect on the firm, i.e. where they take their customers (tourists).

Supply chain – network, internal and external risk

Network or chain effect, meaning how additional firm affects the whole supply chain/network, has compelled researchers to view supply chain risk from three perspectives: (1) internal to the organisation, (2) external to the organisation (but internal to the supply chain), (3) external to the dyadic supply chain extending to the network. Jüttner (2005) argued that the notion that supply chain relationship is dyadic, (i.e. between supplier and a company) is a narrow view especially taking account of the complex relationships that exist between firms and the risk that is associated with such a relationship. In a network, each firm in a relationship has the potentiality of adding value and risk to the entire network. Thus, analysing supply chain beyond triads and the extends networks provides a holistic view of understanding supply chain complexities and its associated risk (Carter, Rogers and Choi, 2015).

Also, as regards to predictability, risk originating from a focal firm and its supply chain network (internal risk) can be reasonably predictable as opposed to risk that is originating external to the supply chain network. Internal risks are usually risk related to machine breakdowns or IT problems. Internal company risks deal with disruptions caused by problems within the organisational boundaries of the company, such as machine breakdowns or IT problems. Risk originating externally from the supply network cannot be easily predicted as compared to risk originating from the firm's supply network. Additionally, risk originating from outside the network, i.e. external to the network are usually environmental-related risk source like socio-political, economic, technological or geographical reasons, extreme weather or natural disasters (Christopher & Peck, 2004). However, an example of internal supply chain risk could be machine breakdown which can have a cascading effect on both upstream and downstream of the supply chain.

From the perspective of this study source of the supply chain risk is very important, especially for complex and large supply chains like big retail company or aircraft manufacturer with several suppliers and tiers. A focal company of four or more tiers of suppliers and large operating facilities spread across a different location may be interested in knowing where the source of the trigger event is from so that appropriate risk management strategy can be put in place.

2.2.2. Supply chain risk categories

Fan and Stevenson (2018) suggest that supply chain risk management categorisation is not only important, but it is among the first steps in formulating a supply chain risk management strategy in organisations. Based on the relevance of supply chain risk categorisation, several studies have categorised supply chain risks. Scholars differ on the number of risks categories, the nature of the categories and

the type of risk that fall under each category of supply chain risk. From the literature reviewed, supply chain risk is categorised into environmental risk, supply risk, demand risk, financial/market risk, and production, manufacturing, organisational risk

Environmental risk category

Environmental risk categories are one of the broadest risk categories that include many types of risk which are often, which is not restricted to the biological or the physical environment. For this risk category, some studies included risks such as natural disasters, terrorism and wars, labour disputes, earthquakes; however, the risks have been categorised them under a different heading. Table 2-2 presents the type of risk types that have been mentioned by past scholars.

Author	**Risk Type**				
Punniyamoorthy et al. (2013)	political	natural	social	policy	"macro-eco- regulatory nomic"
Petersen & Lemke, (2015)	climate	policy			
Bandaly et al, 2012	political	natural	socio-political	regulations	accidents
Rao & Goldsby, 2009	political	natural	social	policy	macroeconomic
Juttner, 2005	political	natural	social		
Soni & Kodali, 2013	political	natural	political	regulation	infrastructure

Table 2-2 - Environmental risk types

Environmental risks can be rear, and outside the control of the firm. By definition, "environmental risk variables are those that affect the overall business context across industries" (Ritchie and Marshall, 1993). It is also important to note that some studies have categorised terrorist attacks, conflicts, weather conditions as a separate category of supply chain risk. Given our earlier definition of environmental risk, we included terrorist attacks, conflicts, weather conditions and other related threats in the context of the supply chain as an environmental risk.

Political (environmental) risk type

Political-environmental risk refers to the risk that government action or inaction will negatively affect the cash flows of a firm (Bekaert, Harvey, Lundblad, & Siegel, 2014). In a supply chain, political risk can affect not just the flow of products but also facilities, funds, information and relevant supply chain partners (Punniyamoorthy et al., 2013; Bandalyet al., 2012; Rao & Goldsby, 2009, Juttner, 2005; and Soni & Kodali, 2013). Political risk can affect both local and multinational firms since a weak government caught-up with political instability might lack the political power or interest to enhance free market practice. Contrarily, a strong and powerful government can deliberately interfere with the market with the wrong motive. Also, political risk can arise from pressures from the public or civil society groups that force the government to take action, which can have a negative effect on the organisation.

Also, political risk can be caused by several factors which can, in turn, trigger other environmental risks like social and policy risk.

Policy / Regulatory (environmental) risk type

Policy risks are related to changes in government policy or inconsistencies in government policies (Rao & Goldsby, 2009). Born & Pfeifer (2014) defined policy risk as uncertainty relating to fiscal and monetary policy. However, since supply chain management is concerned with the flow of information, goods, and funds among different layers of stakeholders both upstream and downstream, policy risk can be associated with uncertainties that can disrupt the supply chains as a result of government policies. Policies relating to ban on the importation, increase in customs duties and tariffs, and local content restriction are policies that can affect supply chains.

Natural (environmental) risk type

Natural risks are risks that are related to earthquakes, tsunamis, floods, fires, extreme weather conditions that could affect the flow of goods or the production facilities (Punniyamoorthy et al., 2013; Bandaly et al., 2012; Rao & Goldsby, 2009, Juttner, 2005; & Soni & Kodali, 2013). Several natural disasters have affected supply chains directly or indirectly. An example of the direct effect of natural disaster on supply chains is the 2011 earthquake and tsunami, which escalated to a nuclear disaster. The Tsunami affected several factories of major component suppliers of large car manufacturer like Honda and Toyota.

Further, a natural disaster like Iceland ash cloud has no direct effect on production facility of any company, but it was able to disrupt Nissan supply chain as two of its factories were shut down because they could not acquire component part from Ireland (Christopher & Lee, 2004). In both cases of the direct and indirect effect of natural disasters, the supply chain with facility, supplier, customer or distribution route close to the epicentre of a natural disaster is the most severely affected. Unlike political or policy risks – most natural risk can hardly be influenced or changed by the focal firm.

Social (environmental) risk type

Social risks are usually connected to communities of people (resident and customers). They have a potential influence on the supply chain, primarily when they reside close to the physical infrastructure of the supply chain. In some cases, civic societies and pressure groups have the backing of the political class and can influence some policies that might have adverse effects on the supply chain. Further, they can take the law into their hands cause damage to the firm's asset as seen in The Niger-Delta region of Nigeria where some communities who are affected by oil exploration activities engage in pipeline vandalisation of installation and kidnapping of multinational company's workers.

Another dimension of social risk reported by the literature is that of terrorism and piracy (Punniyamoorthy et al., 2013; Bandaly et al., 2012; Rao & Goldsby, 2009, Juttner, 2005; and Soni & Kodali, 2013). Though terrorism in some countries is not necessarily targeted on a specific company or supply chain, in a war situation or pirate attacks, supply chains are targeted directly for either ransomed or robbery. For instance, Somali pirates and Boko Haram terrorist have previously targeted markets, banks and trucks in order to steal goods and cash. Although, the fear of such terrorist attacks forces economic activities to come to a standstill. In the case of pirate attacks off the coast of Somalia, shipping firms spend extra money hiring armed guards and also take a longer route.

Supply risk category

Supply risk is potential or actual disturbances that can occur and affect the flow of product or information associated with supplier activities and in general supplier relationships that can cause significant and/or disappointing failures which affect inflows of resources geared toward operation execution (Christopher and Peck, 2004; and Ju¨ttner, 2005). Supply risk has been reported to have huge effects on the firm's supply chain, mainly when the focal firm is excessively dependant on a single source (Hendricks and Singhal, 2005; Tummala and Schoenherr, 2011). presents the types of supply risks types documented by past literature.

Author	**Risk Type**			
Pournader, Rotaru, Kach and Hajiagha (2016)	single sourcing	Opportunistic behaviour	inadequate responsiveness	technological changes
Manuj and Mentzer (2008)	Supplier Opportunism	Inbound product quality	Transit time variability	Risks affecting suppliers
Cagno and Micheli (2011)	Capacity constraints	Cost reduction capabilities	Lead time	Environmental performance
Wagner and Bode (2008)	supplier business risks	production capacity constraints	quality problems	changes in technology and product design
Tang and Tomlin (2008)	supply quality	supply reliability	supplier solvency	Supply cost risks
Tummala and Schoenherr (2011)	Quality of service	responsiveness and delivery performance risks	Supplier fulfillment errors	Selection of wrong partners
Zsidinsi (2003)	Inability to handle volume demand changes	Failure to make a delivery requirement	cannot provide competitive pricing	technologically behind competitors
Oke and Gopalakrishnan (2009)	Imports	Climate	Human-made disasters	Natural disasters

Table 2-3 - Supply risk types

Though most scholars have cited opportunistic behaviour, technological changes, supplier opportunism, product quality, capacity constraints as the prevalent supply risks, other risk associated to a supplier, like supplier solvency have had a severe adverse effect on supply chains of companies. Unlike the majority of the articles reviewed, Oke and Gopalakrishnan (2009) included in their supply risk

categories, risks that are similar to those in environmental risk. This might be unrelated to the fact that Ju¨ttner (2005) had observed that both supply and demand risk could be triggered by environmental risk.

Demand risk category

Demand risk relates to the probability that a trigger event can cause disturbance to the flow of product, information, and funds between the focal firm's supply chain network and the market (Christopher and Peck, 2004). Demand risk, similar to supply risk, can overlap, and be triggered by environmental risk (Ju¨ttner, 2005). Wagner and Bode (2008) discussed demand risk from the angle of both logistics and unforeseen demand, where they argued that both disruptions in the physical distribution of products to the end-customer. This is usually in transportation operations (e.g., a truck driver strike) and where a mismatch between a company's projections and actual demand as well as from poor supply chain coordination could pose a threat to the supply chain. The types of demand risk types described by past scholars are presented below.

Author	**Risk Types**		
Johnson (2001)	Seasonality	volatility	
Oke and Gopalakrishnan (2009)	Economic,	Demand variability and unpredictability	
Christopher and Peck (2004)	Processes	control	asset and infrastructure dependencies
Tummala and Schoenherr (2011)	Fulfilment errors	Inaccurate forecasts	product variety
Wagner and Bode (2008)	Disruptions in the physical distribution	unforeseeable demands	
Rao and Goldsby (2009)	changes in the demand	lack of availability of complementary goods	predictability of the demand for the product

Table 2-4 - Demand risk types

An essential issue in this context, affecting forecast quality and therefore, demand-side disruptions is the bullwhip effect, characterised by an amplification of demand volatility in the upstream direction of the supply chain. Nevertheless, a mismatch between a company's projection and actual demand may not only be caused by inadequate supply coordination but may be beyond the firm's expectation. For instance, a demand for a firms product might increase significantly if its main competitor runs into a difficulty that makes the demand double far exceed the production capacity and the supply chain infrastructure. Also, a new market might be established suddenly, or an existing market might collapse (an example is the SU lifting and re-imposing trade sanctions with Iran vice versa). Examples of a distinct risk that falls under demand risk are listed in Table 2-4. Other scholars like Chopra and Sodhi (2004) and Rao Goldsby (2009) categorised demand risks as forecast errors (Chopra and Sodhi, 2004) and product market uncertainty (Rao Goldsby, 2009).

Financial/market risk category

The financial risk category is concerned with financially related risks that can affect the ability of the firm to take inputs from upstream or deliver outputs downstream. Scholars have discussed financial risk in relation to supply chain as the risk of an increase in currency volatility, risk of high-interest rates (Soni and Kodali (2013), penalties for non-delivery of goods (Christopher and Lee, 2004), commodity prices volatility (Petersen and Lemke, 2015), and mergers or acquisitions (Trkman and McCormack, 2009). A summary of the types of financial risk types reported by past authors is presented in Table 2-5.

Author	**Risk Types**
(Soni and Kodali (2013)	high-interest rates
Christopher and Lee (2004)	penalties for non-delivery of goods
Petersen and Lemke (2015	commodity prices volatility
Trkman and McCormack (2009)	mergers or acquisitions

Table 2-5 - Financial risk types

In other words, financial risk can affect the supply chain partners from performing their roles effectively. Some financial risk, similar to exchange rate fluctuation or interest, can affect both the focal company and its partners. However, a firm-specific financial event like mergers and acquisition (Trkman and McCormack, 200) is not an industry-wide event, but they can have an adverse effect on the performance of either the focal company or its partner to be cash strapped. Firms in countries like Egypt and Nigeria (in 2016) were caught up with the problem of scarcity of foreign exchange which they need to import raw materials which have had a cascading effect on the supply chain.

Production, manufacturing, organisational risk category

Operational risk is the risk of suboptimal output that results from a variety of cases (Aron, Clemons, and Reddi, 2005). It has also been described by Manuj and Mentzer (2008) as "the distribution of outcomes related to adverse events within the firm that affect a firm's internal ability to produce goods and services, quality and timeliness of production, or profitability". Also, operational risk in the supply chain comprises all the factors associated with performing the core process adopted by a firm in converting inputs into the desired output. Badurdeen et al. (2014) mentioned operating uncertainty, credit uncertainty, liability uncertainty, agency uncertainty as to the various sub-categories of organisational risk. However, to Lee and Ulferts (2011), capacity, inventory and safety stock, procurement, quality as the various sub-categories of organisational risk.

Further, Punniyamoorthy, Thamaraiselvan and Manikandan (2011) listed variability in the production process and cycle time, inadequate production capability, frequent product recall process as risks associated with organisation risk. Nevertheless, risks that are categorised under manufacturing, operational, production and organisational risk category are usually similar (Tummala and Schoenherr, 2011; Punniyamoorthyet al, 2011). Though some studies have highlighted technological, information, risk as a

separate risk (Punniyamoorthy et al., 2013), however Pournader, Rotaru, Kach and Hajiagha (2016), Tummala and Schoenherr (2011), Wagner and Bode (2008) included information and technological risk as organisational risk, i.e. risks that are unique to the organisation and can be grouped with other organisational related risks which affect the supply chain.

Other categories of supply chain risk that are similar to organisational risk are process risk and control risk. Jutnner (2005) noted that "processes can either amplify or absorb the effect of risks in the supply chain", while Christopher and Peck (2004) observed that "controls are the assumptions, rules, systems and procedures that govern how an organisation exerts control over the processes". Both scholars agreed that a failure in process or controls could expose the supply chain to risks, and thus, they categorised both process and control risk separately.

From the perspective of this thesis, when organisations are faced with several known and unknown risks, categorisation creates the opportunity to group similar risk types with a view to find a strategy for mitigating them. Rather than creating risk management from scratch, for each risk type, categorisation makes it easier for deciding on the strategies that will be used for a group of risks in a particular cluster. Especially during a disaster, transferring 'lessons learnt' from a similar risk type in the same category can save time in formulating risk management strategy.

2.3. Supply chain risk management

The need to enhance performance and competition, businesses have adopted several business and operations management models such as Total Quality Management, Just-in-Time, outsourcing, lean philosophy. However, supply chains are always under pressure from both upstream and downstream to keep-up with innovations while delivering value. Thus, managing supply chain risk is of high interest in maintaining the expectation of all supply chain stakeholders. However, supply chain risk is an inevitable reality that faces all businesses. Thun and Hoenig (2011) defined risk management as the identification and analysis of risks as well as their control. Also, Kull & Talluri (2008) defines risk management from a formal and informal perspective which could be sets of continues "actions taken by a corporation in an effort to alter the risk arising from their business and 2) a formal process to achieve an optimum degree of risk elimination or control".

Further, Ritchie and Brindley (2007) argue that the concept of risk management should address all three dimensions of the risk construct (i.e. the likelihood of occurrence, outcome consequences and causal pathways) which may require "actions be taken in advance (e.g. consumer liability insurance) to modify, if not necessarily to eliminate, the potential negative consequences should these occur". As a result, the concept of supply chain risk management should extend beyond managing risks of a particular business process or focal company. Instead, it involves both operational (for a particular department or business process) and strategic (for business processes, departments and organisation) risk in a supply chain. To this end, Diehl and Spinler (2013) suggested that "the definition of supply chain risk

management cannot be singular but defining a case specific definition must be a first step in the risk management process".

2.3.1. Risk management process

Supply chain risk management process according to Hallikas, Karvonen, Pulkkinen, Virolainen and Tuominen (2004) includes; Risk identification, risk assessment, decision and implementation of risk management actions, risk monitoring

Risk identification

Risk Identification and categorisation are the first stage in the supply chain risk management process (Sodhi and Tang, 2012). The process requires the firm to identify risks that can disrupt the flow of good both upstream and downstream. At this stage, a firm can identify risks that have disrupted in the past and those risks that similar supply chains face. Further, for a broader understanding of the risks that can affect the supply chain, all stakeholders of the supply chain should report all potential risk to the focal firm. It is easier to gather potential risk from internal source as the organisation employees can inform their immediate superiors of the perceived type of supply chain risk that is eminent or common in their place of work. However, the firm might find it challenging to convince external stakeholders to report on perceive. For suppliers or logistics service providers, one way to collect information about perceived risks from their end will be by asking the parties involved (before a contract in entered) to report write out and rank perceived factors that might impede the fulfilment of the contract. Such an approach will provide the organisation with constant knowledge of some external risk that might originate from the stakeholders of the supply chain.

Still, at the risk identification stage, the firm must maintain a risk management register (Sodhi and Tang, 2012). The risk register comprises a list of the types of all the risk that can affect the supply chain. Since several risks can originate or be triggered from a similar source, it is imperative to cluster similar type of risks under a broad category. Given that supply chains differ from one another, each organisation can have its supply chain risk categories based on the uniqueness of its operation, business environment or risks it considers essential. In section 4.2.2, this study identified environmental risk, supply risk, demand risk, market risk, and organisational risk categories as the most cited risk in the supply chain literature. Though this categorisation might be too broad for some supply chains, it will still be relevant for organisations that are involved in various business activities. As a result, supply chain risk categorisation should assist the firm in delegating who should manage a particular risk category (Sodhi and Tang, 2012).

Risk assessment

Risk assessment is the second stage in the supply chain risk management process. The focus of risk assessment is to give a numerical value of the risk identified, which are then prioritised and allocated

resource to ensure the risk is minimised or neutralised. Since risk has been express mathematically as a function of probability (p) of an event and the consequence severity (s) of its consequence (Manuj & Mentzer, 2008), discussion on supply chain risk assessment will be incomplete without mentioning probability (Winkler et al., 1996). Though probability is recognised as the mathematical tool used to quantify uncertainty, risks assessment has been criticised for employing subjective interpretation of probabilities – "affiliated with the degree of beliefs" (Winkler et al., 1996). As a result, subjectivity can hardly be avoided when assessing risks, particularly for supply chains. This has been demonstrated by (Dong & Cooper, 2016) who explained that an analyst could utilise their experience, records and current operation to assess the subjective probability of a machine breakdown and its potential consequence. However, evaluating several problems in multiple supply chains is likely to be more difficult and as such, will require more subjective interpretations.

Thus, in practice, risks assessment for most supply chains will involve multiple variables from multiple departments. Risk assessment for a new product, for instance, will require the assessment to be conducted by a group of people involved in new product development as it will require knowledge of the product design, manufacturing process and suppliers' processes, distribution, marketing as well as capacity (Chaudhuri, Mohanty and Singh, 2013). A popular subjective supply chain assessment approach is to assess risk using impact assessment scale and probability assessment scale, as presented in Table 2-6 and Table 2-7 below.

Rank	**Subjective estimate**	**Description**
1	No impact	Insignificant in terms of the whole company
2	Minor impact	Single small losses
3	Medium impact	Causes short-term difficulties
4	Serious impact	Causes long-term difficulties
5	Catastrophic impact	Discontinue business

Table 2-6 - Impact assessment scale. Adapted from Hallikas et al., (2004)

Rank	Subjective estimate	Description
1	Very unlikely	Very rare event
2	Improbable	There is indirect evidence of an event
3	Moderate	There is direct evidence of an event
4	Probable	There is strong direct evidence of an event
5	Very probable	Event recurs frequently

Table 2-7 - Probability assessment scale: Adapted from Hallikas et al., (2004)

Usually, the risk assessment scale is presented in a two-dimensional matrix, which is also referred to as risk map (Sodhi and Tang. 2012). Other methods proposed for assessing the likelihood and/or impact includes Failure Mode Effect Analysis (FMEA), Fault Tree and Event Tree Analysis, Failure Mode, Effects and Criticality Analysis (FMECA), Markov processes, Petri nets, Monte Carlo simulation, Bayesian networks, System dynamics, Grey Theory, and Graph Theory (Govindan & Brandt Jepsen, 2016). One of the reasons for the numbers of methods proposed for assessing risk is because risk

assessment is one of the critical processes that help top management to make informed prioritisation and resource allocation decisions (Sodhi and Tang, 2012)

Selection and implementation of appropriate risk management proposed strategies

After identifying and assessing the risks which the supply chain faces, the next step is to select the appropriate risk mitigating strategies. This involves the development of risk response action plans (Tummala and Shoenherr, 2011). The primary purpose of selecting an appropriate risk management strategy is to reduce the probabilities of losses associated with risk events Manuj and Mentzer (2008). Risk mitigating strategies can be categories base on the time they are implemented. Where the risk-mitigating strategy is implemented before a disruption – it is termed to be a proactive risk management strategy.

By contrast, where the risk management strategy is implemented after a disruption, then it is a reactive risk management strategy. However, a proactive strategy for a different type or category of risk can be implemented after a disruption that was initially caused by a different type of risk. Researchers have suggested several strategies for managing supply chain risk (Manuj and Mentzer (2008 b). Importantly, adopting any strategy requires identifying and assessing the risks the organisation is facing as well as the organisation's environment, stakeholders and resources.

Risk monitoring

Risk monitoring for a specific risk comes after the appropriate risk mitigation strategy have been selected and implement. However, for general firm supply chain risk, risk monitoring is a continues aspect of supply chain risk management since the business environment is not static (Hallikas, Karvonen, Pulkkinen, Virolainen, & Tuominen, 2004). Thus, supply chain risk sources and triggers for specific and general risk as well as the high or low risk should be monitored continuously to provide managers with potential threats that might cause supply chain disruption. Also, it is essential to reveal whether the risk mitigation strategy is implemented as planned and whether the risk response actions were effective or if new mitigation strategy should be employed. Blackhurst, Scheibe and Johnson (2008) developed a multi-criteria scoring procedure to calculate part and supplier risk indices. These indices were played a role in the development of a risk assessment and monitoring system which lets the indices to be tracked over time for identifying trends towards higher risk levels.

To close the discussion in this subsection, it is important to note that this thesis is centred around risk information sharing. Although supply chain trigger event can occur within the physical environment of the firm, there is still the need for organisations to have a system that allows for sharing information about the event and initiating the risk management process so that the supply chain is not disrupted. The system in the context of this thesis is informal relationships between supply chain partners. Further, since supply chain risk management involves identification of the potential source of risk, supply chains

that face continuing risk need to promote risk information sharing between members of their supply. As a result, the benefit of an effective risk information sharing serves as a risk mitigation strategy by strengthening the supply chain's ability to identify risk and prepare for disaster "through a coordinated approach among supply chain members. However, supply chains have peculiarities relating to network, complexities and relationships, which will be discussed in the next subsections.

2.4. Supply chain peculiarities and risk information sharing

Unlike in other disciplines where the discussions on risk may be narrow or specific to an aspect, supply chain involves several independent organisations which can be a small internal risk for one organisation but a significant external risk to its partner. Discussion on such supply chain peculiarities and how they are associated with risk information are presented.

2.4.1. Supply chain network and risk information sharing

Criticism has been made on the "oversimplified" view of supply chains (Hearnshaw and Wilson, 2013). For instance, the idea of "supply chain", implies strings of firms involved in the manufacture and supply of a specific product or product family (Johnsen et al., 2008). Hence, analysis using a "chain" or linear approach focuses on dyadic relationship between chain members. However, calls are made for a triadic structure which incorporates horizontal supplier–supplier relations or a supply network which encompass more than three actors. This is because supply chain network considers all stakeholders and relationships in the supply chain (Hearnshaw and Wilson, 2013; Choi and Hong, 2002; Ahuja, 2000). The argument for supply network is further supported by Hearnshaw and Wilson (2013) who reported that "*A supply chain can be modelled as a network by a set of "nodes" that represent autonomous business units as firms who are able to exercise sovereign choices, and a set of "connections" that link these firms together for the purposes of creating products or services*". An example of upstream supply networks with several tiers and interactions is shown in Figure 2-2.

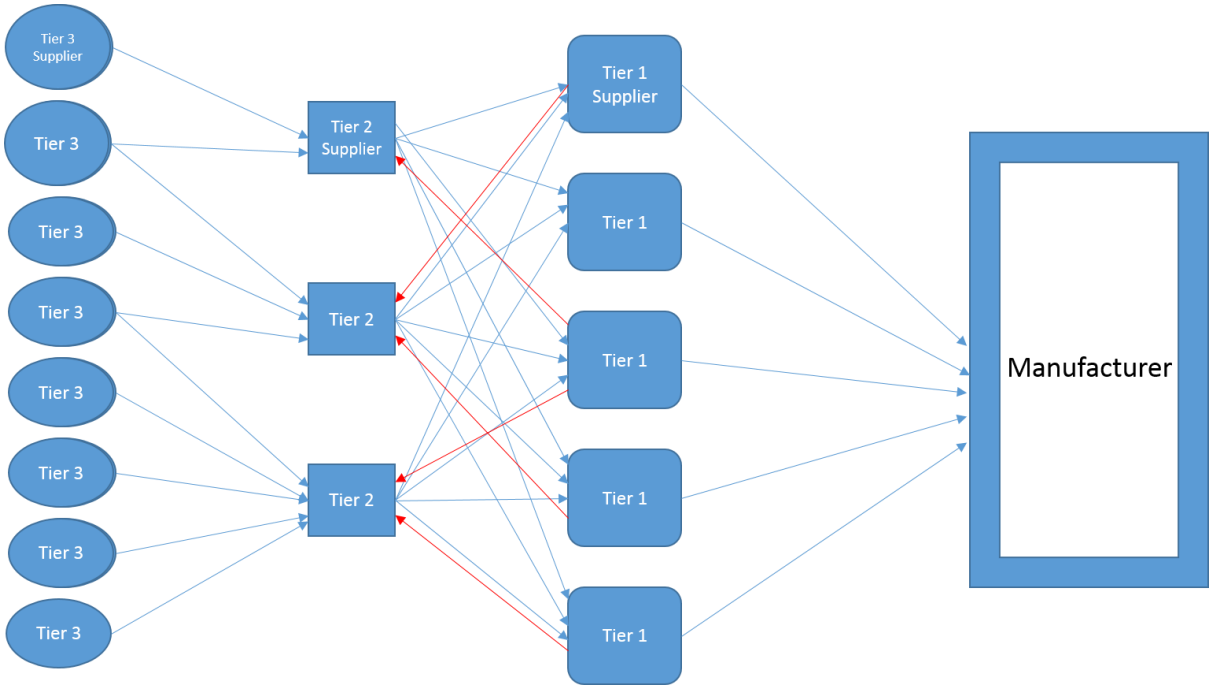

Figure 2-2 - Supply network of multiple tiers and interactions

In most supply network, the upstream usually have more numbers of organisations which may be interlinked to each other or the manufacturing firm. The relationships are typically buyer-supplier in several tiers. They all form the supply network of the manufacturing firm. As stated previously, the organisations are usually interconnected, and they take part in the purchase, use, and transformation of raw materials to provide final goods and services (Harland et al., 2001).

Choi and Hong (2002) put forward three aspects of a supply network system; formalisation, centralisation, and complexity. According to Choi and Hong (2002) formalisation in the supply network context refers to the extent to which the supply network – comprising the focal firm and its partners - is controlled by explicit rules, procedures, and norms that stipulate the rights and obligations of each firm in the supply network. From supply chain risk information perspective, this implies the extent to which explicit rules and procedures for sharing risk information are stipulated, usually by the focal firm. With regards to centralisation, this refers to the degree to which authority or power which the focal firm can exert to its partners to enable them to take specific actions outside their contracts. From the angle of risk information, it is the degree to which the focal firm has control over what partners in the network to share risk information.

Assessing the supply chain risk information sharing from the supply network or network system provides a broader understanding of the challenges of the entire network, which can increase the level of information sharing. Though the network may extend to several tiers, contract obligation is usually between direct partners. Hence, sharing risk information beyond to a member of the network whom a

firm is not obliged is a voluntary act the may warrant justification. Again, issues regarding formalisation and centralisation have to be brought to context.

2.4.2. Supply chain complexity and risk information sharing

Supply chains can be a complex network with several interactions and inter-dependencies among and between individual firms, processes and resources (Surana, Kumara, Greaves and Raghavan, 2005). According to Choi, Dooley and Rungtusanatham (2001), "the concept of complexity allows us to understand how supply networks as living systems co-evolve, and it can help us to identify the patterns that arise in such evolution". Such understanding is vital for adopting appropriate interventions that would lead to the optimisation of the supply network system.

Evidently, the entire supply network is a system among which there are several sub-systems. Further, as shown in Figure 1-1, the complexities upstream (the input side of the focal firm) usually have more variation and interactions than the downstream side (the finished goods or service side). Importantly, while finish product - usually from a focal firm is mostly fewer - the component parts or raw materials and suppliers may be in higher numbers. For instance, aircraft manufacturer may have twenty (models) of finish products but hundreds of components and suppliers. To this end, supply chain integration has been proposed to reduce the difficulties associated with complex supply chains (Leuschner and Rogers, 2013).

Nevertheless, as some firms continue to increase their supply base at the same time adopting several new business models, the supply chain will become more complex. Some researchers have argued that this has caused supply chains to become more vulnerable to different kinds of risk (Christopher and Lee, 2004). As the number of different links (complexities) in the chain is increasing, more of these links is an occurring distance away from the focal firm, and the consequences of erroneous risk assessments can be severe.

When considering risk information sharing in the complex supply chain, the dimension forward by Choi and Krause (2006) is crucial; i.e. the number of suppliers in the supply base and the level of interrelationships among the suppliers. For the number of suppliers, a focal firm will want to have a system where risk information is shared between the focal firm and its suppliers. Further, where there is an interrelationship among suppliers, risk information sharing among suppliers will be beneficial to both individual supplier and the focal firm. In this instance, a triadic or network approach to supply chain risk information sharing (from the supplier's point of view) will be possible. That is, the firm that has information about a risk that will affect the supply chain does not only share with the focal firm but also with other suppliers (firms). The focal company may instigate working relationships among suppliers for the purpose of risk information sharing. In such a situation, the focal company is at the centre coordinating the sharing of the risk information (Choi et al., 2001).

2.4.3. Supply chain relationships

Supply chain management has been described by Harland (1996) as an intermediate type of relationships within various business stages. Harland (1996) Wu and Choi (2005) observes that business trends such as Just-in-time, supplier base reduction, and outsourcing provide the context and reasons why there is an increased interest in the management of supply chain relationships. This will likely increase as new business trends and models emerge. Besides, these business trends have their own risk that makes supply chains more vulnerable and thus, requires a relationship beyond the normal business exchange relationship.

Scholars have provided two extremes of business/supply chain relationship; (1) arms-length and (2) integration/ partnership type III /collaboration (Lambert and Knemeyer, 2004). In an arms-length relationship, "the organisations recognise each other as partners and coordinate activities and planning on a limited basis" (Lambert and Knemeyer, 2004). However, in the integration/ partnership type III /collaboration relationship there is a significant level of integration between firms, "with each viewing the other as an extension of itself" (Lambert and Knemeyer, 2004). Further, some arms-length relationship in a buyer-supplier relationship may be competitive, leading to partners guarding important information (Wu and Choi, 2005). Yet, a collaborative relationship is more cooperative, which emphasises more openness (Wu and Choi, 2005).

Collaborations in the supply chain are centrally aimed to integrate supply and demand (Barratt, 2004). Early forms of supply chain collaboration, as reported by Barratt (2004) are vendor managed inventory (VMI) and continues replenishment programmes (CRP). According to Barratt and Oliveira (2001), information sharing is an essential requirement for successful collaboration among supply chain partners. This submission was further supported by Hudnurkar, Jakhar and Rathod (2014). They selected 69 randomly research papers published in the refereed journals in the area of supply chain collaboration. They found that a total number of 28 factors affects supply chain collaboration and supply chain information sharing is found to be highly talked factors for effective supply chain collaboration.

In all, from the perspective of this thesis, the type of supply chain relationship between partners (whether arm's length or collaboration) will affect the level of risk information, especially when it is not included in the contract. However, personal relationships between people working in partnering firms can be considered as one way to enhance risk information sharing among supply chain partners. Although supported by the social capital and social exchange theory, it is unclear how the informal relationships between supply chain partners can be enhanced for risk information sharing.

2.5. Risk information sharing from other perspectives

Several of the information related studies in the field of supply chain management emphasised demand forecast information sharing (Oezer, Zheng and Chen 2011; Trapero, Kourentzes and Fildes 2010; Småros, 2007; Shamir and Shin; 2016) and collaborative (not for risk) information sharing (Olorunniwo

and Li, 2010; Scholten and Schilder, 2015; Nyaga *et al.*, 2013). However, risk information sharing has not drawn attention in the supply chain management literature with only a few articles mentioning the concept (Fan *et al.*, 2016; Li, Fan, Peter K C Lee, *et al.*, 2015). Since risk is a concept that is used in different disciplines, it is vital to assess how risk information sharing is viewed in those disciplines and subsequently linking the insights to this thesis.

2.5.1. Computer and cyber risk perspective

Risk information sharing in computing and cyber-security perspective is well researched in the literature (Naghizadeh and Liu, 2017; Gordon, Loeb and Lucyshyn, 2003). Studies from this perspective attract academia, organisations and government. One of the reasons for the research interest in this area (computer and cyber-security perspective) is as a result of countless cyber-attack on various organisations and individuals. In one incidence of cyber-attack relating to supply chain, AP Moller- Maersk, a global shipping company in 2017.

Given the danger cyber-attack could pose, many stakeholders such as governments, academicians, and corporate executives have endorsed the sharing of information relating to cybersecurity (Gordon *et al.*, 2015). From the part of governments, several institutions are established to increase cybersecurity by carrying out several duties, among which is risk information sharing. Some of these government organisations include:

- The National Cyber Security Centre (UK)- which part of its mandate is to protect critical services from cyber-attacks, manage serious incidents and improve the basic security of the UK Internet
- Department of Homeland Security (USA)– securing cyberspace; and ensuring disaster resilience.
- Cybersecurity Hub (South Africa) - to protect South African citizens and businesses online, and to contribute to the security of National Critical Infrastructure.
- European Union Agency for Network and Information Security (EU) - assist the EU and EU countries to be better equipped and prepared to mitigate, detect and react to information security problems.

Since cyber risks go beyond IT infrastructure (extending to the information embedded in the system), sharing risk information is regarded as one of the core tenants of cyber-security (Hausken and Kjell, 2017). Sharing risk information is, therefore, necessary to protect critical organisational information such as operational, strategic and confidential information. As a result, the organisations listed above play a role in providing a platform where stakeholders who in normal circumstance will not share information about security breaches, end up sharing information about breaches with one central government agency.

Further, to prevent non-compliance with government-initiated information sharing, some countries mandate firms to disclose cybersecurity breaches. For instance, The United States Securities and Exchange Commission issue guidance of the disclosure guidance on cybersecurity risks and cyber incidences. As part of the benefits of sharing risk information and/or breaches, Hausken and Kjell (2017) argue that organisations can collectively prevent security breaches if proprietory information about breach is shared between firms. Researchers have been carried out to highlight such a benefit. A summary of these benefits of risk and/or breach information sharing is summarised in Table 2-8 below.

Author	Benefits
Hausken and Kjell (2017)	Collective benefit from several firms knowing about risk/breaches
Laube and Böhme (2015)	Authorities can effectively advise and warn other firms
Naghizadeh and Liu (2017)	Leverage on victims experience and invest in the most effective preventive and protective measures
Gordon, Loeb and Lucyshyn (2003)	Give consumers the opportunity to respond quickly to protect themselves
Gordon, Loeb and Lucyshyn (2003)	Reduces the costs of achieving any particular level of information security
Gordon, Loeb and Lucyshyn (2003)	Aids understanding of large-scale cyber-attack situations

Table 2-8 - Benefits of risk information sharing from a cybersecurity perspective

In all, the literature highlights that the benefits of risk and breach information sharing to all stakeholders cannot be overemphasised, even with the reluctance of some organisations not wanting to share. Laube and Böhme (2015) argue that when firms share information about security breaches especially with the authorities, they (the authorities) "can effectively advise and warn other firms, thereby strengthening overall defence and response to cyber threats in an economy". Further, organisations that have not been affected can leverage on the experience of victims of the attack to prevent similar or related attacks and to invest in the better effective preventive and protective measures (Naghizadeh and Liu, 2017).

Similarly, from the consumer perspective, there are benefits to sharing information about breaches. It provides consumers of the breached organisation (whose privacy data may have been compromised), the opportunity to react or respond on time to protect themselves from further harm while paying more attention to the breached company. Although in research emphasis is cybersecurity breach usually narrows down to cost effect on the organisation (Gordon, Loeb and Lucyshyn, 2003), considering the effect on consumers and citizens can enable them to also contribute in cyber risk management process.

Still, on the issue of cost to the organisation - with regards to information sharing- Gordon, Loeb and Lucyshyn (2003) stressed that the overall cost of attaining any specific level of information security could be lowered through information sharing about threats and breaches and in the long run, it enhances social welfare. Similarly, information sharing could also encourage firm's to take a more proactive approach, as compared to a reactive approach toward cybersecurity investments (Gordon et al., 2015).

Despite the arguments for risk information sharing, there are still firms that are reluctant to share information about incidence or attempt of the breach. An example of the cyber-attack at Uber and the refusal

of the company to informing both the authorities and affected individuals immediately after the attack is an example of non-information sharing. Moyano-Fuentes and Martínez-Jurado, 2017) explained that part of the reason for non-sharing of risk/breach information could be due to of lack of trust, especially if it is initiated by a potential competitor or adversary. Other reasons reported to be among the impediments to risk information sharing is the negative impact on firms share price (Cavusoglu, Mishra and Raghunathan, 2004).

However, when the breach information does not involve confidential information, researchers have reported a different reaction. For instance, Campbell *et al.* (2003) examined the economic effect of information security breaches reported in newspapers on publicly traded US corporations. Their results showed that the nature of the breach affects the investor's behaviours. They found a highly significant negative market reaction for information security breaches involving unauthorised access to confidential data, but no significant reaction when the breach does not involve confidential information.

Consequently, to mitigate the lack of information sharing, Gordon, Loeb and Lucyshyn (2003) stress the need to create economic incentives to facilitate effective information sharing. Bearing in mind that if such an incentive is not created, firms will have an incentive not to share information, so that all benefits to information sharing disappear. Also, some researchers have called for cooperative cyber-defence, which also known as Cybersecurity Information Sharing (CIS). The CIS is essential for detecting attacks by timely sharing actionable cybersecurity information (e.g. vulnerabilities, detection signatures, or indicators of compromise) are paramount (Skopik, Settanni and Fiedler, 2016).

From the perspective of this thesis, risk information sharing from cyber-security perspective highlights the benefits of having a central agency that coordinates the sharing of risk information. Nevertheless, supply chains can benefit from such a coordinating agency when the risk relates to cyber-security, despite other types of non-cyber related risk that can affect supply chains. Additionally, evidence shows that unlike supply chain management, this review reveals that sharing cyber-security risks and breaches are mandatory in some countries. Yet, sharing risk information can be a benefit to supply chains, especially when partners are reluctant to share risk information and given the complexities of the supply network. Additionally, similar to cyber-security perspective, understanding that sharing risk information about a vulnerability or breach does not automatically translate to sharing information about an organisations operations or strategy; instead it is aimed at preventing organisations supply chains from disruption. In this case, understanding the difference between sharing business strategic or operational information is different from sharing risk information can increase the level of risk information sharing.

2.5.2. Disaster and emergency perspective

The International Federation of Red Cross Society and Red Crescent Societies defines a disaster as "a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability

to cope using its resources" (IFRC, 2018). Typhoon, earthquakes, conflicts, drought, wild bush fires and public health emergencies, which generally concern the outbreak of particular diseases, are all examples of disasters that disrupt the functioning communities and businesses as well. Disaster is mostly classified as natural, unnatural (human-made), and hybrid Human-made disasters are those catastrophic events that are an outcome from human decisions and actions, natural disasters, such as a hurricane or volcanic eruptions, by contrast, are catastrophic events resulting from natural causes. In contrast, hybrid disasters are disasters that result from both human decisions and action matched with natural forces. An example of a hybrid disaster is excessive deforestation leading to flooding of neighbouring communities.

In all the types of disasters, communication is important to victims, first responders and families of victims for several reasons. Firstly, in both human-made and hybrid disasters, effective disaster communication may prevent or minimise the impact of the disaster. Further, in the pre-disaster stage, disaster communication aims to disseminate information about the impending danger with the aim of making people take necessary precautionary steps to mitigate the impact of the catastrophe. By contrast, in the post-disaster stage, disaster communication plays a role in 'preventing further illness, injury, or death; restore or maintain calm; and engender confidence in the operational response' (Reynolds, 2005). Nevertheless, in an active disaster, both institutional actors and victims need information about what has happened and what is still ongoing within a disaster-affected area and the wider environment (Tagliacozzo, 2018).

Government, which is usually the focal point for information, typically adopt mass media such as radio and television as the primary means of communication in a disaster situation. Additionally, face-to-face, telephone calls, group meetings and social media are also channels used by governments in disaster communication (Bradley, McFarland and Clarke, 2014). In recent times, social media plays an important role and sometimes serves as the primary source of information not only to the public but even to the government and other institutional actors (Collins, Neville, Hynes & Madden, 2016). Social media in disaster communication, according to Lovari and Bowen (2019) "is rapidly emerging, without geographic boundaries, and interactive". Unlike with radio and television channels of communication, social media provides the opportunity for real-time updates of situations and interaction between all stakeholders, including victims. In essence, information about disaster no longer comes only from the top-down, government to communities, but is generated and hared vertically and horizontally among all stakeholders (Collins, Neville, Hynes & Madden, 2016).

Despite its interactive advantage as well as speed, social media have been criticised as been dubious in some cases (Collins, Neville, Hynes & Madden, 2016). Other criticisms on social media are based on the inability to carry out credibility check especially with rapid dissemination which can lead to sharing inaccurate or misleading information spreading fast about a disaster situation (Lovari and Bowen, 2019)

An example of social media being used in spreading inaccurate information was during the Ebola outbreak, where the social media played a positive role in sharing risk information and at the same time was used in causing panic and wrong advice (Nigeria). Notwithstanding, Li *et al.* (2018) contend that social media plays an increasingly important role in information publishing and event monitoring in emergencies like natural disasters.

Another dimension of communication in disaster and emergency perspective that scholars have debated is the "scope of communication" especially in the post-disaster period, which is usually the longest time period in the stage of the disaster. According to Nicholls (2012), the role of communication after disasters should be "to contribute to and, where possible, expedite recovery through a combination of information and dialogue". As a result, the scope of communication may also shift from the response to long-term recovery. In the former phase, communication is aimed at reducing harm, increasing the survival rates, and restoring the critical infrastructure. In the long run, the communications should be geared toward producing social and behavioural change, fostering collective ownership, and providing space for wider dialogue (Asian Disaster Preparedness Center, 2015). Further, in the post-crisis stage, information is exchanged for postmortem, assessment, learning, and constitution of new understandings of risk in order to amended procedures and policies for risk avoidance (Reynolds and Seeger, 2005).

Further, the "right to know" is one of the vital issues in emergency risk information (Reynolds and Seeger, 2005). The right-to-know serves as a risk management strategy in the pre and post-disaster stage which gives victims and stakeholders the opportunity to prepare for a disaster and understand the extent and cause of the disaster. Applicable to human-made related disaster, governments have started mandating organisation to communicate to potential victims the dangers of their business activities. For instance, Washington state and Michigan in the United States passed a law on employee right-to-know. As a risk management strategy, the right to know aims to make people take action, mostly before a risk event erupts (Braun and Niederdeppe, 2012). Similar to the view of the UK government, a well-informed public is better able to respond to an emergency and to minimise the impact of the emergency on the community.

Consequently, in situations of poor communication during a crisis, organisations or government agencies may be held responsible for lack of communication. The central authority mandated to communicate in an emergency situation could be a relevant authority or an organisation that is responsible or linked to the manufacture of a product or event that is about to or has caused harm, whereas government authorities are responsible for communicating health-related or natural disaster risk while organisations are responsible for plant explosion, employee violence, toxic spill, or transportation accident. In this instance, the central authority is the focal point in coordinating sending the information to the target audience. Also, the central authority determines the type of risk information each audience in the

community receives. For instance, the First-responders will receive perhaps more detailed and structured information than individual people (Braun and Niederdeppe, 2012).

Despite the argument for right-to-know, perceive risk can also instigate individuals to seek information about disasters. Defined as a motivational factor in individuals' propensity to seek information perceive risk compels individuals to demand right-to-know before or after a disaster. For instance, in the study of Mäser and Weiermair (1998), they found that the higher the perceived risk, the more searches for information is made, which positively affects the rationality of decision-making process. Similarly, Rimal (2001) found that perceived risk positively correlated with information-seeking behaviours. As a result, although governments are moving towards giving victims right-to-know in some disaster events, peoples perceive risks have also motivated them to seek risk information.

From the perspective of this thesis, crisis communication from the disaster and emergency perspective provide insights for risk information sharing in supply chains. Firstly, the post-disaster communication aimed at restoring and maintaining calm, producing social and behavioural change, fostering collective ownership, and providing space for more extensive dialogue is vital for supply chains that have experience disasters a deeper understanding and broader approach of how to mitigate future risks. Also, social media – which is becoming very popular for disaster communication – can be beneficial for firms to receive information about risk, rather than using social media for mostly corporate communication and marketing. Further, the debate about the right-to-know can be extended to supply to assess whether supply chain members have the right-to-know about risk when a partner knows about a risk event.

2.5.3. Intelligence community perspective

Intelligence sharing for the purpose of preventing crime, terrorism or harm is an initiative individual, institutions, government and business supports (Sales, 2010). Intelligence sharing is the act by which two or more countries, agency or agents aims to prevent or combat common threats by exchanging credible and faster information (or raw intelligence) about threats. Intelligence has been categorically differentiated from information based on the time and context that the information is analysed (Maras, 2017). Hence, intelligence is defined as "a product that results from the gathering, processing, assimilating, examining, evaluating, and interpreting of information about entities gleaned from open-source and/or confidential methods and sources" (Maras, 2017).

Following the 911 attacked in the United States, many changes to intelligence information sharing have taken place. Information sharing is, therefore, the main recommendation, championed as the core of a networked intelligence community working in collaboration for a better suited to threats of the present time. Further, in the post 911, the Department for Homeland Security (DHS) was created in the US. As part of its responsibilities, the DHS is saddled with the "coordination and sharing of information related to threats of domestic terrorism within the department and with and between other federal agencies, state and local governments, the private sector, and other entities". The Department of Homeland

Security also requires companies to share not only information about people (passengers) but also goods that are inbound to the US. As a result, intelligence information sharing can be between and among the intelligence community (comprising of around 16 agencies in the US) and also between the intelligence community and non-intelligence community (like businesses).

Although the intelligence community is a term used for the various intelligence agency most in a country, however, there is distinct identity each agency and group of agencies have which makes them different. Described as intelligence cultures, they are norms, values, beliefs, perceptions and behaviours of a group of people (Turner, 2005). Intelligence culture plays an essential role on how intelligence is shared between agencies within and outside a country. Agencies whose culture encourage secrecy, restricted information sharing among community members severe compartmentalisation of information; distrust and suspicion of peers and outsiders may find it challenging to collaborate with other agencies in the intelligence community. According to Maras (2017), the reasons for lack of intelligence sharing can be traced back to one of Max Weber characteristics of bureaucratic organisation: secrecy. Similarly, the 9/11 Commission's findings reported that there was a "lack of information sharing between federal, state, local authorities and the private sector, especially about individuals with ties to terror groups" (Valledor, 2009). Before 911, Hitz (2000) argued that attack on the Pearl Harbor attack of 1941 "could have been prevented if better information-sharing practices existed between the military and civilian agencies". Table 2-9 highlights some obstacles and way-out to the problem of information sharing in the intelligence community.

S/N	Author	Obstacles	Way-out
1	Maras (2017)	Existing organisational cultures:	Extensive communication with employees.
		Secrecy and limited disclosure of information Extensive compartmentalisation of information	Employee involvement in decision making
			Educational and/or training programs
			Chain of command support for changes
			Change of mission statement
			Incentives for information sharing
			Revision of existing performance appraisals within the IC
2	Shore, Crane and Wilson (2016)	The Mosaic Effect	"connect the dots" to build a more comprehensive picture
		Institutional and Cultural Barriers	The moral imperative to prevent harm where possible
3	Valledor (2009)	Political distraction	Procedural agreements between Justice and intelligence agencies must close existing loopholes to exchanges of information affecting public safety and security

S/N	Author	Obstacles	Way-out
		Sub-optimization of the information sharing environment	Top leaders must be included in the information sharing
		Too many independent database systems that are non-user-friendly	User-friendly integrated information platform
		Lack of trust	Increased partnerships
4	McGruddy (2013)	Strong states/agency taking over control of the information sharing process	A multilateral approach based on an agreed set of standards for intelligence collection and analysis including protocols for sharing and collaboration

Table 2-9 - Obstacles to intelligence information sharing

In the wake of several terrorist attacks and to make society safer, governments of most countries are coming to terms with the need to promote intelligence sharing within and among agencies. In the UK, for example, there has been increased co-operation between the police and the intelligence services (Field, 2009), and "towards a more customer-facing culture"(Hare and Collinson, 2012). Also, there has been calls for the international intelligence community and their respective states to adopt multilateral intelligence collaboration (Mcgruddy, 2013). The argument is that "intelligence to be seen as a public good" which can save lives of people irrespective of the country they are at present (Mcgruddy, 2013).

From the perspective of this thesis, based on the insight from the intelligence community, an organisational culture that promotes risk information sharing among supply chain members is critical in increasing supply chain ability to sense and prepare against disruptions. Also, similar to the intelligence perspective, sharing supply chain risk information should be viewed as a public good that should be shared by partners in the supply chain.

2.5.4. Creditors and lenders perspectives

Credit lenders (especially financial institution) need to know about the credit history of potential borrowers to make an informed decision about the credit they will offer (Bermpei, Kalyvas, Neri, and Russo, 2019). Conceptualised as credit information sharing, it helps in increasing discipline among borrows and reducing moral hazard exerting disciplinary effects (Büyükkarabacak and Valev, 2012). Also, banks, who are the main players in the financial sectors, encourage and practice credit risk information sharing and evidence have shown that it reduces the likelihood of banking crisis (Büyükkarabacak and Valev, 2012). Further, research reported that credit information sharing among lenders promotes bank credit allocation, reduces default rates, reduce moral hazard and adverse selection, and to increase borrowers' incentives to repay their debts (Loaba and Zahonogo, 2019).

The need to share credit information is due to the limited information lenders have on borrowers. Since no single lender has all the information about all borrowers, instead each lender has some information about borrowers they have transacted with before, lenders (particularly banks) credit information sharing is an acceptable practice in the financial sector. This is because sharing credit information eliminates

the information differences across institutions, allowing them to make better judgments about lending to all borrowers. In essence, as most lenders become aware of borrows with bad credit history, extending loans to such people or organisations is reduced.

Though banks and other financial institutions may voluntarily share credit information between themselves, there is a need for a credit information system especially in countries where access to credit information is limited (Luoto, Mcintosh and Wydick, 2007). Thus, efforts have been made to create a credit reference bureau in most countries (Munene and Wanjiru, 2017). In some situations, the private credit bureaus (PCBs) are mostly established by the private sector, while the public credit registries (PCRs) are usually established by governments. The private credit bureau provides reliable credit information on borrowers demanded in the market. In all, there is a repository where lenders can always assess to gain credit information sharing about borrowers.

In contrast to providing negative credit information that aimed at preventing granting loans, defaulters, the credit bureau can serve as a source of positive credit information (Hahm and Lee, 2011). Since credit bureau stores credit history of existing borrowers, those borrowers with no default history can leverage on their records to seek higher credit. Also, institutional lenders such as a bank can participate in positive credit information sharing as a study by Hahm and Lee (2011) found that the performance of the overall banking sector will increase when credit is granted based on positive information.

From the perspective of this research, the insight from the creditors and lenders perspective highlights the need to document senders of risk information based on type and accuracy of the information they have shared in the past. Also similar to disaster and emergency perspective, having a central agency for the purpose of supply chain risk information sharing will be useful in mitigating supply chain risks. Additionally, since supply chain risk can have a negative or positive consequence on the focal firm, encouraging sharing whatever type of risk information may provide the basis for increased firm performance and innovation which will also be advantageous to the risk information sender in the long run.

Bringing the understanding from the computer and cyber risk, disaster and emergency, intelligence community, and creditors and lenders perspectives, a new and broad insight into the concept of supply chain risk information is gleaned. Consequently, this research defines supply chain risk information sharing as the act of communicating critical information to supply chain partners about an event(s) that has the likelihood of disrupting the supply chain. Noting that all firms will want to receive supply chain risk information, some firms are reluctant to share risk information. Hence, this definition is centred on the sharing of risk information by all parties in the supply chain of a focal firm as well as the extended network. Furthermore, although information can be described as meaningful data that is contextualised, particularly from the perspective of the receiver, sending a message to a supply chain partner about the occurrence of a disruptive event, can be argued as risk information if it is contextualised by the receiver. For instance, Nissan might have been sent a message about Coronavirus on day one that the virus was

detected, however, if the message was not contextualised from a supply chain perspective, the receiver (Nissan) could interpret it as any other data. Nevertheless, it is beyond the scope of this research to establish whether senders of risk information should provide a context to the messages they send about disruptive events. However, it can be argued that if all the qualities of information from the field of information management are fulfilled - from the content, time and form dimension - the supply chain would have already been hit by the disaster.

2.6. Summary of section

In this section, conceptual literature on supply chain risk information sharing is presented. The section underscores the importance of understanding the dimensions underpinning supply chain risk information as some aspect of the concept are being used in other disciplines such as information science, computer and cybersecurity, disaster management, intelligence community, and finance. The sections start with explaining the meaning of information as well as information quality and factors affecting it. Also, the concept of supply chain management, supply chain risk management were presented. Supply chain peculiarities with respect to risk information sharing were also discussed. The section closed with a discussion of risk information sharing from other perspectives.

3. Social exchange and social capital theory

Section 2 presented the systematic literature review procedure used to identify the literature that is reviewed in this research. In this section, the relevant theoretical literature is reviewed in order to understand and explain the problem from a theoretical standpoint. As a result, it was crucial to present this section so that the theoretical foundation of the study is presented before extending to the conceptual and empirical elements of the literature review. This was necessary due to the nature of the problem requiring a new explanation from the theoretical standpoint, particularly as a phenomenon from the combination of two fields of study – psychology (relational behaviours) and supply chain management (risk information sharing).

3.1. Social exchange theory

Scholars have recognised social exchange theory as "one of the most influential paradigms for understanding workplace behaviour" (Cropanzano and Mitchell, 2005). The theory builds on the idea that human interactions and social behaviours depicts an interchange, or is affected by physical or intangible actions based on costs or rewards accruing from the interaction (Molm, 1991). In other words, people's actions are driven in anticipation of returns or reward, and they will choose actions in relationships that will yield most rewards and least costs (Molm, 1991; Molm, Takahashi and Peterson, 2000). Although the rules for interactions and interchange between people are not formal, there is no 'free-riding' in a social exchange relationship. Instead, there is an assessment of the costs or rewards which is carried out consciously or unconsciously through cost-benefit analysis (Hamon and Bull, 2016a). Each actor (person or organisation) are concerned about the benefits from the relationship or the cost of the relationship to them. As a result, people draw on their values to select relationship choices of what is most beneficial to them and the level effort they will invest in the relationships. Hamon and Bull (2016) argue that the exchange of benefits is needed for people to start and continue a relationship. However, when people discern inequality, it sets the relationship in danger (Boateng *et al.*, 2019). In essence, the relationships people keep for a long time are those who give the most benefit and least cost or effort.

3.1.1. Forms of exchange

The forms of exchange suggested by Molm, Takahashi and Peterson (2000) relate to direct or indirect exchange, which is an extension of the mutual or reciprocal dependence in relations. An example of direct exchange is when A provides value to B, and B provides value to A. The indirect form of exchange, according to Molm, Takahashi and Peterson (2000), is when the beneficiary of the goods does not return the goods straight to the presenter, but to another actor in the social group. In the context of this research, company A shares risk information to company C (based on the current needs of Company C) even though company A has benefited from risk information shared from company B in the past. The subcategories within the direct and indirect exchange are based on attributes such as reciprocity, negotiation, and contributions to groups (Cropanzano and Mitchell, 2005).

Reciprocity exchanges

Reciprocity or repayment reflects the foundation of social exchange: that something must be given, and something must be returned (Cropanzano and Mitchell, 2005). Interdependence exists between the parties who are all in mutual and complementary arrangements (Molm, 1994). Each actors' contributions to the exchange are performed independently of the other and are non-negotiated (Molm, Takahashi and Peterson, 2000). An actor can initiate an exchange, such as requesting for assistance or advice independently, without knowing whether or expecting, when, or to what extent the other actor will reciprocate or repay in the future (Molm, Takahashi and Peterson, 2000). For example, allowing a colleague to borrow one's possession without defining the expectation (that you may want to borrow something in return in exchange) is based on the principles of reciprocity.

Negotiated exchanges

In negotiated exchange, actors are involved in the negotiated exchange in carrying out joint decision process, for example, explicit bargaining, where the actors come to an agreement to the terms of the trade (Molm, 1994; Molm, Takahashi and Peterson, 2000). Both parties of the exchange agree at the same time, and the reward for both exchange partners can be recognised as a paired offering that forms a discrete transaction (Molm, 1994). In essence, all parties have information about what is being exchanged and their value.

According to Molm (1994) and Molm, Takahashi and Peterson (2000), most economic exchanges other than fixed-price trades fit the negotiated exchanges category, so also are many social exchanges. In a negotiated exchange situation, the flow of benefits is bilateral as "neither actor can obtain a benefit without making an accord that is to the advantage of both parties (however unequally)", Molm (1994) Molm Takahashi, Peterson (2000). A typical example of a negotiated exchange that is binding on both parties can be seen within an online market website where the host guarantees both parties that goods of a particular specification will exchange for a particular amount under a binding assurance. Consequently, risk information sharing can be negotiated between supply chain members who will be binding. Also, similar to the argument by Lovaglia, Skvoretz, Willer and Markovsky (1995) of "best hope" for maximum benefit and "worst fears" for being excluded, this thesis argues that firms can negotiate for risk information sharing in order to mitigate risks in their supply chains.

Generalised exchange

The third sub-category of exchange is the generalised exchange, which involves indirect reciprocity between three or more actors. The generalised exchange was proposed by scholars because it was believed to help buffer resource fluctuations and at the same time initiate reputations to enhance transactions which in turn would promote the growth of moral norms (Molm, Schaefer and Collett, 2007). Generalised exchange is characterised by social solidarity: the integrative bonds that develop between persons, and between persons and the social units to which they belong (Molm, Schaefer and Collett,

2007). Generalised exchange according to Molm, Schaefer and Collett (2007) occurs in a social group with three or more people, who independently give resources to other people of the group without demanding or receiving direct reciprocation from the recipients. Nevertheless, since all members of the group do the same, reciprocation after some time, takes place indirectly (Yamagishi and Cook, 1993).

Generalised exchange can exist in a form where resources flow in compliance with a fixed route among individuals, known as the chain-generalised exchange (Molm, Dame and Schaefer, 2007). However, in pure-generalised exchange, which is the most common form of generalised exchange, resources do not follow a fixed route or structure. An example of pure-generalised exchange would involve A giving to B in one occasion, and giving to C in another occasion, which is not likely to reciprocate to A, but are likely to reciprocate to B or C (Molm, Dame and Schaefer, 2007). Alternatively, in the chain-generalised exchange, A gives to B, B gives to C, and C gives to A. Although in supply chains the relationship and exchange can be complex, but a generalised exchange can be demonstrated between the supplier (as A in the previous example), the focal firm or manufacturer (B) and the distributor or retailer (C).

Cheshire (2007) argued that for generalised information exchange becoming visible, individuals must overpower the temptation of receiving the benefit without contributing and instead practice sharing, which was described as "cooperative behaviour". Hence, as soon as sharing starts, the overall value of the collective goodwill would become greater as more individuals in the network contribute more goods. Furthermore, information preferences of the individual are likely to be satisfied based on the size and the diversity of the group (Cheshire, 2007). Similarly, from the lens of generalised exchanged, corporative behaviour to share risk information between members in the supply network will provide firms with timely information about risk events which they can prepare against.

Social exchange and trust

There is hardly any social exchange that does not involve some uncertainty and risk, although the amount and type of risk may vary (Molm et al. 2000). For instance, an actor may initiate an exchange (in a reciprocal exchange) without knowing what the return will be, meaning that there is a need for trust (Molm et al. 2000). Trust in the context of exchange has been defined by Molm, Schaefer and Collett (2007), as the confidence that the exchange partner will not capitalise on the vulnerability of an actor for personal or any sort of gain. Cheshire, Gerbasi and Cook (2010) described trust as the cognitive notion involving individuals' assessments of another person(s) trustworthiness. Generally, trust is influenced by the other party's qualities such as integrity, dependability, competence, loyalty, openness, credibility, consistency, and reliability (Cheshire, Gerbasi and Cook, 2010). These qualities originate from an individual's personal experience, the reputation of what/who is to be trusted, or when there is a similar source of information that enhances our judgement of one's trustworthiness (Cheshire, Gerbasi & Cook, 2010).

Trust can sometimes be challenged during risky situations in which the partner in exchange has the chance to either to exploit the actor or to uphold being trustworthy (Molm et al. 2000; Yamagishi and Yamagishi, 1994). Blau (2017) argued that the risk and uncertainty typical in reciprocal exchanges are necessary for the development of trust and commitment to relationships. As a result, when people reveal their trustworthiness during risky situations, trust should increase. However, Molm et al. (2000) stressed that as a basis of development of trust in an exchange relationship, there needs to be a substantial degree of similarity of interest between the actors involved.

3.1.2. Power and social exchange theory

According to Molm (1991), the relationship between dependence and power is the core of social exchange theory. As actors in social exchange depend on each other, it creates a source of power. Emerson (1972) suggested that dependence increases when the value of resources (hard or soft) that one actor controls increases. Dependency, therefore, decreases when there are alternative sources of those resources (Emerson 1972). Consequently, as dependencies in social exchange fluctuate, so does the power of actors. Molm (1991) reported that structure and action might be related to power outcomes in several ways.

Structural power was defined by Molm (1991) as the possible power created by the level of dependence between actors who are in an exchange network, which provides one actor with the opportunity to affect the outcome of the exchange. Molm (1991) classified average power and power imbalance as the two main aspects of structural power, which are as a result of power or dependencies between actors. According to Molm, the average power is the average of the two actors' power or dependencies in an exchange relationship. The power imbalance is the extent to which one actor relies (with a skew to one side) on another actor, which may give the less dependent actor power advantage in the relationship. Molm (1991) concluded that where there is high power asymmetry, there is likely to be higher power imbalance, which will give power advantage to one actor; meaning the actor is gaining more than what they are reciprocating. Nevertheless, the structural location of particular relations in a wider network of connected actors can affect the average power and power imbalance in a dyadic relational exchange. For example, in countries where transport-related risk occurs regularly, a third-party logistics company with constant information about transport-related risk will be dependent upon for risk information, which puts the LSP in a powerful position structurally.

Another aspect of power in social exchange relates to reward, punishment and expectation. Molm (1991) contended that actors could achieve additional power when they can grant rewards or enforce punishment in exchange relationships. Further, the effects of actual rewards and punishment should be reduced with higher expectation, since the actor in a higher power position receives a better outcome (Molm, 1991).

3.1.3. Social exchange theory and supply chain risk information sharing

The nature of goods or services that are exchanged within a social exchange context is similar to economic exchange - tangible and intangible goods and services (Cheshire, 2007). Since information is valuable and can be transferred, it is believed to possess similar features as other intangible goods in social exchange (Cheshire, 2007). However, there are two differences between information (as intangible goods) and general tangible goods (Cheshire, 2007). Firstly, the replicability quality of information implies that information can be shared without the original owner necessarily losing a copy of their information (Levine and Shah, 2003). Secondly, the number of consumers may not necessarily reduce the value of the information. Supply chain risk information carries similar qualities of general or business-related information. For example, sharing information about a disruptive event like an earthquake - to all members in a supply chain will not reduce the value of the information. Instead, from the generalised exchange argument, other supply chain members will replicate the gesture when they become aware of a disruptive event that can affect another member of the supply chain.

Further, there is a consequence that when risk information is not shared, the sender may be indirectly affected due to the consequences of the risk not being mitigated by the sender. Apart from the guilt of feeling responsible of not taking part in supply chain risk mitigation of a partner, there is the 'worst fear' that other partners may be reluctant to share with a non-sharing firm in the future.

Similarly, reciprocity in the context of supply chain risk information sharing may be carried out for other reasons. Risk information sharing from an exchange partner might be initiated to gain any favour in return. Risk information sharing may also be carried out by reciprocating a similar type of exchange like sharing risk information with a partner or something different like impressing a partner to strengthen the existing relationship. Also, although there is no empirical evidence that sharing supply chain risk information sharing is, or can be negotiated as social exchange, from the perspective of this thesis, a negotiated exchange can form a basis for risk information sharing in the supply chain.

In addition, the generalised exchange provides a foundation for risk information sharing in the supply chain network. This is based on the understanding that supply chain disruption can have an indirect effect on members of the network. Hence, from the chained generalised exchange, it is expected that supply chain partners in direct contractual relationships are likely to be morally obliged to share risk information with their direct partner. Consistent with the pure-generalised exchange, reciprocity in the supply chain may not follow a fixed route: it may come from any member of the network. This is consistent with the cooperative behaviour described by Cheshire (2007), implying that members must overcome the temptation of not sharing risk information. It is posited here that for the generalised exchange to be effective in supply chains, it should be championed and formalised at the organisational level. Hence, as a social exchange good, organisations have the obligations to reciprocate risk information.

3.2. Social capital theory

The social capital theory is one of the popular theories that have been used in psychology and later extended to other fields including supply chain and disaster risk management, to explain the network of relationships and their advantages to individuals, communities and firms (Nahapiet and Ghoshal, 1998). According to Portes (2000), the main idea of social capital is that people in an individual's network - a person's family, friends and associates are an important, valuable asset (resource) that can be relied upon in a crisis. Put simply by Andriani and Christoforou (2016), the key point to note in social capital is that relationships matter. From the perspective of this thesis, relationship matters not only during a crisis but before the crisis, which can translate to risk information sharing among supply chain members. Although interpersonal and community relationships are popular with social capital, Koput (2010) argues that organisations can also be studies through the social capital lens. Thus, social capital theory is not only focused on individuals but more importantly, on relationships and their outcomes (Andriani and Christoforou, 2016). As a result, social capital does not belong to only individuals but to a social structure, be it an organisation, community, or another social grouping (Koput, 2010).

Scholars have proffered various definitions of social capital. One of the earliest definitions of social capital was provided by Bourdieu (1986) as: "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalised relationships of mutual acquaintance or recognition" (1986). Putnam (2000) differentiated social capital from physical and human capital. Putman explained that while physical and human capital is focused on physical objects and properties of individuals, social capital is concerned about "connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them". Other scholars like Lin (2001) view social capital not only from the resources embedded in social relationships but also the use of the resources. In this regard, Lin (2001) pointed out that ego, which is the central actor, "must be cognitively aware of the presence of such resources in its relations and networks" (Lin 2001). In a supply chain network, an ego can be the focal manufacturing, retail or service company. For example, depending on the context, Tesco, UB biscuits, or DHL can be the central actor in a supply chain social capital context.

The resources in social capital according to Bourdieu (1980) are "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalised relationships of mutual acquaintance and recognition". According to Lin (2001), social resource (used interchangeably as social capital) includes wealth, power, reputation as well as social connections. Though used as a substitute when arguing for 'capital' as 'resource', capital was defined by Lin (2001) as an 'investment in resource with an expected return in the marketplace'. In this regard, the resource embedded in social relationships can be regarded as capital if it results in economic benefits.

This view of 'capital' by Lin (2001) reflects the position of social capital theory as a theory eliciting the central theme that capital is captured in social relationships, which evokes opportunities, actions, and choices on the part of the actors. The theory of social capital, according to Lin (2001) "focuses on the resources embedded in one's social network and how access to and use of such resources benefit the individual actions". Hence, the action taken to maintain and gain valued resources represents the main focus of the theory (Lin, 2001). The theory also has two key assumptions: (1) position advantage, and (2) interaction and action.

The position advantage assumption assumes that an actor that occupies a higher position in the network has access to, and control of greater resources (Lin, 2001). The position gives the actor extra access to resources and information in relation to the whereabouts of the resources (Lin, 2001). Also, the position advantage assumption provides the actor more return (in terms of reciprocity) on favours (Lin, 2001). In contrast, the assumption on interaction and action specifies that social interactions are more likely to take place among individuals at similar or adjacent hierarchical levels – the principle of homophilic interaction. This assumption is discussed in more detail in the bonding dimension of social capital.

From the perspective of this study, the argument behind social capital can be used to argue for supply chain risk information sharing between partners in a supply chain relationship. Firstly, relationships that lead to economic benefit can also mean leveraging on relationships to receive information about supply chain risk. Secondly, where risk frequently occurs in a given location and a supply chain member is usually the first the know about the event, that supply chain member can be regarded as an ego who occupy a central position. In the context of risk information, an ego has position advantage in sharing risk information.

3.2.1. Dimensions of social capital

Scholars have suggested that there are three dimensions of social capital: the structural, the cognitive and the relational dimensions (Nahapiet and Ghoshal, 1998; Krause, Handfield and Tyler, 2007).

Structural dimension

According to (Nahapiet and Ghoshal, 1998), the structural dimension of social capital is concerned with the properties of the social system and the network of relations, i.e., the structure of the linkages between people or organisations as a unit. Hence, structural capital "refers to the overall pattern of connections between actors - that is, whom you reach, and how you reach them" (Nahapiet and Ghoshal, 1998). Structural capital represents the network of people an individual knows and whom they can gain benefits from in time of need. The structural dimension of social capital focuses more on the properties and forms of social organisation that make up society (Nahapiet and Ghoshal, 1998). It is vital to note that it is the network of the relationships and not the quality of the relationships (because the quality of relationships is a relational dimension of social capital) the structural dimension concentrates on. Supply

chain network provides a platform where structural social capital forms. In supply chain network, relationships exist between several independent organisations upstream and downstream of a focal firm.

Further, network ties between actors, network configuration, network density, connectivity, and hierarchy are aspects of the structural capital that has attracted the attention of researchers (Nahapiet and Ghoshal, 1998). Within each group, community or organisation, structural capital researchers considered the connectivity, density, hierarchy and appropriateness of the network of relationships in any given context. Attention was given to the number of ties an actor (individual or organisation) has, with whom and the strength of the ties (Taylor 2007). In this regard, although the supply chain network of a product may include several firms, structural capital may only exist between a few firms who are leveraging on their relationships for benefits.

Due to the relevance of structural capital in examining the nature of relationships between people or firms, it is commonly studied using a network approach and sometimes referred to as social network analysis (Borgatti, 2005). Some researchers that use the network approach or analysis investigated the rate of contact and subsequent social distance among actors in communities or organisational (Edelman et al. 2002). In supply chain firms may be connected directly, but the social distance between them can still be high. Although graphically the interaction patterns are represented in a web-like diagram (Edelman et al. 2002), they do not represent the flow of materials, funds and information. Instead, they depict social relationships and the strength of the ties between each element in the network.

The main type of network ties is bonding, bridging, and linking social capital (Putnam, 1995; Chloupkova, Svendsen & Svendsen, 2003). Although some scholars settled for bonding and bridging social capital (Sajuria et al., 2015; Colling, Neal, and Neal, 2014). However, Andriani and Christoforou (2016) argued for a third type of network tie – linking social capital. Nevertheless, these dimensions help in explaining the peculiarities in social capital based on the uniqueness of members in the network. Also, Putnam (1995) cautioned that the dimensions are not "either/or" categories which social capital can be divided; instead, it is a "more or less" dimensions to which the forms of social capital can be explained.

Bonding social capital

Bonding social capital has been defined by Andriani and Christoforou (2016) as the social capital that exists in the form of ties that develop within groups, most often between individuals who have similar interests, and are familiar with each other, based on values of reciprocity and particularised trust. The members in bonding social capital are usually homogenous and in most times, have an exclusive identity (Putnam, 1995). Hence, individual prosperity is a type of collective gain (Collins, Neal and Neal, 2014). Putnam termed this solidarity for collective prosperity "sociological superglue".

In sociology related studies, bonding social capital is demonstrated with individuals who share similar relevant characteristics such as ideology, religion, geographical location (Sajuria et al., 2015). These bonding ties are the natural result of homophily (McPherson, Smith-Lovin, & Cook, 2001), where people who share similar relevant characteristics, such as geographical location, ideology, and religion, tend to group and work together. From the perspective of this study, supply chains may involve firms in different geographical location; however, they can be bonded by ideology. The ideology can necessitate by concerns of supply chain disruption, which prompts the need to share risk information for collective benefit.

Bridging social capital

Bridging social capital represents an outward-looking network that is inclusive of people of diverse social groups (Putnam, 2000). Bridging social capital stems from desires to gain resources that are usually outside one's immediate social setting. As a result, bridging social capital plays a significant role in coordinating action across different social groups, and provides new information and resources to the closely knitted or bonded groups. According to Sajuria et al., (2015), bridging social capital facilitates sharing and exchange of information, resources, and helps coordinate action across diverse interests. As noted by Putnam (2000), bridging social capital does not reflect either/or categories of social capital, but rather, they are dimensions that can develop simultaneously in different layers and contexts. For example, a homogenous group of religious or ethnic society can have a distinct identity, and at the same time serve as a bridge on wider community network. Similarly, identity in social capital can be translated to supply chains for a particular product or service. Although supply chain analysis usually focuses on the focal firm, product or service, the same understanding of groups with similar identity can seek to bridge risk information need of the supply chain. An example is when a city is shut down because of a health emergency. Manufacturing firms concerned about their supply chains can partner with humanitarian agencies or first responders (even though they have distinct identities, i.e. manufacturing vs health service) to share risk information as well as provide logistics for delivery of relief materials.

Cognitive dimension

The cognitive dimension of social capital reflects "the resources that provide parties with shared representations, interpretations, and systems of meaning" (Krause, Handfield and Tyler, 2007). Cognitive capital is also concerned with shared narratives, codes and language in the form of mutual rules and values or goals facilitating communication that enhance the development of mutual understandings and supports collaborative efforts to achieving tasks and goals (Krause, Handfield and Tyler, 2007). Inkpen and Tsang (2005) identified shared goals and shared culture as the two main facets of cognitive capital. Shared goals, according to (Inkpen and Tsang, 2005), depicts the "degree to which network members share a common understanding and approach to the achievement of network tasks and outcomes".

Shared culture refers to the extent to which norms of behaviour govern relationships between actors (Inkpen and Tsang, 2005).

Although the structural dimension of social capital can be observed physically in relationships, rules, roles, and procedures, the cognitive dimension relates to interpretations of a shared reality and is therefore intangible. According to Bourdieu (1986), the cognitive dimension of social capital is a set of dispositions, reflexes and forms of behaviour that individuals obtain through acting in society. For example, certain words within an organisation may have different, or no, meaning outside the organisation (Ansari et al. 2012).

Some scholars have debated what constitutes cognitive capital (Normal Uphoff, 1999). According to Normal Uphoff (1999), norms of reciprocity and trust are forms of cognitive capital. The implication of categorising reciprocity and trust as a form of cognitive capital is that it eliminates the third dimension of social capital – relational capital. The characteristics of the relational dimension are related specifically to social relationships while cognitive, social capital applies to a wider social context in mental rather than the material realm. Furthermore, a shared understanding within a group, community, or organisation, is cognitive as it provides actors with a set of norms of appropriate ways of acting (Anderson and Jack 2002).

Relational dimension

The relational dimension has been used interchangeably with social capital (Cousins *et al.*, 2006). This dimension of social capital has also received attention from scholars, who have also described it as "the relational view". The relational dimension focuses on the personal relationships and direct ties between actors that have developed with each other through a history of interactions, as opposed to structural outcomes of interactions (Nahapiet and Ghoshal, 1998; Inkpen and Tsang, 2005). The relational dimension focuses on the particular relations people build in the course of their interaction, such as respect and friendship, trust, norms, and identification (Nahapiet and Ghoshal, 1998; Inkpen and Tsang, 2005).

Scholars argue that relational capital translates to assets (relational assets) which can be leveraged as a source of value (Nahapiet and Ghoshal, 1998; Cousins *et al.*, 2006). According to (Cousins *et al.*, 2006), when actors interact in a social context, trust, motivation, and opportunity may raise the level of social exchanges between the groups. It is also important to note that the quality of the interaction strengthens the relationship, and in extension, the relational capital (Lefebvre et al. 2016). Where interaction is weak or doubtful, there is little possibility of the relationship translating to value that is beneficial to the parties.

Anderson and Jack (2002) observed some overlap between the relational and cognitive dimensions of social capital, citing an example with trust and trustworthiness. Although trust and trustworthiness are usually regarded as parts of the relational capital, trust is an attribute of a relationship, while

trustworthiness is still an attribute of the individual or organisation, hence, is a form of cognitive, social capital (Anderson and Jack 2002).

From the perspective of this study, the relational capital between supply chain members can be leveraged as a reason for risk information sharing. Risk information is the value created as a result of the relationship. Consequently, the trustworthiness of the supply chain partner is necessary for the receiver to act upon the risk information received. Furthermore, in view of the strength of ties in structural capital, relational trust can strengthen the ties between supply chain partners.

3.2.2. Levels of analysis

Social capital theories have the implication that social capital could be analysed at micro and macro-level or individual and organisation/community level (Bourdieu, 1980; Coleman, 1988). Following the study of Leana and van Buren III (1999), researchers have analysed social capital as attributes that individuals, nations, communities, individual networks, and firms hold when they interact with others (Fukuyama, 1995; Putnam, 1995). Since the discipline of supply chain management is inclined to business and management, this thesis discusses individual and organisational/firm social capital.

Individual social capital

Both Bourdieu (1986) and Coleman (1988) analysed social capital at the individual level; emphasising on relationships with other individuals in a network focusing on network structure and its effects relations. Whilst Coleman's research was influential on social capital and community ties; it also emphasised how community ties are beneficial to individual actors. Coleman further argued that the structure of relations could play a role in creating obligations between social actors, opening channels for information, creating a trustworthy social setting, and setting norms and enforcing sanctions on forms of social behaviours (Coleman, 1988). Coleman (1988) further noted: "Unlike other forms of capital, social capital inheres in the structure of relations between actors and among actors" (Coleman 1988). From Coleman's argument, dynamics involving an individual actor within an organisation and across supply chain partners in relation to risk information sharing will provide interesting insights if investigated.

Further, individual network position in the network and the benefits that accrue is another aspect of the individual-level analysis of social capital. To Bourdieu (1986), social capital can be viewed in relation to individuals' social relationships and their social position in the society, stressing social capital as a resource which may have an adverse effect on equality in leading society. Additionally, the sphere of social capital should be seen as accumulated history, which should not be reduced to a broken series of mechanical interaction between individuals (Bourdieu, 1986). In the context of information sharing, Bourdieu's view is intuitive because of the importance of 'status' and how the position of the individual actor in the community/organisation/supply chain network could enhance risk information sharing or restrict it.

Organisational social capital

Organisational social capital, according to Leana and Van Buren (1999), is 'a resource reflecting the character of social relations within the firm'. Arregle, Hitt, Sirmon and Very (2007) referred to organisational social capital as a critical resource for organisations. Putnam (1995) first expanded the concept of individual-level social capital to 'stock' of social capital owned by communities, organisations, or even nations. Although Putnam has been criticised for the 'circular reasoning' of social capital that enhances networks, norms, and trust (Edwards and Foley, 1997; Portes, 2000), his work has gained prominence in development agencies such as The World Bank who applied some of his recommendations in their interventions (Feldman & Assaf, 1999). Organisational social capital can facilitate the direction of activities and projects across departments and units, enabling the smooth running of activities (Hitt et al., 2002). Organisational social capital can also enhance competitive advantage as it can improve effective decision-making processes and the execution of the resulting decisions which in the long run can have a positive effect on internal and external activities of the firm (Sirmon et al., 2007; Hitt et al., 2002).

Further, Hitt, Lee and Yucel (2002) reported that organisational social capital benefits a firm as it will provide access to external resources and facilitate internal coordination (Sirmon et al., 2007). Hitt, Lee and Yucel (2002) argued that since no firm controls all of the resources that it needs to compete effectively or dominate the market, it, therefore, must obtain or gain access to the resources it needs from external sources.

Also, organisational social capital is vital to a firm with regards to its role in increasing the availability and access to resources such as information, technology, knowledge, distribution networks, and key contacts which Hitt, Lee and Yucel (2002) referred to as "relationships with critical constituencies". An example of such in the context of this study is a key relationship that an organisation maintains in order to participate in risk information sharing. Although organisations consist of individuals who at an individual level maintain a social relationship, the organisation needs to formalise their social relationships, especially those critical for risk information sharing.

Consistent with the argument by Hitt, Lee and Yucel (2002), even though an organisation may start by 'borrowing' another actor's social capital to satisfy its social capital needs, it must, however, develop its independent organisational level social capital in order to prevent the danger of losing the actors' (that is their employee) support or the spillover effect of an actor's personal mistakes that may jeopardise the relationship. While an organisation may borrow or leverage on the individual level social capital of its employees, it may not necessarily yield the same level of openness or trust, which may enhance risk information sharing. For the purpose of this study, the level of analysis is the organisational level, particularly organisational level supply chain social capital and how it enhances supply chain risk information sharing.

3.3. Section summary

In this section, the two theories underpinning this research were discussed. With regards to social exchange theory and how it underpinned this research, this section emphasised that the nature of goods that are considered by the theory are similar to supply chain risk information. As a result, two critical features of information in an exchange relationship: the replicability quality of information, and, the fear of reduction of value, are applicable to supply chain risk information. Further, dimensions of generalised exchange and pure-generalised exchange of the social exchange theory support the argument as a result of the indirect effect of supply chain disruption, and supply chain partners will support risk information sharing. Yet, consistent with the pure-generalised exchange, reciprocity in the supply chain may not follow a fixed route; instead, it may come from any member in the network.

Also, the section presents the social capital theory and highlights the dimensions and the level of analysis. As a theoretical basis for this study, social capital theory emphasis that an actor can occupy a higher position in a social network and control a greater source of information is linked to this study in understanding the positions a firm has based on its social relationships to receive and share risk information sharing.

From the perspective of this study, social capital theory and relational theory provides lenses which can be used to explain why firms in supply chains should share risk information. Whether the argument is based on generalised or negotiated exchange, sharing risk information among supply chains is necessary to prevent or manage supply chain disruption. From the social capital perspective, the argument on relational capital provides a strong reason why firms should share risk information. As firms in the supply chain use their relationship to create value, risk information sharing can be one of such value that occur because of relational capital. In the next section, the conceptual literature related to this study is reviewed.

4. Review of supply chain risk information sharing related research

This section presents a review of related articles on supply chain risk information sharing by past scholars. The section plays a vital role in presenting empirical research written by past scholars about social relationship and supply chain risk information sharing. In order to establish the gap in the literature, a systematic literature is adopted in searching and selecting related literature to be reviewed. This current section is linked to the two previous sections (section 2 and 3); where key concepts such as risk information sharing where discussed in section 2, then the two theories underpinning this research (social exchange and social capital theory) where explained in section 3.

The current sections start by presenting the protocol used in searching the literature. Next, a justification for systematic literature review is presented. Subsequently, the result of the systematic literature review was revealed. At the end of the related literature review, the gap in the literature was identified and stated.

4.1. Systematic literature review protocol

Preliminary investigations indicated that published literature on the topic of this research cut across several disciplines. In order to reduce bias in locating the right literature that is relevant to this research, a systematic literature review protocol was implemented. The primary purpose of conducting the systematic literature review was to identify and assess the literature that exists in relation to social relationships and supply chain risk information sharing, with the aim of identifying a gap in knowledge that is yet to be filled in the literature. Also, within the literature identified, the theories and the concepts related to this research are reviewed, and they are integrated into the discussions in the theoretical and conceptual review sections. In the following sub-sections, the details of the systematic literature review procedure are discussed.

4.2. Justification for systematic literature review

The systematic literature review protocol was used in this research to map and assess the body of knowledge in the area of this research. The output from the systematic literature review highlights literature that makes scientific contributions linking supply chain risk information sharing to social relationships, which have been published within the past 19 years. Selecting the year 2000 (19 years to 2019) is to serve as a manageable mark of where to start the review. Although scholars like Kembro and Naslund (2014) argues that researches published post-2000 are contemporary, for the purpose of this systematic literature review, it is thought that rather than search for an infinite number of years, it is logical to start with a particular year and look for papers before and after that year.

Still, on the output of the systematic literature review, this study uses the SLR output to identify the knowledge gaps as well as current themes of research that are significant to this thesis. Further, the output of the systematic literature review informs the identification of areas that are under-explored in

relation to supply chain risk information sharing. Although the purpose of the systematic literature review was to address the question relating to what research has been conducted in the topic of interest, it also provided a basis for developing the research question of the thesis, as it demonstrated the need to ask such question within the context of the literature.

Given the number of studies published and the potential for bias in selecting the correct research to review, the systematic literature review has been recognised as one of the most transparent and scientific processes of improving the quality of the literature review process and its outcome (Tranfield, Denyer & Smart, 2003). Moreover, a systematic literature review not only provides a consistent result, but it also provides reliable and dependable evidence which helps in identifying the knowledge gaps or inconsistent findings, which supports the development of unanswered questions and signifies the need for a new research (Tranfield et al., 2003). Additionally, a systematic literature review provides an opportunity to cluster research based on their themes (Tranfield et al., 2003; Crossan and Apaydin, 2010).

For this thesis, the systematic literature review adopts the three-stage protocol outlined by Tranfield et al. (2003). The stages include planning, execution, and reporting (Tranfield et al. 2003).

4.2.1. Stage 1: Planning the review

The planning stage of the systematic literature review can typically be iterative but is centred on establishing the inclusion and exclusion criteria for the literature, finding and selecting potential studies, and grouping the identified studies (Tranfield et al., 2003; Durach, Kembro & Wieland, 2017). In implementing the search strategy for identifying relevant research, only research published in peer-reviewed journals available at the SCOPUS and ISI Web of Knowledge's Social Sciences Citation Index (SSCI) database from 2000 to 2019 were considered. Each of the inclusion and exclusion criteria is presented in Table 4-1, along with their reason for use.

Inclusion Criteria	Reason for inclusion
Research articles and/or reviewed papers published in peer-reviewed journals.	Considered to be a more thorough and critical avenue for validating knowledge, which can be accessed, developed upon or challenged by the global research community (Patel & Desai, 2019).
Articles contained within the ISI Web of Knowledge's Social Sciences Citation Index (SSCI) database.	Scopus and Web of Science are considered as two widely recognised databases for management related research (Kembro and Naslund, 2014).
Theoretical, conceptual and empirical studies.	To provide a foundation for the research, as well as a link to findings from past studies. (Crossan and Apaydin, 2010).
Quantitative and qualitative research.	To understand the research problem investigated using qualitative as well as quantitative methods.
The year 2000 to current.	A baseline of the year 2000 is consistent with past research (Kembro and Naslund, 2014). Nevertheless, studies published before 2000 will be identified using cross-referencing as *"the published literature is interlinked to a considerable degree, one paper (stem) leads to others (branches*)" (Srivastava, 2007).
Exclusion Criteria	Reason for exclusion
Research published before 2000	Following the study of Kembro and Naslund (2014), most contemporary research on the topic started in the year 2000. However, key articles predating 2000 were selected using cross-referencing.

Inclusion Criteria	Reason for inclusion
Other than Published Peer-reviewed journal articles (i.e. books, book reviews, conference papers, periodicals, magazines, doctoral dissertations, unpublished articles).	To focus only on published peer-reviewed journals consistent with the majority of highly cited review papers in the field of supply chain management (Patel & Desai, 2019; Kembro & Naslund 2014; Srivastava, 2007). Articles, reviews and conference papers that appeared in renowned peer-reviewed journals are considered as 'certified knowledge'".
Narrowly focused articles (e.g. mathematical model papers).	Social relationship relates to the "soft" aspect of organisation which are better studied using a quantitative or qualitative empirical approach.

Table 4-1: Inclusion and exclusion criteria for systematic literature review

4.2.2. Stage 2: Execution

This stage involves the identification of research to be reviewed using search strings, search keywords, and research fields of studies. In order to manage the search, articles were broadly grouped into highly cited and recent papers consistent with (Crossan and Apaydin, 2010).

4.2.3. Initial search strings, search keywords, and research areas

A detailed search strategy was specified to ensure that the search could be replicated using the same strings. Replicability is one of the main characteristics that distinguish a systematic literature review from a narrative literature review (Tranfield et al., 2003). For this study, synonyms and other operational terms of the keywords "risk", "information", "sharing", and "social", "relationships" and their derivatives were used to search for relevant articles. To further reduce retrieval bias, faculty librarian was consulted for appropriate keywords and search strategy to include relevant published researches.

4.2.4. Grouping literature

The systematic literature review conducted for this research was undertaken to map and assess the main body of knowledge in the area of supply chain risk information sharing and how relational behaviours have enhanced it. Following the suggestion of Crossan and Apaydin (2010); Mishra, Raghunathan and Yue (2007), the literature was grouped into highly cited papers and most recent papers. For the highly cited papers, citation-based criteria of a minimum of five citations per year were used (Crossan and Apaydin, 2010). Both the SCOPUS and Web of Science databases provided information about the number of times a paper has been cited. The second group consisted of recent studies, which was created to reduce researcher bias since not including the most recent papers may exclude those that have not yet attracted enough citations.

Additionally, inclusion and exclusion criteria were applied to each of the two groups. Each paper within these two groups was further subjected to a two-stage screening where the title and the abstract were screened to find papers that were considered to be relevant to this study. Details of the number of papers screened in the two groups are specified in the next sub-section.

Group 1: Highly cited papers

The frequency of citation a paper receives has been considered to be an adequate measure of the quality of a published research paper as it is an indicator of the knowledge contribution and development of the field (Crossan and Apaydin, 2010). According to Garfield (1972), an indication of the significance of a scientific journal article is the total number of citations it has received. Also, Sharplin and Mabry (1985) highlighted that less cited articles might have a less significant impact on scientific research as compared highly cited articles. Although there are critics of citation analysis, it has widely adopted by researchers (Crossan and Apaydin, 2010; Mishra et al., 2018).

At this stage of the systematic literature review, using 2000 as the start year, 5,446 individual peer-reviewed research papers were identified. In order to separate the papers with high impact from the initial search, all papers were sorted based on the number of citations it received per year, with a minimum of five citations each year in a progressive sequence (i.e. increasing by at least five citations each year from the year of publication) (Crossan and Apaydin, 2010). On the application of this filter, 1,189 research papers were included, while 4,257 were eliminated, and 118 were discovered to be duplications between the two databases. Further, title analysis was conducted on these 1,189 highly cited papers, which reduced the number of papers to 480. Finally, an abstract analysis was conducted on the 480 papers, and the final papers from this stage reduced to 97. Table 4-2 presents a summary of the influence of the inclusion and exclusion criteria on the number of highly cited research papers.

Stage	Group Name	Number of studies		
		Included	Excluded	Duplicates
1	Initial search	5,446		-
1.1	Highly cited papers	1,189	4,257	118
1.2	Title analysis	480	709	-
1.3	Abstract analysis	97	383	

Table 4-2 Highly cited papers groupings.

Group 2: Recent papers

In the recent papers group, 1,121 research papers were categorised as recent papers during the initial search. This constitutes papers that were published during the period from 2016 to 2018. The grouping was created to reduce citation bias, which has the potential to discriminate against articles that were published within the past two years (2016-2018) which have not received sufficient exposure to the community and subsequently have fewer citations (Crossan and Apaydin, 2010).

The suggestions by Crossan and Apaydin (2010) were also implemented to remove articles that were published in journals that have a grade 2 or less following The Association of Business Schools' (ABS) academic journal quality guide. This reduced the number of recent articles to 323. Within the new figure of 323 articles, 60 articles were already highly cited and were initially captured within group 1. Consequently, duplicate studies were removed. Table 4-3 presents a summary of the changes in the number of recent papers used for this thesis.

Stage	Group name	Number of studies		
		Included	Excluded	Duplicates
1	Recent papers (initial search)	1121	-	-
1.1	Grade 2,3,4, and 4* journals	323	798	60
1.2	Title analysis combine	73	250	-
1.3	Abstract analysis	44	29	-

Table 4-3 Recent paper groupings

In Table 4-3, the title analysis was undertaken on the remaining 323 papers. On the application of the title analysis criteria, the number of papers included reduced to 73. Finally, the abstract analysis was conducted on the remaining 73 papers and the number of papers to be included for review further reduced to 44. A summary of the combined number of research papers from Groups 1 and 2 to be reviewed is presented in. A list of the papers is provided in appendix 1.

Stage	Group Name	Number of studies				
		Initial Search	Included	Excluded	Duplicates	Papers for review
1	Review papers					
1.1	Highly cited papers	5,446	97	5,231	118	97
1.2	Recent papers	1,121	44	1,017	60	44
1.3	Total	6,567	141	6,278	178	141

Table 4-4 Combined papers grouping

4.3. Result from the systematic literature review

The result from the studies reviewed indicated that supply chain performance has always been at the centre of most supply chain information research. For instance, the seminal work of Ragatz, Handfield and Scannell (1997) was built on the argument that knowledge and expertise should enhance supply chain performance. Although their study concentrated on supplier integration and new product development, it, however, identified several practices including information sharing as an enabler to supplier integration for new product development. Similarly, the studies that came after Ragatz, Handfield and Scannel (1997) were still occupied with the emerging area of supply chain integration how it can enhance businesses (Seidmann and Sundararajan, 1997; Monczka et al., 1998). Presently, with the rise of supply chain disruption, scholars such as Fan & Stevenson (2019) suggested the proactive search for new ideas and information in order "to learn about the experiences of other organisations in dealing with supply disruptions". Nevertheless, the area continues to gain the attention of scholars (Nagaraja and McElroy, 2018; Zhao, Li and Zhibao Li, 2018; Dwaikat et al., 2018; Zhao, Zhu and Zheng, 2018). For example, studies have been carried out between information sharing and performance (Huo, Zhao and Zhou, 2014) (Yu et al., 2004), information sharing and bullwhip (El-Tannir, 2018; Zhao and Zhao, 2015; Costantino, Gravio, Shaban, et al., 2013) information sharing and supply chain practices such as supply chain collaborations (Nyaga, Whipple and Lynch, 2010) and supply chain coordination (Thomas et al., 2015).

Overall, researchers on information sharing in supply chain can be viewed through the lens of studies concerned with bullwhip effects and supply chain performance (El-Tannir, 2018; Zhao and Zhao, 2015; Costantino, Di Gravio, Shaban & Tronci, 2013), and those that are concerned about issues such as attitudes towards information sharing, collaboration and relational issues (Kwon and Louis, 2004; Li and Lin, 2006; Klein, Rai and Straub, 2007; Qureshi, Kumar and Kumar, 2008; Klein and Rai, 2009).

4.3.1. Attitude towards information sharing

Researchers have investigated the firm's attitude towards sharing supply chain information with partners and competitors. Firstly, in a study carried out by Eurich, Oertel and Boutellier (2010), they found that sharing of item-level event data, as well as the willingness to share event data, was low. Some of the concerned raised on whether to share or not to share supply chain information relates to whether total supply chain costs will be reduced (Tran, Childerhouse and Deakins, 2016), privacy and security of information shared. To this end, Tran, Childerhouse, and Deakins (2016) investigated how managers perceive risks associated with sharing information with trading partners and how they attempt to mitigate them. They found that "managers perceive several types of risks when exchanging information across external supply chain interfaces and adopt different approaches to handling them".

Further, when the information relates to supply chain risk, Sarkar and Kumar (2015) found that sharing the disruption information is found beneficial in reducing order variability and supply chain cost. However, these may be affected by the size or complexity of the supply chain. Eurich, Oertel and Boutellier (2010) reported that members of large or complex supply chains that have many participants tend to be less willing to share information as compared to smaller or less complex supply chains. This can be further argued to be as a result of less interpersonal relationships (Tran, Childerhouse, and Deakins, 2016) in large or complex supply chains.

Although there are suggestions for information sharing hubs in some supply chain context (Altay and Pal, 2014), the wiliness to share information still influences the attitude towards information sharing (Altay and Pal, 2014). Yet, contrary to the practice of social exchange Comyns and Franklin-Johnson (2016) reported that organisations who face familiar crisis repeatedly are usually unwilling to communicate crisis information on time; instead, they delay till a later time.

From the research presented in this section, it is evident that the attitude towards sharing supply chain risk information depends on the context, content and complexities of the supply chain. However, the research does not suggest how interpersonal relationships between supply chain partners can enhance supply chain risk information sharing.

4.3.2. Collaboration studies and risk information sharing in supply chains

Supply chain collaboration involves "two or more independent companies (that) work jointly to plan and execute supply chain operations with more success than when acting in separation (Simatupang and

Sridharan, 2002). Simatupang and Sridharan (2002) categorised collaborative supply to include information sharing. According to Whipple and Russell (2007), supply chain collaboration encourages real-time information exchange which makes it possible for an organisations supply chain to respond to and recover from disruptions with minimal impact. To this end, several types of research have considered aspects of supply chain collaborative activity such as information sharing and its outcomes such as an increase in firm performance (Panahifar, Byrne, Salam and Heavey 2018) and mitigating disruption (Bakshi and Kleindorfer, 2009). For instance, Yigitbasioglu (2010) found that information sharing improves buyers' performance concerning resource usage, output, and flexibility. Similarly, Bakshi and Kleindorfer (2009) considered a supply chain with two participants, who are faced interdependent losses arising from disruptions such as terrorist strikes and natural hazards. They found that firms are more willing to collaborate in such situations than compete.

Panahifar, Byrne, Salam and Heavey (2018) investigated various characteristics of information sharing and trust and their criticality for effective information-centred supply chain collaboration initiatives. Similarly, Revilla and Saenz (2017) develop a taxonomy of how companies implement supply chain risk management emerging from internal actions and inter-organisational actions undertaken with external supply chain partners. Their findings revealed that firms pursuing an inter-organisational orientation (collaborative and integral) face the lowest levels of supply chain disruption. Yet, rather than committing fully to one collaboration strategy, Zhu, Krikke and Caniels (2016) emphasised that firms should prepare to switch strategies when they find themselves faced with different types of disruptions.

On the antecedent of information and collaboration, Wu, Chuang and Hsu (2014) proposed a new research model to investigate the relationships among SET-based variables, information sharing and collaboration, and supply chain performance. Findings show that social exchange-based issues are relevant to determine information sharing and collaboration and which have both partial mediation effect on supply chain performance. Yet, Schoenherr, Narayanan and Narasimhan (2015) found that the indirect effect of collaboration on agility performance via trust is significant only beyond a threshold level of collaboration. Similarly, Qin and Fan (2016) found that institution authority and information security exert a significantly positive effect on the degree of information sharing and the effect of agency collaboration, whereas cost has a significantly negative effect.

From the studies in this section, it is evident that relational attributes play a role in supply chain collaboration practice such as information sharing. However, supply chain collaboration is a unique type of relationship between partners; hence, it is unclear whether the similar relational antecedence will hold for non-collaborative relationships.

4.3.3. Relational studies and information sharing in supply chains

The issue of social relationships and information sharing continued to attract interest in supply chain management research with calls for/emphasis on relationship length (Li *et al.*, 2015), relationship-

specific investments (Klein, Rai and Straub, 2007), commitment (Im and Rai, 2008; (Nyaga, Whipple and Lynch, 2010), formal socialization activities (Klein and Rai, 2009), community socialization (Xu *et al.*, 2016), managerial ties (Wang, Ye and Tan, 2014), reciprocity (Kembro and Selviaridis, 2015) and trust (Kwon and Suh, 2004; Li and Lin, 2006; Klein, Rai and Straub, 2007; Qureshi, Kumar and Kumar, 2008; Li *et al.*, 2015; Ha, Park and Cho, 2011; Kulangara, Jackson and Prater, 2016). Further, some studies specified social capital dimensions (Li, She, and Ye, 2014), social exchange theory-based issues as "important to determine information sharing" (Wu et al., 2014).

With regards to the trust-related studies, a majority of the studies focus on either how trust affects information sharing in supply chain (Newell *et al.*, 2019; Firouzi, Jaber and Baglieri, 2016; Li et al., 2015; Ha, Park and Cho (2011); or the other way round (how supply chain information sharing affects trust) (Klei and Rai, 2009; Nyaga, Whipple and Lynch, 2010; Wang, Ye and Tan, 2014). A third of stream of research doesn't directly investigate the relationship between trust and information sharing; however, they found both trust and information sharing to have impacted some aspect of supply chain performance (Xu *et al.*, 2016) and serves as key criteria for the selection process (Qureshi, Kumar and Kumar 2008).

For the researches investigating how trust affects information sharing, mixed results have been recorded. Firouzi, Jaber and Baglieri (2016) found that it is not beneficial for the manufacturer to trust the supplier. Yet, Li et al. (2015) contend that the effectiveness of risk information sharing is enhanced by trust. Similarly, Ha, Park and Cho (2011) collected data from Korean firms through a mail survey to assess the role of trust in supply chain collaboration and logistics efficiency. They found that affective trust has a significant influence on collaboration in information sharing.

Yet, studies focusing on how information sharing influence trust are consistent in the type of influence between information sharing and trust. For instance, Klein and Rai (2009) studied strategic information flows between buyers and suppliers within logistics supply chain relationships. They found that information sharing and formal socialisation activities increased the buying firm's trust in its vital supplier. Similarly, Nyaga, Whipple and Lynch (2010) contend that collaborative activities, such as information sharing lead to trust and commitment, whereas trust and commitment, in turn, lead to improved satisfaction and performance. At the managerial level, Wang, Ye and Tan (2014) found that through trust, managerial ties can significantly influence the extent of information sharing and the quality of the information shared. Their study also found that managerial ties also have a direct impact on the extent of information sharing, but not on the quality of the information shared (Wang, Ye and Tan, 2014). With regards to information quality, Li and Lin (2006) demonstrated that top management has a positive impact on information sharing but has no impact on information quality. (Lee, So and Tang, 2000) investigated the benefit of information sharing to supply chain. They argued that there was not any quantifiable benefit (at that time) of information sharing on the supply chain. Although Lee,

Padmanabhan and Whang (1997) had previously studied information in the supply chain, their focus then was on information distortion they referred to as the bullwhip effect.

Although the research by Kwon and Suh (2004) was among the first research to an explicit focus on social dimension in supply chain relationships, in their study, they found that information sharing reduces the level of behavioural uncertainty, which, in turn, improves the level of trust. Nevertheless, in the earlier work conducted by Ragatz, Handfield and Scannel (1997), stressed that formal trust is among relationship structuring determinants that are needed to overcome barriers of supplier integration for new product development.

Further, relational attributes have been investigated as a means of governance. Eckerd and Sweeney (2018) investigated the effect of dependence and information sharing on the governance decision within the context of inter-organisational conflict and assess the extent to which contractual and relational governance approaches lead to more sufficient outcomes. Their results show a strong reluctance for the use of relational governance mechanisms to resolve conflict when the relationship is characterised by strong joint dependency or information sharing.

In the context of interpersonal information, Durach and Machuca (2018) and Li et al., (2015) studies where more specific to risk-related information sharing and not demand related. However, they both have contrary findings. While Durach and Machuca (2018) found no support for a positive impact of interpersonal information sharing on firm resilience, (Li et al., 2015) found that risk information sharing improves financial performance, and the effectiveness of risk information sharing is strengthened by relationship length and supplier trust. Though Li et al., (2015) investigated the relationship between risk information sharing and financial performance, and whether the association of the two can be strengthened by collaborative relationship characteristics including relationship length and supplier trust. Their study was quantitative and used predefined conditions under which risk information sharing is effective. Yet, Kembro (2015) in their study on information sharing in the extended supply chain argued that "in order to capture the contextual information regarding the supply chain studied", minimal control of the observed behaviours is needed to understand the phenomenon under study as it enables collecting rich data from multiple firms.

Other dimensions of the social aspect of information sharing as reported in the literature are communication method, cultural factors and innovation. As regards to a communication method, Carr and Kaynak (2007) studied relationships among communication methods and found that traditional communication methods, information sharing within a firm, and information sharing between firms, and supplier development are significant factors for improving a buyer's performance through their indirect and direct effects on firm performance. Similarly, Shin, Ishman and Sanders (2007) studied the effects of cultural factors on information sharing in China. The found that guanxi, Confucian dynamism, and collectivism all had a significant influence on information sharing. While with regards to innovation,

Kulangara, Jackson and Prater, (2016) found that Information sharing impacted trust and innovation significantly and trust mediated the impact of information sharing on innovation capabilities.

While this research focuses on relational dimensions of supply chain information sharing; the majority of the studies focus on demand related information sharing. While a considerable number of studies were centred on risk information sharing and performance. However, in the context of supply chain risk information sharing, a mechanism that produces or enhances these relationships are vaguely specified

4.4. Gaps in the literature

Although 141 related articles were reviewed in identifying the gap in the literature, the conceptual and theoretical review together with the practical understanding of the Nigeria context has further provided a basis to assess past published papers related to this research. An overview of related empirical research on relational behaviours and supply chain risk information sharing is presented in Table 4-5.

Authors	Focus	Method	Description	Country
Durach and Machuca (2018)	Interpersonal relationships in supply chain risk management	Survey	Survey of 229 manufacturing firms in Austria, Germany, and Switzerland.	Austria, Germany and Switzerland
Johnson, Elliott and Drake (2013)	Exploring the role of social capital in facilitating supply chain resilience	Interviews	Data were collected from three separate tiers of the supply chain involved in response to an extreme event (the Lambrigg, UK rail crash).	United Kingdom
Cheng, Yip and Yeung (2012)	Supply risk management via guanxi in the Chinese business context	Survey	Surveyed manufacturing firms in Hong Kong and applied structural equation modelling to analyze the survey data.	China
Ojala and Hallikas (2006)	Risks faced by enterprises in their partnership relationships in the area of investment decision-making	Case study	Case study of two industrial original equipment manufacturers (OEM) and nine of their suppliers.	-
Ziegler, Ylitalo and Mäki (2016)	Social dynamics and transformational needs of a collaborative relationship in the demand-supply chain	Case study	One case study that was a part of a multi-case research project	UK
Singh and Albores (2013)	Balancing push and pull information management within the supply chain	Case study	Exploratory case study using fifteen interviews and four focus groups.	-
Comyns and Franklin-Johnson (2018)	Corporate Reputation and Collective Crises: A Theoretical Development Using the Case of Rana Plaza	Secondary published data	Data from company press releases, company websites, company Twitter accounts, newspaper articles, reports by NGO's as well as the websites of various organizations.	Bangladesh
De Oliveira and Handfield (2017)	Supplier financial disruption risk mitigation	Survey	Survey data from 175 firms in North America and Brazil.	North America and Brazil
Kurniawan, Zailani, Iranmanesh and Rajagopal (2017)	Risk management culture moderating vulnerability mitigation strategies on supply chain effectiveness	Survey	Survey of 209 Indonesian manufacturing firms.	Indonesia

Authors	Focus	Method	Description	Country
Nguyen, Nguyen, Deligonul and Cavusgil (2017)	Developing visibility to mitigate supplier risk: the role of power-dependence structure	Survey	Surveyed of seafood processing firms in Vietnam	Vietnam
Mandal (2015)	Towards an Empirical-Relational Model of Supply Chain Flexibility	Delphi Survey	Web-based survey of 132 supply chain professionals in the Indian context.	India
Markmann, Darkow and von der Gracht (2013)	Identifying and assessing future challenges for supply chain security in a multi-stakeholder environment	Survey	Real-time Delphi on the Internet.	-
Wieland and Wallenburg (2013)	Relational competencies on supply chain resilience	Survey	Survey data collected from manufacturing firms from three countries.	Germany, Austria and Switzerland.
Degeneffe, Kinsey, Stinson and Ghosh (2009)	Segmenting consumers for food defence communication strategies	Survey	Survey more than 4,000 US consumers, using "predictive segmentation".	United States
Blos, Quaddus, Wee and Watanabe (2009)	Supply chain risk management (SCRM) implementation	Case study	Case study on the automotive and electronic industries in Brazil.	Brazil
Wiengarten and Longoni (2018)	Exploring the role of information sharing in manufacturing networks	Survey	Survey data collected through the International Manufacturing Strategy Survey (IMSS).	Multiple countries
Fan, Li, Sun and Cheng (2017)	Information processing perspective on supply chain risk management	Survey	Surveyed 350 Chinese manufacturing firms	China
Anderson, Baskerville and Kaul (2017)	A mechanism for balancing the tension between sharing and protecting information	Case study	Case study of the iterative development of the information security policies for a health information exchange.	United States
Fan, Cheng, Li, and Lee (2016)	Supply Chain Risk Information Processing Capability from Information Processing Perspective	Survey	Surveyed 350 manufacturing firms in China.	China
Hennelly and Wong (2016)	Focus on understanding the initial formation of the inter-firm relationship	Case study	Case studies of three pairs of new inter-firm relationships based on interviews and other archival data are analysed.	United Kingdom
Tran, Childerhouse and Deakins (2016)	Supply chain information sharing: challenges and risk mitigation strategies	Case study	An exploratory Case study involving semi-structured interviews.	New Zealand
Riley, Klein, Miller and Sridharan (2016)	How internal integration, information sharing, and training affect supply chain risk management capabilities	Survey	Used Q-sorts and confirmatory factor analysis to develop new warning and recovery measures. Survey data from 231 hospital supply managers.	United States
Chen, Sohal and Prajogo (2016)	Examines how to mitigate supply risk discussing uncertainty, variability and trust	Case study	Four case studies comprising of two manufacturers based in Australia and four suppliers based in China.	Australia and China
Li, Fan, Lee and Cheng (2015)	Joint supply chain risk management from an agency and collaboration perspective	Survey	Surveyed 350 manufacturing firms in China.	China

Authors	Focus	Method	Description	Country
Scholten and Schilder (2015)	The role of collaboration in supply chain resilience	Case study	Case study of eight buyer-supplier relationships in the food processing industry.	Netherlands
Brandon-Jones, Squire, Autry and Petersen (2014)	Relationship between information sharing and connectivity visibility and performance	Survey	Survey data collected from 264 UK manufacturing plants.	United Kingdom
Cheng, Chen and Chen (2013)	Inter-organizational relational benefits and information sharing in supply chains	Survey	Data collected from 528 manufacturing firms that were among the top 1,000 Taiwanese manufacturing firms	Taiwanese
Alfalla-Luque, Medina-Lopez and Schrage (2013)	A study of supply chain integration in the aeronautics sector	Interviews and focus group	Interviews with the experts in the aeronautics sector Questions were to be analysed in the focus group.	Spain
Ha, Park and Cho (2011)	Investigate the effect of trust on supply chain collaboration and logistics efficiency	Survey	Mail survey of logistics/SC managers who are responsible for outbound SCM in supplier firms.	South Korea
Eurich, Oertel and Boutellier (2010)	The willingness of companies to share item-level data and perceived privacy	Case study	A case study involving 16 interviews with organizations	Belgium, Germany, Switzerland and the USA
Yigitbasioglu (2010)	Information sharing with key suppliers from a transaction cost theory perspective	Survey	Survey of 221 Finnish and Swedish non-service companies obtained through a mail survey.	Mail survey

Table 4-5 Overview of related empirical research (surveys, case studies and qualitative interviews)

As presented in Table 4-5, the related empirical research papers are surveys, case studies and qualitative interviews which collected actual data from or about organisations or individuals. These researches have predominantly carried out on developed countries with few from developing countries and none from Nigeria; which like all countries, has its uniqueness based on its culture, environment, economic activities and people. For example, unique behaviours firms are deploying as they face disruptions due to the insurgency in North-Eastern Nigeria have not been captured in the literature, which is a distinct gap in knowledge.

Furthermore, the literature reviewed promotes sharing risk information as a way of reducing supply chain disruption (Sarkar and Kumar, 2015; Bakshi and Kleindorfer, 2009). Similarly, most of the literature agrees that social relationships enhance supply chain risk information sharing (Newell, Ellegaard and Esbjerg, 2019; Firouzi, Jaber and Baglieri, 2016; Li et al., 2015; Ha, Park and Cho, 2011; Klei and Rai, 2009; Nyaga, Whipple and Lynch, 2010; Wang, Ye and Tan, 2014). Some studies have specified some of the relational behaviours that enhance information sharing in the long run (Li et al., 2015; Ha, Park and Cho, 2011; Klei and Rai, 2009; Nyaga, Whipple and Lynch, 2010; Wang, Ye and Tan, 2014).

Yet, the relational antecedents (trust, relationship length, commitment and reciprocity) identified by past studies might not be sufficient or the only basis for firms to share supply chain risk information

from the onset of a supply chain relationship, especially in the context of developing countries such as Nigeria. The argument is, in a situation where the supply chain concerns are related to risk events such as insurgency, strikes, unfavourable government policies, armed robbery on the highway, communal clashes - that are all common in Nigeria - context-specific relational behaviours are likely to be developed by firms. Accordingly, this research asks: how and to what extent do relational behaviours enhance supply chain risk information sharing?

4.5. Chapter summary

In order to identify the gap in the literature, this study conducted a systematic literature review to identify related empirical studies from the field of supply chain management. A three-stage protocol of; planning, execution and reporting is used to select relevant articles. A total of 141 number of articles were selected in the final stage. The problem of supply chain disruptions and means of mitigating it has been well researched by past studies. The related literature review provided the opportunity to categories the literature and identify the aspects that are yet to be researched. It was found that there was a lack of literature that has investigated relational behaviours and supply chain risk information sharing from the point of view of the supply chain managers given them a chance explain the relational behaviours they practice for the enhancement of supply chain risk information sharing. Despite the need to identify more ways to identify supply chain risk on time, the past literature adopted existing quantitative approach while focusing in a different context. To bridge the gap, the focus of this study is to examine how relational behaviours enhance supply chain risk information sharing. The subsequent section will present the methodology that will be used to carry out the data collection.

5. Research methodology

Sections 3 to 5 of this thesis, review the relevant theoretical, conceptual and empirical literature. This is done in order to present the theoretical foundation of the research and also explain key conceptual discussions and the empirical studies conducted by previous researchers. This current section presents and justifies the research methodology adopted for the thesis. The section also presented a philosophical position, followed by the methodological stance. Given that the methodology section reveals strategies and considerations made of how the research will be carried out, it is important to remind what is the research question that needs to be answered, which is:

- How and to what extent do relational behaviours enhance supply chain risk information sharing?

5.1. Research philosophy

Research philosophy is defined by Saunders, Lewis and Thornhill (2015) as a system of beliefs and assumptions about the development of knowledge. These beliefs and assumptions influence researchers on the choices they make before and during their research. As a result, it is expected that researchers acknowledge that their beliefs and assumption can influence the knowledge they create. For instance, as the author of this thesis, it is important to note and declare how my experience, beliefs and assumption can influence the knowledge created. Most importantly, there is the need to accept and declare that the knowledge created in the course of this academic endeavour is not the only truth out there and it has its limitations (which are presented in section 9). However, the researcher has put in all efforts and followed the appropriate methodological principles that are required before reaching a conclusion.

There is a strong philosophical debate that has been ongoing amongst philosophers in relation to the relationship between data and theory of research (Easterby-Smith, Thorpe & Jackson, 2009). The researcher doesn't have the resources and skills to make a significant contribution to the existing philosophical debate. Yet, an attempt is made to understand the philosophical discussions in order to choose the argument that best suit this research. For instance, right from a higher level of argument on the field of business and management, which are related to the field of supply chain management, Saunders, Lewis and Thornhill (2015) observed that there is argument by the unificationists and pluralists. Whilst the unificationists see business and management as fragmented, and as a result, it can be "a true scientific discipline", in contrast, the pluralists see the diversity of the field of business and management as helpful, as it enriches the field (Saunders, Lewis and Thornhill, 2015). In the case of this research, the diversity argued by the pluralist is vital as the argument of relational behaviours which is rooted to the field of sociology is used in this thesis in making a case for the research problem. Although by making the case of the pluralist may imply taking a side, however, the intention is not to be dragged into the philosophical argument. Yet, Saunders, Lewis and Thornhill (2015) suggested that the awareness of the depth of difference and disagreements between the distinct philosophies help to both outline and justify

one's own philosophical choices in relation to the chosen research method. Easterby-Smith et al. (2013) add that research philosophy is essential to the notion of research design which guides the overall arrangements that enable satisfactory research outcome from research activity.

5.1.1. Ontology

Ontology relates to the assumptions about the nature of social entities or realities (Bryman and Bell, 2015; Saunders, Lewis and Thornhill, 2015). One of the fundamental questions that concern social ontology is whether social entities can and should be regarded as independent entities that exist and have a reality external to social actors, or whether social entities are built from the perception and actions of social actors as a social construct (Bryman and Bell, 2015). In the context of this research, one ontological question is whether the researcher believes organisations exist outside the people working in it and whether the organisation can compel or motivate employees to share risk information? Although in law, most registered organisations are entities that exist outside its owners, the owners (people) brought the organisation to life and decided what the organisation can and cannot do. However, the organisation can develop a culture which outgrows one individual or the owners. With this understanding, the researcher believes relational behaviours can be started, promoted, discouraged by the people, which enables the subsequent actions towards risk information sharing to become almost automatic. Two views of ontology as described by Bryman and Bell (2015) objectivism and constructionism.

Objectivism

Objectivism is an ontological position that states that reality or social phenomena and their meanings exist outside the mind of social actors (Bryman and Bell, 2015). In an extreme case of objectivism, Saunders, Lewis and Thornhill (2015) explained that some objectivist believes that the social world is made up of solid, granular things that are unlikely to unchanging. Lakoff argued that objectivism is "one version of basic realism" agreeing to the notion that reality exists independent of social actors (Lakoff, 1987). The main assumptions of objectivism position are:

1) The real world exists, and it has objects that can be characterised based on their relations and properties.
2) Reality can be modelled and shared with other social actors because it is totally obvious and structured in a way by all actors that feel it.
3) Symbols are depictions of reality and can only be significant to the extent that they correspond or resemble reality.
4) The human mind processes abstract symbols and presents them so that it reflects nature.
5) The human thought is symbol-manipulation, and it is free of the human physical self.
6) Social actors or "knowers" exist separately from meanings of things developed in their (Jonassen, 1991; Lakoff, 1987).

Based on the assumptions of objectivism, Bryman and Bell (2015) infer that "we can discuss organisations or an organisation as a tangible object". In essence, the organisation has a reality, since it has rules and regulations, hierarchy, procedures, and so on, that is external of individuals that work in it (Bryman and Bell, 2015). Furthermore, since an organisation can apply pressure on its workers in order to make them follow a certain requirement, it implies that organisations symbolise a form of social order (Bryman and Bell, 2015). Hence, an organisation can be a coercing, restraining or pressuring force on its members. In the context of this research, with respect to risk information sharing, an organisation may be regarded as an object reality that can coerce or restrain its members from sharing, or not share risk information informally. Evidence of such is in the intelligence community were sharing intelligence may be coerced (for instance NATO or EU members) or restrained by the organisation, e.g. GCHQ in the UK restraining its members from sharing intelligence with agents of another country.

Constructionism

Constructionism, also referred to as constructivism, is an ontological position which emphasises that social phenomena and their meanings are continually being carried out by individuals/social actors (Bryman and Bell, 2015). Some constructivist scholars generally suggest that both social phenomena and categories are created through social interactions between actors, and as a result, it is in continual change (Bryman and Bell, 2015). For example, in some organisations where employees work in teams, the desire to contribute to a brainstorming session can be enhanced when all team members agree to put forward their thoughts. So rather than being forced, people willingly decide to contribute or not. The decision for individuals to participate or not can be influenced by the current environment, past experience or future plans.

According to Bryman and Bell (2015), researchers in present times now use constructionism to show their own experience of the social world as construction, i.e. they present an exact type of social reality, instead of a definitive one. This aspect of constructionism knowledge which is regarded as intermediate is generally referred to as postmodernism (Bryman and Bell, 2015). In the argument presented by contemporary constructionist scholars, topics such as culture are regarded as an 'outer reality' that acts on and constrains people, which can also be an emergent reality in an endless state of construction and reconstruction (Bryman and Bell, 2015). This implies that rather than defining culture as a perfect applicable solution to events, people have to adjust and adapt their understanding of new events with regards to what is different from their previous understanding (Becker, 1982).

In the context of this research, relational behaviours in organisations, similar to the constructionist views, the researcher argue that relational behaviours are not fixed; instead, they evolve through social interactions. As organisations have different partners in their supply chain, the nature of the informal relationship between partners will continue to evolve, changing time to time as the people change, and

new members enter the organisation. At the same time, relational behaviours both at the organisational and individual level are expected to evolve as the business environment changes.

5.1.2. Epistemology

Research epistemology relates to the diversity of means of inquiring into the nature of both social and physical worlds (Easterby-Smith, Thorp and Jackson, 2013). It focuses on the question of what is or should be considered as acceptable knowledge in a discipline of research (Bryman and Bell, 2015). According to Hunter (2002) "the term epistemology describes theories of knowledge agreed by individuals and created in collective contexts". Unlike ontology, that appears abstract, Saunders, Lewis and Thornhill (2015) suggested that epistemology is more obvious. In the field of business and management, Saunders, Lewis and Thornhill (2015) observed that different types of knowledge in the form of visual, textual numerical data, narratives, stories, facts and interpretation could all be considered knowledge.

Johanek (2000) argued that some, but not all, theories of knowledge (or epistemologies), are responsive to context. As a result, an individual epistemology is not static; instead, it changes and evolves. To make sense of the world, individuals and groups may embrace several epistemologies at different points in time (Hunter, 2002). According to Johanek: *"On a daily basis, we don't live at an epistemological level; we live in the immediate, emotional, political, social world of things we like or are good at (such as form) or things we need to get done at the present moment—that is, for academia, our teaching, researching, and publishing"* (Johanek, 2000). Johanek further stated that people – whether researchers or teachers - create epistemology abstractly as a way of defending their idea, their preferred teaching methods and their preferred research methods (Johanek, 2000). Nevertheless, Saunders, Lewis and Thornhill (2015) stress that epistemology gives researchers in the field of business and management greater choice of methods than many other disciplines. However, Saunders, Lewis and Thornhill (2015) caution that researchers should understand epistemological assumptions and how it is related to the strengths and limitations of their research findings.

For the purpose of this research, three epistemological positions are discussed (interpretivism, positivism and pragmatism are discussed. These epistemological positions are similar to what Saunders, Lewis and Thornhill (2015) called research philosophy.

Interpretivism

Interpretivism regards social reality as an outcome; a world that is established from the meanings people produce and reproduce as an essential part of their normal activities (Blaikie and Priest, 2019). In interpretivism, the study of the social world requires different rationality of research that echoes the uniqueness of human contrary to natural order (Bryman and Bell, 2015). Interpretivism requires that the social scientist should understand the subjective meaning of social action and as a result, a strategy is necessary that respects the difference between people and the substances of the natural science (Bryman and

Bell, 2015). As a result, Saunders, Lewis and Thornhill (2015) argue that interpretivist are critical of positivist attempt to research about and generate law-like rules that apply to everybody.

From the perspective of interpretivist, Saunders, Lewis and Thornhill (2015) stress that the way a researcher sees the different groups in a supply chain relationship through different lenses. Hence, the supply chain manager in a focal organisation, the van driver, the operations staffs, as well as all individual people and their organisations in a supply chain should be interpreted differently as they are all experiencing different realities (Saunders, Lewis and Thornhill, 2015). It is argued that if research is focussed on all firms and people in a supply chain, the individual richness will be lost. Since the world is complex and choices for action are not always clear, interpretivist research investigates people's views of how they make meaning of the world and the structures, arrangements and process within it (Bryman and Bell, 2015).

From the perspective of this thesis, it is important to acknowledge that each organisation and people within the organisation have a distinct reality. Studying individual actor will reveal a rich experience that will be useful. Yet, supply chain risk, as well as risk information sharing, transcends beyond individual firm and actor. The understanding of individual actors' behaviour is equally important as that of the immediate supply chain and the larger network. As a result, a philosophy the accommodates both individuals, and multiple behaviours are needed to investigate risk information sharing in supply chains.

Positivism

A positivism epistemological approach takes the perspective that reality is considered to consist of isolated events that can be observed by senses (Blaikie and Priest, 2019). Measurement should be carried out through objective methods rather than through intuition, reflection or sensation since the social world and its properties exist externally (Easterby-Smith, Thorp and Jackson, 2013). The philosophical assumptions of positivism as listed by Easterby-Smith, Thorp and Jackson, (2013) are:

1) The observer must be independent of what is being observed.
2) The choice of what to study, and how to study it can be determined by objective criteria rather than by human beliefs and interests.
3) The aim of the social sciences should be identifying causal explanations and fundamental laws that explain regularities in human social behaviour.
4) Science proceeds through a process of hypothesising fundamental laws and then deducing what kinds of observations will demonstrate the truth or falsehood of these hypotheses.
5) Concepts need to be defined in ways that enable facts to be measured quantitatively.
6) Problems as a whole are better understood if they are reduced into the simplest possible elements.
7) In order to move from the specific to general, it is necessary to select a random sample of sufficient size, from which inferences may be drawn about the wider population.

8) Such regularities can most easily be identified by making comparisons of variations across samples (Easterby-Smith, Thorp and Jackson, 2013).

Some scholars argue that the assumptions of positivism may not be flexible in studying social realities (Bryman and Bell, 2015). For example, the assumption that the observer is independent of what is observed may not allow researchers to ask follow-up questions in an interview as it will be considered that the researcher is trying to influence the answers. Whilst, in reality, the researcher may want to get deeper information from the interview. In the context of this research, such restriction may limit the depth of understanding about the relational behaviours and how they enhance supply chain risk information sharing.

Although scholars such as Henderson (2011) have contended that positivism should be moved from a narrow perspective to a broader and encompassing way to investigate real-world problems and as a result, arguing for *post-positivism*. Post-positivism does not suggest abandoning positivism, but rather it suggests the need to consider things that exist beyond positivism (Henderson, 2011). Similar to the arguments of positivism is modernism, which highlights appreciating rationalism and empirical knowledge above other ways of knowing, post-positivism does not contradict these assumptions (Ryan, 2006).

Pragmatism

Pragmatism focuses on action and change and the interaction between knowledge and action (Goldkuhl, 2012). Pragmatism rejects the notion that there are pre-determined frameworks or theories that shape truth and knowledge; and that people cannot create their own truth out of anything (Easterby-Smith, Thorp and Jackson, 2013). The main argument in pragmatism is that important knowledge constructions originate from the real-life experience of the individual or researcher (Easterby-Smith, Thorp and Jackson, 2013).

The pragmatism approach, therefore, encourages the researcher not only to observe the world but also to intervene in the world (Henderson, 2011). Thus, it is pluralistic and oriented towards "what works" and practice. Easterby-Smith, Thorp and Jackson (2013) noted that pragmatism is: "a valuable perspective in management research because it focuses on processes that are particularly relevant to the studies of knowledge and learning". Furthermore, Johnson and Onwuegbuzie (2004) recommend pragmatism since it can help to mediate conflicting philosophies such as interpretivism and positivism. According to Creswell and Clark (2011), pragmatism is usually related to mixed method research. Pragmatism is concerned with "what works" and practices focusing on "*the consequences of the research, on the primary importance of the question asked rather than the methods, and on the use of multiple methods of data collection to inform the problems under study"* (Creswell and Clark, 2011

Based on the strengths presented by the pragmatic theorist, it can be claimed that the pragmatist approach better fits this research, especially after considering the nature of the research problem and the research question. Firstly, Johnson and Onwuegbuzie (2004) argue that the interpretivist ontology associated with mixed method empowers participants, honouring individual differences and recognising the salient voice of the participants. This means that in research of this kind pragmatism philosophy can be used in justifying why the silent voice of supply chain managers should be heard in order to understand the relational behaviours they use to receive and share risk information in their supply chain. Yet, as the individual context is important in interpretivist ontology, the flexibility in pragmatism which allows for applying the mixed method approach in this research offers an opportunity to ask a wider population whether a particular relational behaviour is applicable or not to their own context.

Furthermore, the pragmatist approach of starting with a problem with the goal of contributing practical solutions that guide future practice is appropriate for this research. For example, In the wake of the recent Coronavirus (Covid-19) which threatens auto industry supply chain (Foldy, 2020), the pragmatist approach provides a justification to conduct research that focuses on supply chain disruption with a view of guiding future practice. Similarly, based on the argument from social capital theory and the need to share risk information, the pragmatism philosophy is considered appropriate to justify carrying out this research in order to contribute to the field and practice of supply chain management.

5.2. Mixed method approach

The mixed methods research approach is defined by Johnson and Onwuegbuzie (2004) as the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study. A categorisation commonly used to distinguish between methodological choices relates to qualitative and quantitative research (Bryman & Bell, 2015). However, some scholars have argued for a third categorisation called mixed methodology (Onwuegbuzie and Turner, 2007; Creswell and Clark, 2011) suggesting, "that a three-paradigm methodological world might be healthy because each approach has its strengths and weaknesses and times and places of need". This provides early researchers with more options in chosen the research approach that is appropriate for the problem they wish to solve, particularly in the field of management where understanding behaviours both at individual firms/person and collective group are needed.

Arguing for research strategy as the general orientation to conduct research, particularly in the field of management, Bryman and Bell (2015) highlighted the following as the characteristics of quantitative research strategy:

1) Entails a deductive approach to the relationship between theory and research, in which the emphasis is on testing of theories;
2) Has incorporated the practice and norms of the natural model and positivism in particular; and,
3) Takes a view of social reality as an external, objective reality.

Yet, emphasising on words rather than quantification, qualitative research strategy has the following characteristics:

1) Predominantly emphasises an inductive approach to the relationship between theory and research, in which the emphasis is placed on the generation of theory;
2) Has rejected the practice and norms of the natural scientific model and of positivism in particular in preference for an emphasis on the ways in which individuals interpret their social world; and,
3) Takes a view of social reality as a constantly shifting emergent property of an individual's creation.

As stated previously, a third methodology known as mixed method has been proposed (Onwuegbuzie and Turner, 2007; Creswell and Clark, 2011). Mixed method research employs pragmatic philosophy (Creswell and Clark, 2011; Johnson and Onwuegbuzie, 2004; Onwuegbuzie and Turner, 2007). The logic of inquiry in mixed method research includes induction (which aims to discover patterns of association amongst individuals or social phenomenon); deduction (for testing of patterns or theories that have been observed); and, abduction (for providing reasons and uncovering the best explanation of results) (Onwuegbuzie, 2004; Blaikie and Priest, 2019). According to Baker (2003), academic research in the field of management should contribute to knowledge and understanding about management as a practice and discipline because management "research is about knowledge and action". He, however, observes that the association between knowledge and action is not direct. As a result, researchers should be open to adopting different approaches to management research (Onwuegbuzie and Turner, 2007).

In the context of this thesis, the goal of the researcher in understanding relational behaviours firms practice in order to receive and share risk information with a view of creating a knowledge that may encourage firms to act and make their supply chains more resilient, this can be achieved through a mixed method approach. The inductive logic in mixed methods is useful in exploring relational behaviours that enhance supply chain risk information sharing. Also, the relational behaviours discovered through the inductive approach can be tested across a larger observation to ascertain whether it is being practised or not. Furthermore, abduction approach is needed to explain results that have been found through the inductive and deductive approach.

5.3. Research design

Research design is a combined statement of, and explanation for, the choices involved in the preparation of a research project (Blaikie and Priest, 2019) which Creswel and Clark (2011) called; the procedure of inquiry. The research design is significant as it not only reveals the philosophical assumption the researcher brings, but it plays a role in selecting the method and setting the argument for explaining or interpreting results (Creswel and Clark, 2011). The research question specified for this thesis seeks to investigate how, and to what, extent does relational behaviours enhance supply chain risk information

sharing. The research question for this thesis is not only to narrow the aim of the thesis, but it reveals the philosophical stance of the researcher; pragmatic philosophy. Since this thesis is built on the pragmatic philosophy, the research question of this thesis further dictates the type of research design and method to be used for data collection (Onwuegbuzie and Leech, 2006)

The strategy for answering the research question for this thesis involves starting with qualitative interviews, followed by a quantitative survey (Creswell and Clark, 2011). In essence, the research question is both exploratory and confirmatory. It is exploratory due to a lack of clarity in terms of how social relationships enhance supply chain risk information, hence requiring an exploration of the phenomenon through qualitative strategies. It is then confirmatory due to the need to generalise (confirm) the qualitative findings through a quantitative means. Creswell and Clark (2011) recommended adopting a mixed method research approach when a single data source is inadequate or insufficient. Also, where the results from either qualitative or quantitative needs further explanation, exploratory results need additional explanation. Furthermore, a mixed method approach is recommended when a theoretical stance need to be advanced through the use of both qualitative and quantitative method, and the research problem needs to be investigated through more than one stages.

Given the nature of the problem – a need exists in the literature to explore how social relationship enhances supply chain risk information sharing because the enablers are unclear. Also, to assess the extent that the detailed qualitative result from a relatively small number of interviews can be generalised to a population, proponents of mixed method research (Creswell and Clark, 2011) have recommended Sequential Exploratory Design (SED) for this type of problem. They argued that when the research problem or the phenomenon investigated is more qualitative, or the researcher wants to detect key variables to study quantitatively, when variables are unknown, to explore a phenomenon in-depth and extend the occurrence of its dimension (Creswell and Clark, 2011). As a result, the SED suits this research as it enables the researcher to explore phenomenon – relational behaviours towards sharing risk information - using a quantitative approach and build on with quantitative research for better generalisation (Creswell and Clark, 2011; Teddlie and Tashakkori, 2003).

The justification for SED is in line with the fact that qualitative data from interviews can be used to develop parts of the questionnaire for the quantitative data that will be subsequently collected (Creswell and Clark, 2011; Tashakkori and Teddlie, 2003). In social network research, Domínguez and Hollstein (2014) observed that a qualitative study might be used to explore new practices, while the quantitative strands could help in identifying the prevalence of such types of practice, which in turn would help to provide a more comprehensive picture of the condition. In Figure 5-1, the research process corresponding to the sequential exploratory design described above is illustrated.

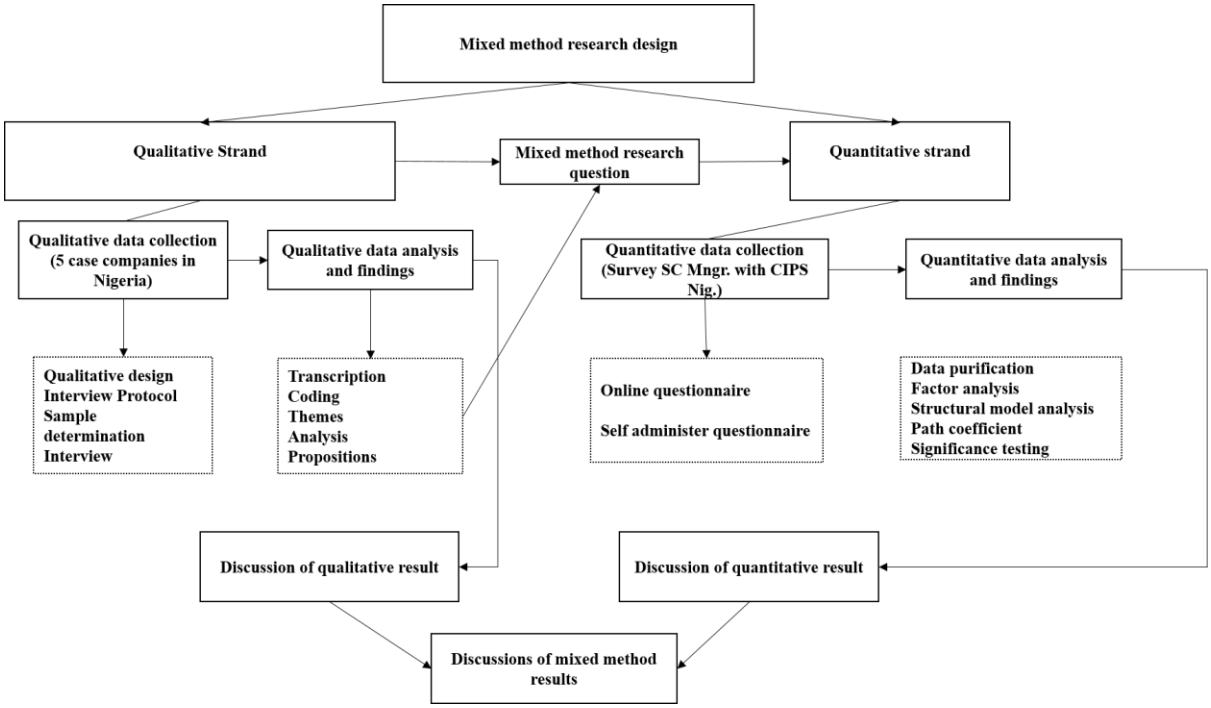

Figure 5-1 - Research methodology processes

Figure 5-1 demonstrates that the research problem was identified after reviewing the literature and briefly discussing with one industry expert about the gap identified. The research question was subsequently stated in an explorative form, as shown in section 6.2. In order to answer the research question, a qualitative strategy was designed to establish the prevalence of the problem and identify how it can be mitigated through social relationships.

Four steps for implementing an exploratory design recommended by Creswell and Clark (2011) is incorporated into the research design. In the qualitative strand, the four steps are; sampling key participants to be interviewed, collecting open-ended data with protocols, evaluating qualitative data by means of developing themes especially those particular to a qualitative method, and detecting the information required to inform the quantitative phase as shown in Figure 5-2.

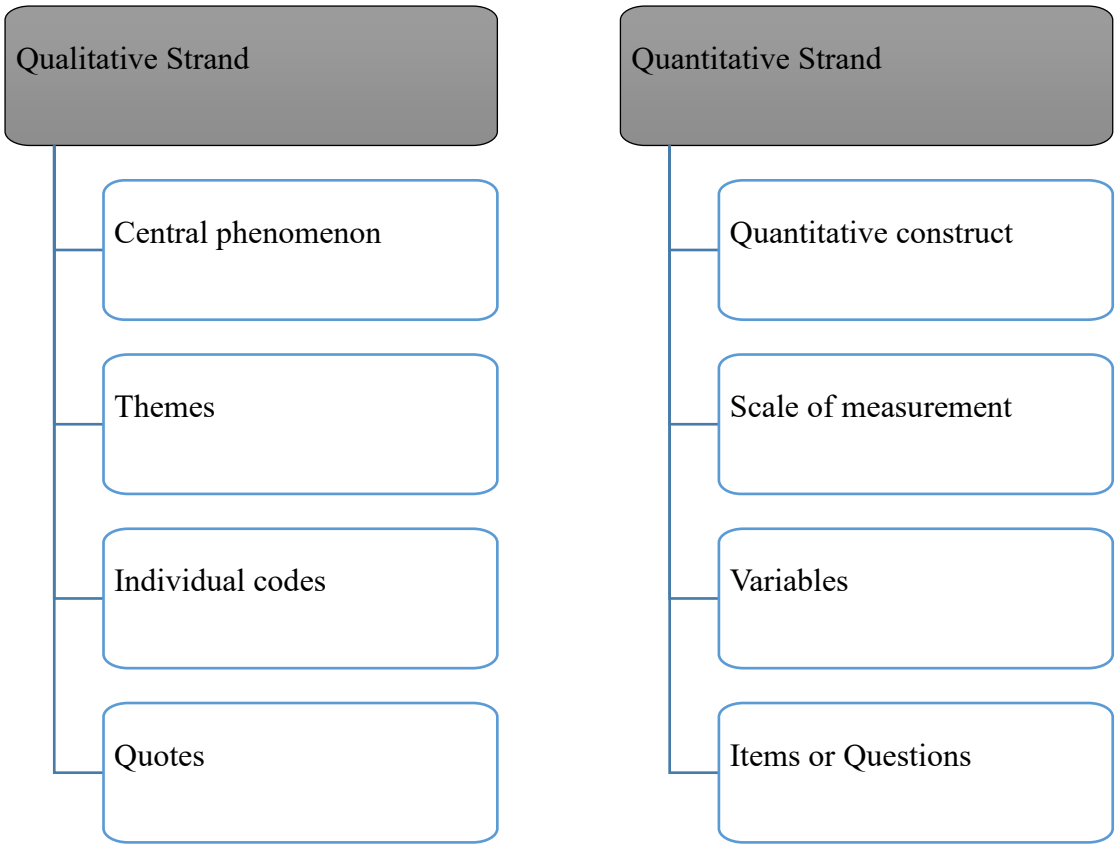

Figure 5-2 - Aspects of qualitative results that will inform quantitative data collection

The second step recommended by Creswell and Clark (2011) was to improve the quantitative research question and the mixed method question, decide how the participants would be chosen for the quantitative sample and then, based on the qualitative result, design a pilot survey and test for quantitative data collection instrument.

The third step involved designing and implementing the quantitative strand of the research. Creswell and Clark (2011) suggested that the quantitative research question or hypothesis that builds from the qualitative results should be stated, determine the qualitative approach to be used, choose a quantitative sample that will confirm or test the generalisability of the qualitative results. Also, gather closed-ended data with the instrument designed from the qualitative result, analyse the quantitative data using descriptive statistics and other statistical tools to answer the quantitative research question. The final step is to review and interpret the qualitative and quantitative results and discuss ways the quantitative results generalise or test the qualitative results (Creswell and Clark, 2011).

Creswell and Clark (2011) caution researchers on the use of sequential explorative design, stating;

- The challenges relating to time to implement,
- The challenge to specify quantitative aspect,

- The necessity for using a small purposeful sample in the first phase and a large sample of dissimilar participants in the second phase to evade question bias,
- how to use data for quantitative measures,
- guaranteeing the scores established on the instrument is valid and reliable (Creswell and Clark, 2011).

This research has carefully considered the challenges and has undertaken practical strategies to address them. For instance, in building the instrument to be used in the quantitative strands, relevant literature and a pilot test with independent academics and industry experts are carried out. Also, a purposeful sampling strategy is used to select participants for the qualitative strand.

5.4. Summary of section

This section presented and discussed the research methodology of this thesis. The section is vital, as it states the logic and strategies considered for executing this research. The section starts with the research philosophy where the ontological and epistemological issues relating to this research are revealed. Furthermore, the mixed method approach adopted in this research was also discussed. Finally, the research design for the thesis was presented. In the next section, the first phase of the mixed method approach (qualitative design) for this research is presented.

6. Qualitative research design – exploratory interviews

This section presents the qualitative research design for this thesis. The qualitative strand of this thesis is needed for answering the (qualitative) explorative aspect of the research question; how do relational behaviours enhance supply chain risk information sharing. Based on the nature of the research problem identified, about the lack of understanding of the relational behaviours that enhance supply chain risk information sharing despite the argument from social capital theory and social exchange theory, a qualitative design is therefore needed for this type of problem. Since the research problem identified and the fact that this thesis is situated in the field of supply chain management, it is essential to design this aspect of the research to collect relevant data, in accordance with the peculiarities of firms supply chains, and then integrate the process to overall thesis in a logical and coherent manner.

Further, the first part of the research question asked in this thesis – how do relational behaviours enhance supply chain risk information sharing - necessitated a qualitative exploratory strategy in order to collect in-depth data about a contemporary phenomenon within a real-life context, especially when the phenomenon and context are not clear (Yin, 2003; Creswell, 2009). The interest at this stage is to understand whether firms leverage on relational behaviours for risk information sharing for their supply chains; the type of relational behaviours they create for the purpose receiving supply chain risk information; and, how relational behaviours are used to enhance risk information sharing in firms supply chains. Furthermore, the type of knowledge needed at this stage of this research cannot be gleaned solely from a statistical questionnaire. Additionally, Tukamuhabwa, Stevenson and Busby (2017) observed that qualitative interviews in case study research could allow for researchers to build rapport with informant which is beneficial in revealing in-depth information that may be difficult to obtain using a survey. In this regard, a qualitative exploratory interview fits the context and purpose of this stage of this thesis. The outcome of the qualitative exploratory interviews generates results which provide insights on how relational behaviours enhance supply chain risk information and thus, becomes the input to the quantitative strand of this thesis.

6.1. Research ethics

Academic research is guided by a code of ethics by institutional and/or professional bodies. Cooper and Schindler (2008, p. 34) define ethics as the norms or standards of behaviour that directs moral choices about people's behaviour and our interactions with others. Researchers need to create a balance between the concern of the participants and researchers quest for new and valuable knowledge via their research; underscored by high moral priorities (Creswell, 2009). The concern of the participant can be related to sharing confidential information or any information that can lead to harm or loss of employment.

As part of the criteria for this research, the author was granted ethical approval from the Department of Design, Manufacturing and Engineering Management, University of Strathclyde, Glasgow. Afterwards, consent form (from the ethical approval form) was given, signed and returned to select managers who

are decision-makers for supply chain activities for their companies in Nigeria; who are the interviewees in this research (for the first phase qualitative strand of the research). The research has no 'known risk' as it does not involve any form of a clinical trial, psychoanalysis, danger of loss of a job, national or company security. The benefit of the research was explained to the interviewees and its potential contribution to supply chain resilience and better supply chain risk management, which is important to businesses and academics as a whole.

Easterby-Smith, Thorp and Jackson (2013) identified ten principles of ethical practice:

- ensuring that no harm comes to participants;
- respecting the dignity of research participants;
- ensuring fully informed consent of the research participant;
- protecting the privacy of research subjects;
- ensuring the confidentiality of research data;
- protecting the anonymity of individuals or organisations;
- avoiding deception about the nature or aims of the research;
- declaration of affiliations, funds sources and conflicts of interest;
- honesty and transparency in communicating about the research; and,
- avoidance of any misleading or false reporting of research (Easterby-Smith, Thorp and Jackson, 2013).

In compliance with the code of ethics, all participants interviewed were informed about the research, how the data collected was planned to be used, and the implication. After disclosing all information relating to the research and data collection, participants were then handed a consent form to read, sign, and return before the commencement of the interview. An example of the consent form is included in Appendix 2 Participants were given the opportunity and encouraged to ask questions and make observations of any issues regarding the research or the data to be collected. This is in line with the honesty and transparency principle of research ethics – participants were kept well informed about the research, the outcome of the research and the implications.

Consistent with the principles of research ethics by Easterby-Smith, Thorp and Jackson (2013), the anonymity of the participants was upheld. As a result, the names of the individuals and the organisation were not revealed to anyone, and it did not appear in any part of the thesis. This further ensures the privacy of the participants and their organisation. Also, affiliations of the researcher's institution of study and funding organisation were declared to the participants to avoid conflict of interest.

For the survey questionnaire issued within the quantitative aspect of the research, the same ethical principles used for the qualitative interviews were adopted. However, since it was a questionnaire survey, an information sheet was included on the first page of the survey and participants were informed about

the research, its objective and implications. Further, participants were informed not to disclose their personal identity or name of their organisation. Participants were, however, asked to provide an email if they wanted a summary of the final research. The participants' email addresses do not appear in any part of the thesis.

6.2. Selection of the interview firms

One of the advantages of qualitative research is the researcher's choice in selecting the appropriate respondent that is will provide relevant data in solving the research problem. Although researcher's judgment in selecting respondent creates research selection bias, but with the research problem in focus and the effort to report the result 'as it is', purposive sampling in qualitative research continues to be used to assess data that may be impossible to reach using a probability sampling (Yin, 2009). Also, Creswell (2013) observed that accessibility is another reason why some students choose a case study. Nevertheless, in this thesis, logical steps are taken to reduce researcher bias in selecting appropriate companies.

The first criteria for selecting a case company is based on whether the firms have experienced supply chain risk in the past. Although it is impossible to know about the internal supply chain risks firms faces, however, firms located in areas that have experienced environmental disasters can easily be identified as risk-prone. For instance, firms with supply chains linked to Wuhan in the coronavirus (Covid19) outbreak of 2019 can be recruited for this research. However, the researcher is faced with a problem of accessibility. Based on the social capital available to the researcher, firms in Nigeria were considered accessible. The researcher then contacted the branch coordinator of CIPS Northern-Nigeria to assist in listing firms that will be willing to participate in this research. Although there are other supply chain risk faced by most firms in Nigeria (such as political risks), the insurgency crisis is considered as one of the main risk causing event that affects firms supply chains in Nigeria (Sri-Pathma, 2015). Other events, such as communal class, high-way armed robbery, strikes, petroleum shortages, are common events that disrupt supply chains in Nigeria.

Before travelling to Nigeria for the qualitative exploratory study data collection, the branch coordinator listed eight firms that he has contacted their supply chain manager about this thesis, and they are willing to take part in the research interviews. However, upon arrival in Abuja, it was impossible to arrange an interview with three of the firms. The contact person in the firm explained that the top management did not grant them permission to be interviewed by the researcher. The researcher was meant to believe that leaders of some firms in the country think that the information they give to researchers will be passed on to tax authorities or competitors; hence, some firms prevent their staffs to be interviewed by researchers.

The phone numbers of the contact person in each company were passed to the researcher. Calls were made to arrange for the interview. In the end, data were collected from the remaining five firms. The

remaining five firms were located between Abuja, Kaduna, and Zaria axis. The branch coordinator provided the option to contact more firms if needed, however, after data was collected in the third firm, some patterns in the response began to emerge. Although Eisenhardt (1989) argued that cases between four and ten work well, the emphasis both by Eisenhardt (1989) as well as in this thesis is to ensure that relevant data has been collected to the point that no new data appeared in relation to the research question (Saunders *et al.*, 2018).

Each company selected for data collection in this research is a corporate entity, and it is part of a supply chain, and it (each case company) has developed social relationships with their partners that can be leveraged as a source of receiving and sharing risk information in their supply chain. The profile of the case company and interviewees is presented in Table 6-1.

SME	Company Size based on employment criteria	Type of Business	Age of SME (years)	Respondent
Company 1	Medium	Soya Oil Processing	12	Transport Manager. Purchasing Manager.
Company 2	Medium	Petroleum product transportation and sales	25	Operations managers (1&2).
Company 3	Medium	Food and Beverage - Yoghurt	15	Assistant GM for Logistic and Transport
Company 4	Small	Food and Beverage - Yoghurt	3	General Manager
Company 5	Medium	Animal feed production	10	Procurement and Supply Chain manager.

Table 6-1 - Profile of organisations of the interviewees

In all five companies where used for the qualitative exploratory interview in Nigeria between 2nd to 18th January 2018. The five companies selected are in the food and beverage, animal feed production and petroleum distribution and marketing industry. The size of the companies are classified as medium-sized (except for company 4, which is small-sized), based on the Small and Medium Enterprise Development Agency of Nigeria (SMEDAN) categorisation, all cases company are categorised as SMEs (Small and Medium Enterprises Development Agency of Nigeria, 2013). All cases are involved in high-level supply chain activities in the form of procurement, transportation, distribution, and sales – which have been previously affected when a supply chain-related disaster occurs. The interviewees occupy positions where they are responsible for tactical and strategic supply chain management decision making in their organisations. Supply chain decisions in the form of making the day-to-day decision for moving products, funds and information between internal (functional areas in the organisation) and external with other firms as well as long term strategic decisions. Hence, although they are referred to as supply chain managers in this thesis – which is based on the theoretical understanding of functions the respondent does - their title is sometimes different as presented in Table 6-1.

6.3. The interview protocol

The interview protocol is part of the general strategy for collecting the qualitative data in the exploratory phase of this research. The protocol developed for the exploratory phase of this thesis contains information about:

- The aim of the thesis and research question
- The theoretical lenses adopted for the research
- General questions asked about the company and interviewee
- Specific questions asked about the firm's supply chain risks
- Specific questions asked about the social relationships in the firm's supply chain

The complete protocol is attached in appendix 3. Since the focus of this research is on relational behaviours and risk information sharing, face-to-face interviews are chosen as the appropriate source data collection for this phase. The interviews are semi-structured and open-ended; allowing the respondent to give insights about questions asked whilst the researcher to probe further questions when interesting points are revealed during the interview session. The main interview questions and their sources are presented in Table 6-2.

Main interview Question	Source
1. Describe the type of informal relationship you have with your suppliers and customers (does it encourage risk information sharing)?	Wang, Ye and Tan (2014); Kembro and Selviaridis (2015); Lambert and Knemeyer (2004)
2. Do you share risk information with your partners?	Lambert and Knemeyer (2004)
3. Do your SC partners firms share risk information with you (focal firm)?	Lambert and Knemeyer (2004)
4. How do you think social relationships will affect the way supply chain risk information is shared between you and your partners?	Shin, Ishman and Sanders (2007)
5. Do you have a personal relationship with your customer, and how do you think it enhances risk information sharing in your supply chain?	Durach and Machuca (2018)
6. How do you go about determining the quality of supply chain information that is gotten as a result of social relationships?	Beynon-Davis (2009)

Table 6-2 Main interview questions and source

Guided by the understanding from the literature review, the interviews were designed to collect information about firms' policy, managers' experiences, and personal relationships with their partners and how such relationships enhance supply chain risk information sharing. The interviews started with general questions relating to supply chain risks faced by case companies, internal structures for risk information sharing, and their social relationships with their partners both at the firm to firm level and at an individual level. The actual wording of the question is presented in table Table 6-1, and the first question

was inspired by the by Wang, Ye and Tan (2014); Kembro and Selviaridis (2015); Lambert and Knemeyer (2004) and is aimed at gaining insight about the type of informal relationship the companies maintain with their supply chain partners. The second and third question is aimed to strengthen the first question as Lambert and Knemeyer (2004) argues about the nature of supply chain relationships – from arms length, where no information is shared to collaboration, where full information sharing takes place. Based on the nature of this research, companies are required to have an informal relationship with their partners. However, it was important to ask the interviewees about the nature of their supply chain relationships in order to allow an individual company to explain their own context. Also, although most companies will prefer to receive information rather than share, it was vital to ask (in question two) whether the interviewee's firm share risk information and whether they receive risk information (question three) from their supply chain partners?. Additional justification is that information sharing exchange of information between the sender and receiver (Dawes, 1996).

The fourth question is central to the focus of this research and as such, it asks the interviewee 'how do you think social relationships will affect the way supply chain risk information is shared between you and your partners?'. The questions were inspired by Shin, Ishman and Sanders (2007) who argue that contextual factors such as '*guanxi*' (informal relationships) are a factor the influence information sharing in the Chinese context. Given that this research is contextually different, it was important not only to ask if informal relationships enhance risk information sharing but how?.

For the fifth question, although organisations are sperate entity from employees and owners, it is important to ask about inter-personal relationships at the individual level as not all organisations clearly state how and individual relationships should be leverage for risk information sharing. Insight for this question was inspired by Durach and Machuca (2018) who argued interpersonal relationships is important in supply chain risk management.

In the sixth interview question asked, interviewee, are asked about how they determine the quality of information they received. Apart from the need for information quality to make an informed decision (Beynon-Davis, 2009), given that Nigeria is a third world country, its also important to identify the approach companies use to ascertain information quality. This is also because, unlike in developed countries where there are centralised institutions to confirm or deny certain information, Nigeria has no centralised body where supply chain risk information can be confirmed and validated.

6.4. Qualitative data collection

Qualitative data collection from case companies in the form of in-depth face-to-face semi-structured interviews targeted managers responsible for supply chain, procurement, operations, transportation, and distribution. Seven semi-structured interviews were conducted in total, with one interview for company 3, 4, 5, and two interviews for company 1 and 2. Multiple interviews per firm were requested by the researcher from all firms to reduce researcher bias and increase the depth of the information in each

firm. For example, in company 1, the experience narrated by the procurement manager on the type of relationships with the firm partners and risk was different from the transport manager, who were both in the same firm. Nevertheless, the interview guide was used to ensure that relevant data were collected based on the interview protocol.

The interviews were conducted in January 2018. The interviewees were informed that their participation was voluntary and they are allowed to withdraw at any time. They were also requested to read and sign a participant consent form if they agreed to continue with the research. The interviews were conducted at the business premises of the companies. Participants were asked if it was ok to record their voice during the interview digitally? Although there was apprehension with one of the participants in company 1, all interviews where digitally recorded and transcribed verbatim, as suggested by Piekkari and Welch (2006). Notes were taken during the interviews as well. The interviews lasted between thirty minutes to one hour. Interviewees and their firms were assured of anonymity and confidentiality. Instead of using a company's official name, pseudo names of Company 1, Company 2, Company 3, Company 4 and Company 5 were used. As part of the validation process, transcribed interview reports were shared with the interviewee not only to reconfirm the emerging ideas but to clarify what they meant and give them the opportunity to retract any statement they are uncomfortable with. All interviewees accepted the transcribed data as a representation of what they mean.

6.5. Qualitative analysis and validation

The first step in the data analysis of this research starts with familiarising with the data on an individual interviewee and company level. This was achieved through repeated reading of the transcripts, which Yin (2014) suggest will reveal patterns, insights, or concepts that seem promising. At this stage, pre-coding activities such as highlighting with different colours, bolding and underlining are carried out. Further, Yin (2014) suggest that a researcher can start with their theoretical proposition, which in the case of this thesis is the argument from social capital and social exchange theory on the need to leverage on social relationships to share risk information in supply chains. Although Saldaña (2009) argues that data reduction occurs continuously throughout the life of a qualitative thesis, in the qualitative data analysis of this research, a deliberate effort is made towards data reduction by selecting, focusing and simplifying the data so that conclusions can be drawn and verified. Both data familiarisation and data reduction constitute the first phase of the data analysis stage of this thesis.

The next stage involves deciding and adopting an appropriate coding method. With the research question in mind, Saldaña (2009) suggested that the researchers ontological and epistemological stance should guide the choice of coding method. Whilst the ontological questions address the nature of the participant's realities, the epistemological stance influence the exploration of the participant's actions and perception found in within the transcribed interview (Saldaña, 2009). To reveal the nature of participants and their firm organisation on the issue of social relationship and risk information sharing, In

Vivo coding is selected as it presents the voice of participants (Saldaña, 2009). Also, to explore the participant's actions and perceptions, descriptive coding is selected (Saldaña, 2009). Hence, both In Vivo and descriptive coding were chosen because they reduce researcher bias, specifically In Vivo coding, as it brings out the voices of the supply chain managers interviewed in this research.

The coding process began with First Cycle coding, where; single words to a full sentence are coded. That is, based on the researchers understand of the literature and the research problem Where distinct language related to relational behaviours is used by the interviewee, In vivo coding method, is applied (Saldaña, 2009). Also, in the First Cycle coding, a descriptive coding method is used to summarise the topic of the message. Similarly, a descriptive code is used in the First Cycle coding of this research to summarise the primary topic of the excerpt (Saldaña, 2009). Although there can be bias in chosen a descriptive code, however, for this thesis, the researcher's choice is influenced by the literature. At the end of this stage of the data analysis, some of the First Cycle (In Vivo) codes includes; "draw very close", "good rapport", "taken the relationship to a personal level", "no reason to hold back risk information". Also, some of the First Cycle (descriptive) codes includes; shared values, motivation, and trust.

For the next stage of qualitative data analysis in this research, Second Cycle coding was adopted. According to Saldaña, (2009), the main goal of Second Cycle coding is to develop thematic conceptual, categorical and/or theoretical organisation from the First Cycle codes. For this research, Pattern codding is selected for the Second Cycle codes. Miles and Huberman (1994), observed that pattern coding is appropriate for examining social networks and pattern of human relationships, also for the formation of theoretical constructs and process such as negotiating. Similar to the argument in this research, relational behaviours are related to social network, which is stressed by Miles and Huberman (1994) as appropriate for Pattern Coding. Example of First Cycle codes that are grouped into Pattern codes is; "part and parcel of the success", "partners instead of competitors", "our partners in progress", and "similar fears" are Pattern coded as collective prosperity.

Whereas the First Cycle coding involves generating codes across all cases, pattern coding is aimed at finding patterns of similar codes with a common idea between cases. The coding in this stage is based on similar relational behaviours participants talk about which have been coded in the First Cycle and repeated in multiple instances. As a result, Pattern codding facilitates cross-case analysis in multiple case analysis, such as this research (Miles and Huberman, 1994).

In the final stage of the qualitative data analysis, the results alongside the existing theoretical, conceptual and empirical literature were reflected on for an understanding of the data. This iterative process of comparing not only coded data but also reflecting on emerging themes alongside a practical understanding of the existing theory has been described by Miles, Huberman and Saldana (2014) as a triangulating strategy, and it helps to ensure the validity and credibility of the analysis. For example, by establishing

that the emerging theme from the qualitative analysis of this research is linked to social capital theory; using theory to describe actions and meaning, it has increased the theoretical validity of the qualitative analysis (Miles and Huberman, 2014). Other efforts taken in this research to increase the validity and reliability are: the creation of qualitative exploratory study protocol, the use of clear sampling criteria to select case companies as part of the qualitative exploratory study protocol, clear description of the case company profile, formalised coding and pattern code matching across cases.

Other strategy suggested by Miles, Huberman and Saldana (2014) that was employed was checking for representativeness, checking for researcher effects, looking for contrary evidence, and checking out for rival explanations.

6.6. Summary of section

This section presented the qualitative research design for this thesis. The section is needed for explaining and justifying the procedure used in carrying out the explorative phase of this research. Included in this section are discussions about research ethics as well as strategies for the selection of cases. The section also presented the interview protocol, qualitative data collection procedure, and lastly, qualitative analysis and validation.

7. Qualitative result and interpretation

This section presents the findings of the qualitative data for the first phase of this mixed method research. The qualitative strand provides rich data and a deeper understanding of the relational behaviours that supply chain managers practice for the purpose of risk information sharing. As stated in section 7, the qualitative analysis involves process such as data familiarisation and other precoding activities like highlighting with different colours, bolding and underlining. The data familiarisation is preceded with data reduction and then data coding. The data coding had the first cycle and second cycle codes. The final stage of the qualitative data analysis involves reflecting on the emerging themes alongside related literature.

This current section consists of four main sub-sections which start with an overview of the case companies of the interviewees. This provides information about the nature of business and the supply chain characteristics of the case company of the interviewees. Next, the qualitative data analysis procedure applied was presented, and it was, discussion of the interview result and finally, developing the initial research model.

7.1. Background of interviewees companies and supply chain risks faced

Background of the case companies of the interviewees explains the general business activities, and profile of the companies, as well as the types of the supply chain risks the company faces. In order to manage the interview time and process, the main interview questions were asked as specified in the interview protocol. Subsequently, a general question about the firm size, nature of supply chain, business environment and market were asked. Another reason for moving general questions to the end of the interview is because if the interview was to end abruptly because the interviewee is needed elsewhere and only general question are left to be asked, the interviewee could ask other non-supply chain staff member to provide general information. During the interview session, there were several interruptions which recording had to be paused. Yet, no interview ended abruptly without asking all questions (both specific questions for the research aim and general questions about the business). Details of the companies of the interviewees and the type of risk they faced are discussed thus:

company 1 – soya oil processing

The company is based in the city of Kaduna-Nigeria, and it is into the processing of soya cooking oil for domestic consumption. The company sells its finished good to all states in Nigeria by transporting the goods to its customers. The company has multiple suppliers which are located in the central-Northern region and southern states of Nigeria. The major suppliers for raw materials are located in the Northern region, while its suppliers for chemicals are located in Southern Nigeria. The company has partnerships with its suppliers, third party logistics, distributors, and retailers. As presented in table 6.1, the company is classified as a medium-sized company, based on the Small and Medium Enterprise

Development Agency of Nigeria (SMEDAN) categorisation. The company (Company 1) has a supply chain relationship with Company 5.

Two interviews were conducted in the company; one with the transport manager and the second with the purchasing manager. The main supply chain risk faced by the organisation includes demand-related risks due to fluctuation of the price of its products, supply-related risks due to seasonality of the raw materials, transport-related risks due to the nature of roads in Nigeria, and operational risks caused by both internal operational problems or cascading effects of demand and supply risks.

company 2 – Petroleum transportation and sales

Company 2 is a petroleum transport and sales company based in the city of Kaduna-Nigeria. The company has petrol stations, and at the same time, transports petroleum product for its own petrol stations and to its customers who own petrol stations mostly in the Northern part of Nigeria. The Companies' petrol stations are located in the Northern region of Nigeria, but it sources petroleum products from the Southern states of Lagos and Port Harcourt. As a petroleum transportation company, its operations spread across all parts of Nigeria. Similarly, based on the nature of its operations, the company has supply chain partners spread across different parts of Nigeria. The company is categorised as a medium company based on the Small and Medium Enterprise Development Agency of Nigeria (SMEDAN) categorisation.

Separate interviews were conducted with two of the operation managers in the company. The most common risk faced by the organisation is transport-related, which disrupt inbound and delivery of petroleum products. Other supply chain risks faced by the organisation relates to social risk, particularly in terms of communal crises that lead to the destruction of vehicles owned by the organisation.

Company 3 – Food and beverage

Company 3 is into the manufacture of yoghurt and is categorised as a food and beverage firm. The firm is located in the city of Zaria-Nigeria. Based on the nature of its business, the company has few suppliers but many customers who are private retailers and the government. The company own its transportation fleets and supply its finished products to customers across different regions in Nigeria. Similar to the previous company of (company 1 and company 2), then it is categorised as a medium company size.

One interview was conducted with the Assistant General Manager, who oversees logistics and transport of the company. The company's supply chain faces transport-related risk resulting from armed robbery in the highway it uses to distribute its products. The company also face socio-political risks, which affect the company due to the political and religious affiliation of its owner. Additionally, the company faces demand-related risk as a result of the seasonality of their products.

Company 4 – food and beverage

Company 4 is also in the food and beverage industry where it is into the manufacturing of yoghurt. The company is located in Zaria, Nigeria. The leading supplier of raw materials for the company is based in Lagos, and all goods are transported by road. The company has been in operation for three years, and it supplies its finish goods for the market in Kaduna and Abuja (the capital of Nigeria). Based on company categorisation by SMEDAN, company 4 is categorised as a small-sized company. Also, as presented in table 6.1, the company has been in operation for three years.

One interview was done with the General Manager of the company. The supply chain risk faced by the company is mostly transport-related from the supplier, which creates further operational risks and other supply chain risk faced by the organisation like capacity constrains which affects the organisation's ability to meet the demand of its products.

Company 5 – animal feed production

Company 5 is into the production of animal feeds, and it is located in Kaduna, Nigeria. The company has a supply chain relationship with company 1, who supply its raw materials for its manufacturing process. The company has a large supply base for raw materials and chemicals. For the raw materials, the company has different types of arrangement with its supplier in order to secure its supplies. Its raw materials are mostly agricultural commodities, and they are sourced from suppliers in all part of Nigeria. Company 5 is categorised as a medium-size company based on categorisation by SMEDAN.

One interview was conducted with the procurement and supply chain manager of the company. One of the main sources of supply chain risk faced by the organisation is a financial-related risk, which is as a result of fluctuation in the price of commodities. The company also faces political risks that relate to a ban on the importation of critical raw materials, which causes scarcity of raw materials. In addition, the policy risk which causes rises in the price of raw materials due to government policies to buy and on some agriculture products which are used as raw materials the organisation uses. Other general types of risks faced by the organisation are transport risk which happens when raw materials in-bound or finished goods out-bound. The background of the supply chain risks that affect the companies in this thesis highlights the need to develop a means of mitigating the supply chain risks. In view of the aim of this exploratory aspect of this thesis, relational behaviours used by the firms in receiving and sharing risk information in their supply chain are examined.

As discussed in previously in section 6.2.1, questions were asked about managers' personal relationships with their partners; both at the firm to firm level, and at an individual level, how the companies' social relationships enhance supply chain risk information sharing with partnering firms in the aspects of: "source of risk information ", "type of informal relationship with supply chain partners", "perception

of whether and how informal relationship encourages risk information", "ways of receiving information about supply chain risk", and "relational strategies used for encouraging risk information".

7.2. Qualitative findings

The application of the analysis procedure described within Section 7.1 revealed several emerging themes indicative of relational behaviours used for the enhancement of supply chain risk information sharing. The relational behavioural themes include relational closeness, relational incentives, and collective prosperity with partners. An extract of the qualitative data from quotes to descriptive codes, then themes as well as literature that assisted in naming the themes are provided in Table 7-1.

Data reduction	Descriptive code	Theme
"if you have personalised the relationship the other party would not see any reason to hold back anything, they would gladly inform you" (Company 1)	[1]Close personal relationships	Relational Closeness
"if you had not developed this interpersonal relationship, nobody will give you such information" (Company 1)	[2]Inter personal relationship	Relational Closeness
"We give welfare to our partners; they give us information on the situation" (Company 2)	[3]Incentive to share information	Relational Incentives
"if there is any problem they will let us know before we even load" (Company 3)	[4]Motivated to inform	Relational Incentive
"motivation is the key issue in relation to all this social-related aspect because when you have a very good understanding and when somebody (your partner) is in trouble, and you intervene, any information that you want to get from him he will be desperate to give you…" (Company 3)	[5a]Motivation [5B]Very good understanding	Relational Incentive
"That is why I told you that when you have a mutual understanding, you draw them very close to you, you do a kind of nice thing to them, I think all the information they, have they will disseminate it to you," (Company 3)	[6a]Mutual understanding [6b]Draw him very close	Relational Closeness
"because whatever danger that affects them affects us, because they are our partners in progress with us, without them we might not be getting our needs as at when due..." (Company 4)	[7]Common danger [7a]Partners in progress	Collective Prosperity
"Once there is any issue, or they foresee that one material will give issue (i.e. rise in price) maybe in one or two months' time, they foresee what happens at times, so they tell us" (Company 5)	[8]Concerned about partner's interest	Collective Prosperity

Table 7-1: Extract of qualitative data: summarised and analysed

In Table 7-1, some quotes from the interview are presented alongside the In Vivo and descriptive codes used in codifying them. The unit of analysis for this research is the firm; hence, quotes for the interviewee represents the company. Multiple codes - sometimes mixture of codes - are used for a quote, especially where more than points is made. Furthermore, the theme, as well as the theme sources, are presented in the table. As stated previously in section 7, a triangulation strategy recommended by Miles, Huberman and Saldana (2014) is used to reflect on the emerging themes alongside the data and the theory.

Guided by the interview protocol (see appendix 3), interviewers were asked a specific question on whether relational behaviours enhance supply chain risk information sharing? The question was important so that the opinion of the interviewee can be stated right from the onset. The findings reveal that all the supply chain managers interviewed mentioned that social relationship is playing a role in receiving timely risk information that can disrupt their supply chain. Also sharing of information regarding other internal supply chain risks, like internal operations and quality risk, were also found to be facilitated by informal relationships as further described by the interviewees. In the next subsections, the qualitative findings within the context of the three emerging themes (relational closeness, relational incentive and collective prosperity) which are the behaviours that are promoted so that supply chain risk information sharing can be enhanced, are further explained.

7.2.1. Developing relational closeness with partners

The findings of the qualitative phase indicated how the importance of developing closeness with partners enhances supply chain risk information sharing. The closeness between supply chain partners has previously been identified as creating a personal bond between partners (Nahapiet and Ghoshal, 1998), but has not previously been identified as having an influence on risk information sharing. Though partners have no formal requirement to share supply chain risk information, the extent of closeness has been identified within the interviews as making partnering firms feel obliged to share supply chain risk information. The following quote from one of the supply chain managers, who emphasises this point.

*"if you have personalised the relationship the other party would not see any reason to hold back anything, they would gladly inform you" (*Company *1).*

All of the supply chain managers interviewed followed similar reasoning: that when the relationship was personalised beyond a formal relationship, partners would see no reason to hold back information about events that could otherwise cause disruption to the supply chain. Instead, they would take appropriate action to inform partners of the risk event. For instance, during the interview, a supply chain manager in Company 4 described an incidence where one of their supply chain partners inform them that they there is a plot (by armed robbers) to attack them after they leave the partners premises.

At an individual level, the relational closeness was not restricted to individuals in the same position. Instead, a close relationship was identified as being maintained with key individuals that were more likely to share not only external risk information but also internal risk information:

"As I am concerned if there is any way that I know that I can move… more closely to them, which will enhance me getting more from them, I will do "(Firm5).

7.2.2. Providing relational incentives

Consistent with the findings of Nahapiet and Ghoshal (1998), incentives were found within the analysis to create a condition for exchange. According to Wathne and Heide (2004), it is possible for companies

to design incentive structures that reward the necessary behaviours. Alternatively, a company can identify or select partners that possess the capability and motivate them to support its strategy, like risk information sharing in this context (Ouchi, 1980).

Our analysis identified that relational incentive was one of the practices that the supply chain managers, deployed in order to receive supply chain risk information. Incentive in this context takes various forms, both at an individual and company level. For instance, a manager in Company 2 indicated that some actions which are taken for granted, for example, simple relational behaviours such as a "smile" could motivate risk information sharing: *"So some people if you smile to them they will assist you*". Though this may seem impossible in the absence of physical contacts or a long conversation, it is a common practice in marketing where customers are sometimes viewed as "rational and emotional animals" (Schmitt, 1999). In the context of risk information sharing, this research found that simply smiling (a relational incentive) encourages members to share risk information with each other as quoted by the manager in Company 2. Yet, it is important to state that whereas smile in some context may not mean anything significant, in the context of Nigeria, a smile can inspire several positive actions and behaviours such as pricing and subsequently purchase of an item, starting or extending a conversation.

Similarly, motivation was identified as a relational incentive for supply chain risk information sharing. Motivation serves as a reason why a person acts in a particular way, and in the context of this research, it is the reason a partner chooses to share risk information. As one of the managers reported:

*"Motivation is the key issue in relation to all this social-related aspect because when you have a very good understanding and when somebody (your partner) is in trouble, and you intervene, any information that you want to get from him he will be desperate to give you, but when you don't have a good understanding and relationship, some information will be hidden (*Company *3).*

Company level risk information sharing incentives were identified within the interviews in the form of corporate gifts:

*"We ensure that we maintain a relationship and we do not just maintain it because at the end of the year we equally ensure that there is a package - a corporate gift" (*Company *Company 1).*

However, such gifts do not directly translate to exchange for risk information; rather, it strengthens the relationship and acts as an incentive for partners to share risk information. At the individual level, the findings indicated that companies give both tangible and intangible gifts that are usually given to customers (e.g., an award of recognition, gift cards, and vouchers) to both frontline staff (like drivers) and managers of partnering firms. Similar to corporate gifts, the understanding gleaned from the interview is that corporate gifts are used as an incentive. It can serve as an incentive for individual/firms to share risk information. The manager in Company 1 had this to say:

"At the end of the year, we equally ensure that there is a package a corporate gift for the year we equally mention those people because they have been our best partners and we allow the chief executives to know that, it's not that the information we are getting from them we are using it for any personal thing, but we use it to help us".

Furthermore, in Nigeria, sending gifts are very popular during the festival period. Culturally, individuals regard such gifts as a sign that the other person cares. At the organisational level, the end of the year is usually the time of informal engagements, like parties. From what the manager in Company 1 is describing, they use such occasion to encourage behaviours such as risk information sharing, special pricing, after-sales service, among others.

7.2.3. Establishing a sense of collective prosperity

The interview data analysed indicated that establishing a sense of collective prosperity with supply chain partners was a relational tactic that supply chain managers used to enhance supply chain risk information sharing. As declared by a supply chain manager in Company 5:

"because of the understanding and for the fact that they know we see them as part of the people we operate with, once there is an issue, or they foresee that one material will give issue, maybe in one or two months' time, they foresee what happens at times, so they tell us."

The interesting point in relation to this quote is that partners are likely to benefit from a windfall (increased profit) if they do not share the risk information. However, because they understand that it is only a short-term profit that may affect future operations of their partner, they choose to share such information. It is also important to note that the market is not a monopoly (there are other firms in the market), and all companies have multiple partners for each supply chain activity. Since supply partners were willing to share information that has a direct impact on their profit, it was therefore unlikely for them to hold back other non-demand related risk information. In addition, the statement by the interviewee in company 4 who indicated that some element of closeness promotes collective prosperity: "*for the fact that they know we see them as part of the people we operate with".*

In relation to the focal company sharing risk information with partners, the manager in Company 5, stated:

"because whatever danger that affects them, affects us because they are our partners in progress… without them, we might not be getting our needs as at when due. Therefore, if we see anything at our locality, we furnish them with all the information".

It is important to note at this point that Company 5 has a supply chain relationship with Company 1, and shares a similar view of collective prosperity. As a result, the relationship between partners have informed members on the collective gain when supply chain risk information is shared, and at the same time, collective loss when supply chain risk information is not shared. Whilst referring to the

relationship with Company 5, one of the managers in Company 1 has this to say: *"we make them feel as if the whole system is a project and all of us are part and parcel of the success of the project" (Company 1)*. Also, as a link to relational closeness, the same manager stated that: *"the only way through which you can get this information is because you have taken the relationship to a personal level" (Company 1)*. In the next subsection, the findings are interpreted in a wider context of what has been written by past scholars.

7.3. Interpretation of the interview result

As stated previously in Section 7.3.3, this research builds on the argument from social capital theory, that social relationships can be leveraged as a means of generating value between social actors. In the context of this research, value relates to supply chain risk information, which can prevent loss resulting from a disruptive event. Since a disruptive event can occur outside of a firm's business environment, it is extremely challenging to get timely information in relation to all-risk events. But, if firms have risk information on time, it will enable them to prepare and respond effectively (Li *et al.*, 2006); as against when risk information is known at a later time. In this research, it has been found that by investigation how relational behaviours supply chain risk information sharing is enhanced through promoting behaviours such as relational closeness and collective prosperity.

Firstly, with regards to relational closeness, researchers such as Dibble, Levine and Park (2012) argue that relational closeness strengthens the emotional bond between people, which further enhance the degree of idiosyncratic knowledge each person know about each other. Similarly, the research interviews indicated how supply chain risk information is received due to supply chain partners practising the relational behaviour of maintaining a close relationship with each other and having no reason to hold back supply chain risk information from one another. At the organisational level, Stevenson and Spring (2009) suggested that developing closeness could be associated with the use of local suppliers. This was demonstrated in the close relationship between Company 1 and Company 5, who are all located in the same city. Managers in both companies (Company 1 and Company 5) speak the same regional language, which in Nigeria can make people closer. Given both managers are influential in their organisation, they can promote risk information sharing. Hence, as firms are relationally closer to each other, they possess a mutual understanding of each other's business, the type of supply chain risks that affect each other, and the extent of disruption that may occur. Consistent with social capital theory, due to the closeness of the relationships between supply chain partners, partners are relationally obliged to share risk information so that they can maintain the relationship. Based on this discussion, the following proposition is developed: ***developing and promoting relational behaviour of closeness with supply chain partners enhances supply chain risk information sharing***

Also, establishing a sense of collective prosperity with partners is in part achieved through enhanced supply chain risk information sharing, as partners are concerned with maintaining both the relationship

as well as the prosperity of all. This can be impaired when there are disruptions, and information is not shared. Collective prosperity behaviours which are similar to long-term orientation and solidarity (Ivens, 2004), underscore supply chain partners to suppress their personal interest at the detriment of the supply chain. Instead, supply chain partners carry out actions, such as risk information sharing, for the benefit of all parties in the supply chain. The idea behind collective prosperity is similar to shared goals. They both promote togetherness between partners which may usually have different objectives. From a social capital theory perspective, both collective prosperity and shared goals enhance social bonding between partners (Reddish, Fischer & Bulbulia, 2013). It involves people voluntarily coming together for a common goal (Bisung et al., 2014), and it is mostly motivated by social relationships between them (Narayanan and Raman, 2004). In the interview findings in this research, codes such as mutual understanding and exchange of ideas are used from the literature (Chow and Chan, 2008) to describe behaviours that demonstrate collective prosperity among supply chain partners. Also, both the data and the literature (Chow and Chan, 2008) demonstrate that collective prosperity promotes bonding between partners which enables the sharing of information and knowledge.

Furthermore, where there is a social connection between individuals or partners, Chow and Chan (2008) reported that there is pressure to act collectively or share information. Whilst within organisations, the corporate vision and goals are the driving force for individuals and department to collaborate and be a concern for each other. Yet, across the supply chain, collective prosperity can be part of the motivation to carry out voluntary actions such as risk information sharing to prevent supply chain disruption. Evidently, the findings from the data support the literature in revealing how collective prosperity enhance supply chain risk information sharing. With this understanding, the following proposition is formulated: ***The relational behaviour of collective prosperity enhances supply chain risk information sharing.***

The findings from the interviews indicated that collective prosperity behaviours are further enhanced when supply chain managers are relationally close to each other. Durach and Machuca (2018) stressed that investments in interpersonal relationships are significant antecedents that are re-deployable in managing supply chain disruption. In the context of supply chain risk information sharing, such interpersonal relationships bring partners close to each other, which enables them to understand that in a supply chain, a risk event that can affect a member's operation can have negative prosperity on the entire supply chain. This implies that relational closeness is linked to collective prosperity, which in turn affects supply chain risk information sharing. In light of this, we propose that: ***collective prosperity mediates the relationship between relational closeness and supply chain risk information sharing.***

Furthermore, incentives are common business practices, particularly in the principal-agent relationship in organisations, where the principal provides agents with incentives to reduce opportunistic behaviour (Li, Mukherjee and Vasconcelos 2018). Alternatively, other purpose of incentives is that it aims to encourage increased effort from an actor which Maestrini et al. (2018) argue that it stimulates suppliers

to act in a particular desired manner. Levin (2003) further argued that real-world incentive is usually informal. Nevertheless, incentives tend to be more effective when dependency tend to be high (Maestrini Luzzini Caniato and Ronchi, 2018). In the context of this, the findings reveal that supply chain members use some relational incentive to promote risk information sharing. An incentive can involve tangible direct reward or intangible reward like a "smile" as reported by one of the interviewees. Not incentivising may imply that supply chain partners may not receive risk information. Consequently, the following proposition is developed: ***relational incentive enhances sharing supply chain risk information.***

7.4. Developing an initial research model based on findings and literature

The findings from the qualitative phase and strengthened by the literature review in Sections 2-4 supports the development of the conceptual model developed in this section.

The literature review indicated the need to receive timely risk information to prepare against disasters that can disrupt the supply chain. A supply chain can be considered to be complex with several interactions, layers and relationships which may not allow a chain member to have information about a particular risk event. From the literature reviewed in this thesis, the understanding of supply chain risk information sharing in the light of disciplines like crisis and disaster management underscores the need to prompt supply chain members about the disastrous event which the need to act. In the context of companies of this research, sharing timely risk information has been reported to be important in mitigating supply chain disruptions.

The exclusion of supply chain risk information sharing in supply chain contracts can clearly make it difficult to share risk information; which could otherwise allow managers to take mitigating action. However, the theoretical literature investigated in Section 2 provided the foundation for supply chain managers to share risk information. The related literature reviewed in Section 4 revealed relational behaviours such as trust, commitment, relationship length, and reciprocity as enablers to supply chain risk information sharing. However, unlike the past studies that examined the relational behaviour in a different context and used a quantitative prescriptive strategy to assess predefined relational behaviours, this study has adopted an approach that seeks to understand the problem from the perspective of the supply chain managers and their organisations in Nigeria.

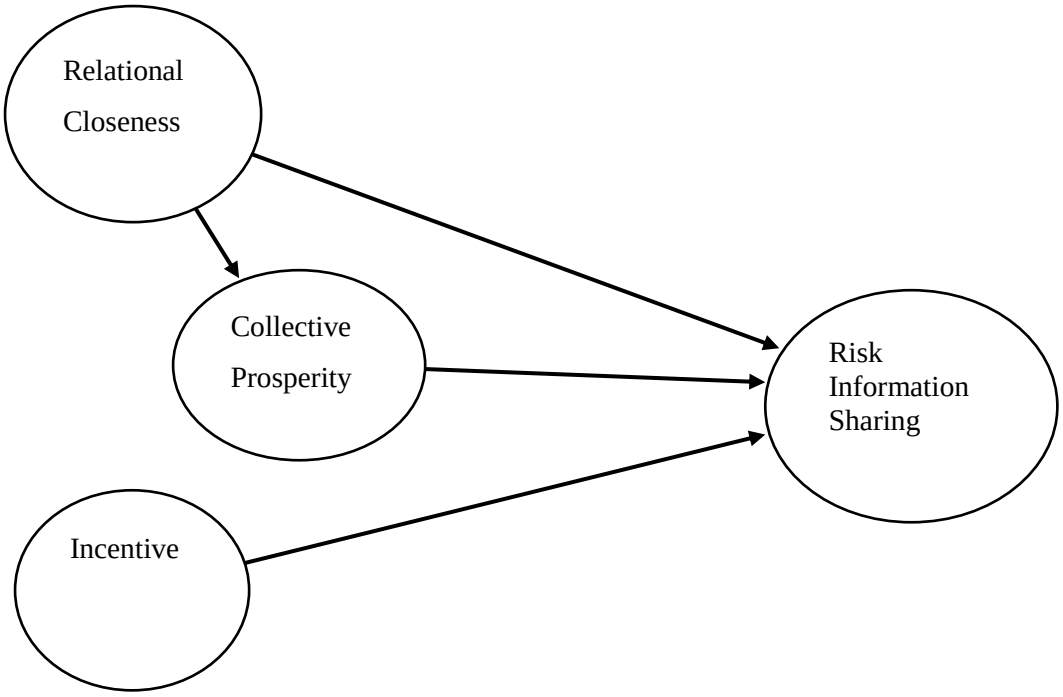

Figure 7-1 - Initial research model

Consequently, the findings from the semi-structured interviews with supply chain managers have uncovered three new relational behaviours that were not previously identified in the supply chain risk management literature as having a relationship with risk information sharing. These relational behaviours of closeness, collective prosperity, and incentive as established from the interviews, are proposed as potentially enhancing supply chain risk information sharing. Within Figure 7-1, the three relational behaviours are modelled, based on the propositions from the qualitative discussion in the previous section, to explain how they relate to supply chain risk information sharing.

In Figure 7-1, relational closeness is illustrated to enhance supply chain risk information and collective prosperity. This proposition was based on the analysis of the interview data as well as the literature, which indicated that the closer the relationship between supply chain partners, the more they are likely to share risk information. Also, the closer the relationship between partners, the more they understand the benefit to promote their mutual interest, collective prosperity, to share supply chain risk information. Nevertheless, even without closeness, the findings indicated that collective prosperity behaviours are enablers of supply chain risk information sharing, as presented in Figure 7-1. Additionally, Figure 7-1 proposes that relational incentives are relational behaviours that enhance supply chain risk information sharing.

This qualitative investigation provided insight in relation to how social relationships enhance supply chain risk information sharing by providing evidence of new relational behaviours that were previously unknown within the supply chain management literature. This phase of the research has contributed to

answering the exploratory aspect of the research question of this thesis, which is to examine how relational behaviours enhance supply chain risk information sharing.

7.5. Section summary

This section analyses and discusses the qualitative data collected for this research. The findings of the semi-structured interview of supply chain managers in five companies revealed three new relational behaviours that promoted enhances supply chain risk information sharing. The chapter concludes by presenting an initial research model which was developed based on qualitative interviews and the literature review. In the next section, the quantitative data are analysed to test and validate the model developed.

8. Quantitative research design

This phase of the research starts with a deductive approach guided by theory and then implements a survey design strategy to test the propositions obtained from the qualitative research. According to Bryman and Bell (2015), quantitative research involves the collection of numerical data and focusses on revealing a view of the association between theory and research as deductive, a tendency for positivism in the natural science approach, and an objectivist notion of social reality.

Survey design is a framework for the systematic collection of data from a sample, for the purpose of making generalisations about a population (Bryman and Bell 2015). This is mostly carried out by questionnaire or by structured interview, on multiple cases (not less than two) and at one point in time in relation with two or more variables which are then investigated to discover patterns of relationships. Although regular organisational patterns are usually challenging to detect and explain, survey design guided by a positivism approach aims to measure human or organisational behaviours and underlying relationships using large samples (Easterby-Smith, Thorp and Jackson, 2013). Consequently, this research adopted a survey design to execute the quantitative aspect of the research.

8.1. Instrumentation and questionnaire development

Instrumentation procedure is developed to measure the presence or extent of a property in any social object (Hammersley, 1987). Survey research requires the use of a measurement instrument, which is a tool that helps researchers conducting research to collect data from and about every member of the study sample. This research follows the instrumentation guidelines recommended by Schwab (2004); Shiu, Hair, Bush and Ortinau (2009).

For this research, the latent constructs used were derived from the qualitative phase (section 8) whilst the measurement scales were derived from literature. Latent construct is theoretical, implying they are a phenomenon that cannot be observed directly. For instance, relational closeness, collective prosperity and relational incentives are phenomenon that cannot be directly observed or measured quantitatively. Rather, scales are used to measure latent constructs. In this thesis, scales that had previously been used in published research - although they had different goals from this research - were adapted to suit this thesis. Adapting scales that have been used by previous researchers is a strategy employed to increase the validity of the instruments used in this thesis.

As the latent constructs specified for measurement in this research have less tangible property and more abstract features, it was, therefore, necessary to operationalise the construct by designing and using questions and scale measurements to collect the required data (Shiu, Hair, Bush & Ortinau, 2009). Operationalisation involves explaining the constructs developed in this thesis by stating the activities required to measure them. These activities include the design and use of questions and measurement scales to gather the data needed (Shui et al., 2009). As stated in a previous example, since construct

such as relational closeness, collective prosperity and relational incentives cannot be measured or observed directly, it is recommended (Shui et al., 2009) to use indirect measurement by operationalising their components. As a result, questions will be asked and measured on the components that constitute the latent constructs of this thesis.

The main questions asked in relation to the constructs in this thesis can be categorised as what Shui et al., (2009) calls 'state of current and past behaviour data' as they seek to determine the extent to which relational behaviours enhance supply chain risk information sharing. To determine the extent, the ordinal scale is used to measure the latent constructs collected in this research. The ordinal scale was most appropriate because it enabled the respondent to express the relative magnitude between answers to a question (Shiu, Hair, Bush & Ortinau, 2009).

8.1.1. Likert-type Scale

Although there are different types of scales used in organisational research (Thurstone, Q-sort scale, Semantic differential, Guttman scale), the Likert scale is widely used and considered to be an objective measure of peoples' opinions and attitudes (Hartley, 2013); also respondents are most familiar and comfortable responding to them (Cooper and Johnson, 2016). The Likert scale was therefore chosen as an appropriate scale for measuring the items related to the latent construct of this research. The Likert scale asks for the respondent to respond to a range of statements that they must agree or disagree with respect to a range of characteristics (Krosnick and Presser, 2010).

Although, there has also been opposition in relation to using a Likert type scale in behavioural research, stressing that it can only offer ordinal data. Carifio and Perla (2007) argued that this is a fundamental misinterpretation problem, which has nothing to do with the scale itself but instead originates from a misunderstanding of data type and related psychologies of interpretations. They further contended that "ordinal item response formats can and usually do produce scales that are empirically interval level scales" (Carifio and Perla, 2007). Also, the way the response is set and wording of the anchoring terms, are the defining reasons in determining if the scale used is at a ratio, ordinal, or interval level (Carifio and Perla, 2007). Notwithstanding, Hair et al. (2012) contends that the partial least square – structural equation modelling techniques are robust and can analyse non-parametric data and any type of scale

8.2. Questionnaire design

This research adopts the self-completion questionnaire method to collect data. With the advancement in ICT, self-completion questionnaires can be done online (internet survey) or offline (mail or postal questionnaire). The idea behind the self-completion questionnaire is that the respondent should read the questions and answer the question by filling out the questionnaire themselves without the presence of a trained interviewer (Bryman and Bell, 2015; Shui et al., 2009). When compared to face-to-face interviews, self-completion-questionnaires have the risk of missing data, and lower response rates have the benefits of quicker time to administer, low cost, and an absence of interviewer effects (Bryman and

Bell, 2015). The questions asked in the questionnaire were created from the literature reviewed and the interviews from the qualitative phase of the research.

During the design of the questionnaire, this research adopted insight from the 'flowerpot approach' (Shui et al., 2009), which suggests a logical hierarchical order to capture data from the general to the specific (Shui et al., 2009). Consistent with the flowerpot approach, the questionnaire was divided into three sections starting with the introductory section, which provided the respondent with a description of the foundation of the research. Following the introductory section was the main items for quantitative measurement. Two open questions were also included in this section of the questionnaire to gain additional in-depth data, but not for empirical statistical analysis. The final section of the questions related to eliciting responses relating to demographics and socio-economics aspects (Shui et al., 2009). Putting the demographic and socio-economical question in the last part of the questionnaire was to further reduce respondent fatigue before answering the main questions which are most important. Efforts were made to avoid double barrel, negative or biased questions; instead, all questions were written in clear and concise English.

The questionnaire is made available both online and paper version, which was prepared using Qualtrics survey management software for the online version, and downloaded into Microsoft Word for the paper version. In the online version, few questions were asked per screen for faster download speed. Similarly, for the paper version, few questions were asked per page, with moderate spacing and font size (See Appendix 4).

Deciding on the Questions

Shui, Hair, Bush and Ortinau (2009) observed that some questionnaire design lacks the theory behind the questionnaire development. They stressed that the design of the questionnaire should be conducted scientifically and should integrate established rules of logic, objectivity and systematic procedure (Shui et al. 2009). Consequently, this research starts by considering appropriate words to be used within the questionnaire. A key focus was the consideration in constructing questions that were directed towards testing hypotheses, rather than merely gathering facts (Shuie et al., 2009). In addition, following the suggestions by Creswell and Clark (2011) regarding the question set up for the sequential explorative design, questions for quantitative testing were structured as closed-ended questions.

8.2.1. Independent variables: Relational behaviours

Instrumentation of scales for the three latent constructs behaviours that enhance supply chain risk information sharing was conducted after reviewing empirical papers and conducting the qualitative strand of this research. The constructs of relational closeness, relational incentive and collective prosperity are proxies for relational behaviours. Since most of the existing measurement scales used to measure constructs like relational closeness are from the field of psychology, adaptation and refinement are needed.

Relational closeness

This research adapted the Unidimensional Relationship Closeness Scale (URCS) from the empirical research of (Dibble, Levine and Park, 2012). It was however deemed necessary to refine the Dibble, Levine and Park (2012) instrument (which is mostly used in the field of psychology) to fit with business management research. For instance, while the Dibble, Levine and Park (2012) measure some items that depict love, blood or intimate relationship (e.g. "My _____ is a priority in my life"), instead, this research only selected items that depicted non-intimate, love or blood relationships that occur socially in normal business life. Furthermore, although organisations are built and managed by people, it is still a separate entity from its owners and employees – and organisations are not known to have "blood or intimate relationships". Dibble, Levine and Park (2012) measured relationship closeness with a twelve-item, five-point, Likert-type scale. However, for this research, the Dibble, Levine and Park (2012) Unidimensional Relationship Closeness Scale was reduced to eight-items with each item rated on a seven-point Likert-type scale ranging from 1 = strongly disagree to 7 = strongly agree. The operational definition of relational closeness for supply chain risk information sharing is the extent of relational bond between supply chain members, which enhances risk information sharing.

In this research, the eight items adapted from the scale of Dibble, Levine and Park (2012) to capture the relational closeness towards enhancing risk information sharing were:

- The relationship with our supply chain partners is close;
- We and our supply chain partners disclose important information to each other;
- We have a strong connection with our supply chain partners;
- Our supply chain partners are our priority in our business;
- We collaborate regularly with our supply chain partners ;
- We create informal events to meet with our supply chain partners;
- Our relationship with our supply chain is important to our business; and,
- We consider our supply chain partners when making important decisions.

Relational incentive

This research adapted the incentives scale from the empirical research of (Maestrini *et al.*, 2018a). Although the domain of the research by Maestrini et al. (2018) is on supplier performance, the main idea behind the measurement is the same: reward or displeasure with respect to a particular reason. Similarly, De Toni and Nassimbeni (2000) argued that incentive is rewards granted to suppliers to increase quality, reliability and meeting-up with delivery time in the supply contract. In this research, it is argued that relational incentive for supply chain risk information can still be measured using a similar scale. The relational incentive for risk information sharing is operationalised in this research as the extent to which risk information is shared due to increased relational benefits and rewards provided by supply chain

partners. Adapting the scale used by Maestrini et al. (2018), the relational incentive is measured with three-item with each item rated on a Likert-Type scale ranging from 1 = strongly disagree to 7 = strongly agree. The three-items are as follows:

- Our business partners are likely to be awarded when they inform us about issues that affect our business;
- Our relationship with our partners would be negatively affected if they refuse to inform us about issues that would affect our business; and,
- When we work jointly or combine effort with our partners, we are happy to share the benefits between the two of us.

Collective prosperity

Collective prosperity is measured while reflecting on the interview codes in the qualitative strand; the literature review and assessing the measurement by Bisung *et al.*, (2014). The construct entails several items pointing towards an action that is motivated by a social relationship, which leads to a collective good (Narayanan and Raman, 2004). Within the context of this research, collective prosperity for supply chain risk information sharing is operationalised as an obligation to carry out actions that enhance supply chain risk information sharing for the benefit of all partners. The obligations in this regard are inspired by social relationships, and they are aimed to benefit both the focal firm and its partners. In the context of this research, collective prosperity is a relational behaviour (construct) that explains voluntary actions taken to share risk information for the benefit of mitigating supply chain disruption. It is considered appropriate to measure collective prosperity in the context of risk information sharing in supply chains of independent but still interrelated firms. Collective prosperity is measured using five items with each item rated on a Likert-Type scale ranging from 1 = strongly disagree to 7 = strongly agree.

In this research, the five items were developed to measure collective prosperity are:

- We consider the long-term benefit of our relationships;
- When making important decisions, we consider the going concern of our supply chain partners as well;
- We understand that a crisis that affects our partner's supply can be passed on to us;
- We are willing to inform our partner of dangers that can affect them; and,
- We are willing to collaborate with our partners to address a common issue related to our supply chain.

8.2.2. Dependent variables: Risk information sharing

Risk information sharing was measured in this research by adapting the Li et al., (2015) measurement. The goal is to adapt items that are relevant to the context of this research. Given that the study of Li et

al., (2015) focused on financial performance, two items measuring the sharing of information on demand, and integration of information system were dropped. Faisal, Banwet and Shankar (2006) argued that information sharing would enable supply chain partners to understand those risks which may affect them once they are a member of a supply chain. Although most of the measures of supply chain risk information include proprietary information, we argue that some of the risk information (e.g. external related risk) may be about events that occur outside a focal firm's environment; thus, the information in public space and is not a property of the focal firm. Therefore, this research operationalised risk information sharing as the extent to which critical information about an event that may disrupt the supply chain is communicated to a firm's supply chain partner. Risk information sharing is measured using five items with each item rated on a Likert-Type scale ranging from 1 = strongly disagree to 7 = strongly agree.

In this research, the five items developed to measure risk information sharing are:

- It is expected that members in the supply chain keep each other informed about events or changes that may affect the other party;
- Our partners keep us fully informed about issues that affect our business;
- We provide information to our partner frequently and formally and not only according to the specific agreement;
- We share accurate risk-related information with our supply chain members; and,
- We are willing to share real-time information on demands with our suppliers.

8.3. Sampling framework

This research, particularly the questionnaire administration element, was carried out with the support of the Chartered Institute of Procurement and Supply (CIPS) Nigeria branch. The population of the research comprised of the 5,994 registered members within CIPS Nigeria as of May 2019. The main advantage of using CIPS members is the possibility to reach a cross-sectional sample of knowledgeable industry experts. Furthermore, the views from such a sample are from experts in different cases (heterogeneity) which strengthen the discussion of the results. The selection of CIPS is consistent with the recommendation of New, Green and Morton (2002) in relation to getting the right respondent. With the lack of a database to reach supply chain professionals in Nigeria, CIPS provides a forum where supply chain members could be accessed. Consequently, they formed the target sample for this research.

The notion behind sampling is to select a relatively small manageable number of elements from a population with the expectation that the information collected is a representation, which accurate judgement could subsequently be made about the larger population (Shui et al., 2009). Due to the UK data protection law; which CIPS globally enforce on its members in the Nigeria branch, it is impossible to develop a list of the entire CIPS members in the Nigeria branch. Further, like with most professional association,

CIPS has active and non-active members. It is logical for research to seeks to collect data from the active members who now form the sampling frame of this research (Shui et al., 2009). The sample frame of this research is the eligible (active) members of CIPS Nigeria that are available for selection, of which there are 1,211 as of May 2019. One of the advantages of collecting data from the active members is because CIPS require all active members to complete a continuing professional development programme annually. This provides active members with up to date knowledge of several aspects of the profession.

Although the sampling unit was comprised of all active members of CIPS Nigeria, it was still impossible to generate a list of the members due to CIPS data protection law mentioned earlier. This subsequently made it challenging to access the 1,211 active members. Hence, two strategies were adopted to approach potential respondents:

1. Administer a questionnaire to active members on CIPS Nigeria social media platform; and,
2. Administer a questionnaire to active members at the CIPS Nigeria conference 2019.

The final sample size for this research was 501. This reflected the number of respondents accessible from the CIPS Telegram social media platform and the CIPS Nigeria conference 2019. Shui et al. (2009) observed that "it is not uncommon that not all sampling units in a sampling frame are reachable". As a result, it was important to ascertain the expected reachable respondent (Shui et al., 2009).

In all, the sampling (inquiry) logic for this research was aimed at collecting the right information from the right people in order to facilitate analysis and discussion and provide an answer to the overall research question of the research (Onwuegbuzie *et al.*, 2017; Easterby-Smith, Thorpe and Jackson 2012; Shui et al., 2009). Consistent with the argument of relying on the knowledge of key informants (Kumar, Stern and Anderson, 1993), members of CIPS Nigeria are considered knowledgeable in the types of supply chain risks that are common in Nigeria. This screening process was aimed at collecting data from people who have a better experience and will be able to answer questions regarding supply chain risk information sharing and relational behaviours in their organisations. This strategy was in line with past studies that have surveyed supply chain-related professional bodies like the National Association of Purchasing Managers in the USA (Carter and Jennings, 2002), and the Chartered Institute of Procurement and Supply UK (Holt and Ghobadian, 2009).

8.4. Pilot testing of the questionnaire

Pilot testing of the questionnaire was carried out with six industry professionals and three academic experts following the suggestions by Rothgeb, Willis and Forsyth (2007); and Earl Babbie (2012). Rothgeb, Willis and Forsyth (2007) recommended that a questionnaire review was necessary to identify problematic questions for either the interviewer or the respondent. Therefore, piloting allows the researcher to gain valuable feedback regarding the appropriateness of the questionnaire, which may

present a challenge for respondents completing the questionnaire. Rather than piloting only with potential respondents, the questionnaire was piloted with both industry professionals and academics experts consistent with the suggestion by Babbie (2012). Also, to ensure the questionnaire was well structured, a Questionnaire Appraisal System (QAS) developed by Forsyth, Levin and Fisher (1999) was adapted for the pilot stage. The QAS was useful as it covered areas regarding comprehension, information retrieval, response selection, and synthesis and evaluation, which provided quick feedback about draft questionnaire items (Forsyth, Levin and Fisher, 1999). Emphasis was placed on clarity of the question which should be unambiguous; whether there were any omissions; clarity of the instructions; and the time it took to complete the questionnaire. After piloting, suggestions were made on vagueness, ambiguines and subjectivity of some questions, mostly in the section on general organisation information. Suggestions were made about including more questions that ask about the current position, and how long participants have worked in the organisation. The suggestions made during the piloting of the questionnaire were considered, and the questionnaire was modified by rephrasing the vague, ambiguous and subjective words. Also, questions asking about current position and how long participant have worked in the organisation were now included. The final the questionnaire was subsequently distributed.

8.5. Questionnaire response collection

8.5.1. First distribution

The first distribution targeted all CIPS Nigeria branch members on the Telegram social media platform. An introduction about the research was posted by a senior official of the branch on the platform. A link to the Qualtrics questionnaire was posted on the group platform on 27th December 2018, allowing each of the 398 members on the platform (as at that date) the opportunity to complete the questionnaire. Since the group was a social media site where there were continuous discussions, the link and a reminder to fill the questionnaire were repeated five times on different days within the data collection period. Also, in the reminder message, members were asked to share the link with other CIPS members who were on the group but are not active on the Telegram social media platform. Furthermore, within the time of the first post on the group, all new members added to the group were forwarded a link to a private chat about the research, together with the link of the survey. The reason for reaching out through private chat is because new members added to the platform would not have seen the link shared before they were added to the platform. However, before sharing using the private chat option, a discussing was made with the administrator of the group, permission was granted to introduce the research and send the link to new members via private chat. The online questionnaire was available for five months and closed on the 25th of May 2019, so that a sufficient number of respondents can complete the questionnaire.

8.5.2. Second distribution

The second distribution was made at the CIPS Nigeria branch conference in 2019. The second distribution was initiated because a sufficient number of respondent have not yet completed the questionnaire online. The researcher had information about the CIPS Nigeria conference and decided to use the opportunity to boost the response rate. Due to resource constraints, the researcher was not physically present at the conference. However, permission was sought from the local organising committee to distribute a paper version of the questionnaire. The permission was granted, and the researcher liaised with the organisers to include the questionnaire among the paper schedule of event handed during the registration at the conference venue. An announcement was made during one of the conference breaks to return all completed questionnaires.

8.5.3. Questionnaire response

The sample frame provided a list of 1,211 active members of the CIPS Nigeria branch. As stated previously, due to the data protection law which CIPS global enforce on all its branches, it was impossible to have access (via email) to members of CIPS Nigeria. As a result, only 398 members of the Telegram group are accessible to administer the questionnaire. After administering the online version of the questionnaire, 75 responses were recorded, constituting an 18% response rate of the active CIPS Nigeria members. Easterby-Smith, Thorp and Jackson (2013) suggested that where there is no face-to-face contact with individual respondent, the response rate could be low, and such cases, "20% response rate would be regarded as good". Yet, Bryman and Bell (2015) observed growing tendencies that people are refusing to take part in surveys. The following reasons for the low online response rate were considered to be as:

- *Randomisation of response options*: In order to reduce respondent biases in choosing repeated options, the randomisation option of the Qualtrics survey tool was enabled to randomly order the responses. Respondents subsequently had to read through the options to choose their preference, with some respondents complaining about the randomisation, saying answering the questions was stressful.
- *Use of smartphone*: Some participants took a long time to complete the survey, while some started completing and then stopped before completing. Internet availability in Nigeria is weak in some parts of the country, which may have affected completion.
- *Lengthy cover letter*: The cover letter was written following ethical guidelines that require detailing a broad range of information on the research and ethical disclosures.
- *Telegram social media app*: The Telegram social media app is not as popular in Nigeria as compared, for example, to WhatsApp. Initially, the branch had a WhatsApp group, but due to the restriction on the maximum of 250 people, a Telegram social media group was created for the CIPS Nigeria members.

- *The number of members online*: It was observed that prior to reposting a reminder on the CIPS Telegram page, the number of active online members ranged from between 8 to 30, with some having a higher frequency of repeated activity on the group.

To mitigate the low response resulting from the use of the online survey (via the CIPS Nigeria Telegram group), action was taken to utilise the opportunity of the CIPS Nigeria conference held on April 2019, to distribute the questionnaire for a second time. The official number of people registered for the conference was shown on the CIPS website was 200. This included both CIPS and non-CIPS members. Consequently, 200 paper copies of the questionnaire were made available and distributed. Organisers of the conference revealed that about 103 participants of the conference had CIPS membership.

Similar to the online questionnaire, a screening question was used to establish whether respondents were members of CIPS Nigeria branch. Additionally, the respondents were asked whether they have previously completed the online version. Consequently, the usable response from the survey was 31 questionnaires fully completed, constituting a 34% response rate for the newly completed questionnaire of CIPS members. The relatively low number of responses is attributed to the fact that some may have already completed the online version. Also, since the conference has its main programme of activity, it was impossible to secure a particular time for participants to complete and return the survey. Instead, participants had to divide their time and attention between taking an active role within the conference and completing the questionnaire.

8.6. Data preparation

Data preparation is the process of transferring data from a questionnaire, in the context of this research, to a data warehouse (Shui et al., 2009). The rationale behind data preparation is to avoid using wrong data within data analysis software. This study followed the four-step process recommended by Shui et al., (2009): data validation, data editing and coding, data entry, and finally, data tabulation. These steps helped to detect error in the early stage before the data analysis.

In the first stage of the data preparation process, the data was validated. The main reason for data validation is to ensure that the questionnaire survey was conducted correctly (Shui et al., 2009). Primarily, the stage validation process involved: checking for fraud – whether the interview was falsified; checking procedure – whether the data were collected according to plan; checking correct completeness – whether respondents completed all the questions; and, checking courtesy – whether respondents were treated respectfully (Shui et al., 2009). With regards to fraud in the questionnaire administration, the questionnaire was administered with the assistance and knowledge of CIPS Nigeria branch who are complying with CIPS global in implementing a strict code of conduct for its members. Furthermore, the Qualtrics survey package provided the location of all completed questionnaires and can be independently verified. For the procedure, a strategy for collection of the questionnaire was implemented, and when the

response was low, an alternative action was taken to administer the questionnaire at the CIPS conference, which was administered by an official of CIPS Nigeria.

The next process proposed by Shui et al. (2009) involving data editing, and it required checking of the raw data to ensure that no mistake had been made by the respondent or the interviewer. Although the questionnaire was issued both online and on paper, all completed questionnaires were carefully checked. The online version had the option to export directly to excel without human input. However, the paper-based questionnaire, which had human input, was checked for errors like whether respondents answered or ticked two responses in the same question

In the third and fourth steps, the data collected were coded by assigning numerical values to the responses of every question by each respondent and are subsequently entered to the computer manually (Shui et al., 2009). The layout of the question provided for the respondent to tick the box under the option of their choice. A master code form was established to assign coded values to each response with '1' representing 'strongly disagree' leading up to '7' which represents 'strongly agree'. Although the same response was used both for the online questionnaire and paper-based questionnaire, the online questionnaire was randomised by the Qualtrics software, which interchanged the responses. Nevertheless, with the master code form, all responses were coded and entered using a Microsoft Excel spreadsheet.

8.7. Management of errors: Validity

Validity is concerned about the assessment of the extent to which the conclusions reached from the experiment are valid (Shui et al., 2009). It is considered as the most critical "criterion of research which affects the integrity of the conclusions generated" (Bryman and Bell, 2015). Adcock and Collier (2001) contended that a valid measure would be achieved when the operationalisation and scoring of the indicators used in the research meaningfully represent the idea the researcher seeks to measure. Shui et al., (2009) provided a detailed discussion on the various threats to internal, external construct validity which are summarised in Table 8-1. In this research, the steps taken to address the threats are discussed alongside.

Internal Validity	
Threat	Procedure
History	No historical event affected the data collection process.
Testing	Understanding of testing had already been gained during piloting and not while administering the instrument.
Instrumentation	Questions with similar measurements were grouped to avoid contamination.
Selection bias	A transparent sampling procedure was implemented to avoid bias in selecting a specific group of respondents.
Statistical regression	No sample groups were selected based on their response.
External Validity	
Treatment vs history	The survey was conducted for an extended period with no historical event posing a contamination threat.
Treatment vs testing	Respondents were not sensitised to respond in a particular manner.

Treatment vs setting	The generalisation is restricted to sample.
Construct Validity	
Inadequate pre-operationalisation	A detailed literature review and the explorative study were conducted.
Single method bias	Statistical methods were used to check the common method bias.
Demand characteristics	The expectations of the research conclusion were hidden to avoid the respondent providing a particular response.
Diffusion of treatment	The respondent was required to provide their personal opinion about their organisation.

Table 8-1 - Actions taken to ensure internal, external and construct validity

8.7.1. Management of errors: Face validity

Face validity is highly recommended for consideration, particularly when a researcher develops a new measure (Bryman and Bell, 2015). Face validity measures whether the appearance of the content reflects the concept in question (Bryman and Bell, 2015). Although the instrument measures used in this study were adapted from other studies (Dibble, Levine and Park, 2012; Maestrini et al., 2018; Bisung *et al.*, 2014; Li et al., 2015), a test of face validity was still carried out. One of the means of assessing face validity is to ask other people whether or not the measure appears to represent the concept it purports (Bryman and Bell, 2015). This study tested the face validity by administering the questionnaire to three academics and four industry experts. All experts are knowledgeable in relation to the underlying concept that was being measured based on their work experience. Input from these experts leads to the refinement of some the wording of the questions, as explained previously, which improved the quality of the questionnaire.

8.7.2. Management of errors: Discriminant validity

Discriminant validity is concerned with the extent to which the scales of one construct is different from other constructs (Hair *et al.*, 2016). That is, a similar scale should not be repeated for two different constructs using the same instrument. Intuitively, this study restricts all scales to only one construct. Further, Heterotrait-Monotrait Ratio was used to inspect the discriminant validity of the constructs by relating the average variance-extracted values of two constructs with the square of the correlation between the constructs which is discussed in section 8.4 of this thesis (Hair et al., 2016).

8.7.3. Management of errors: Convergent validity

Convergent validity assesses the extent to which a set of variables correlates positively with the same construct (Hair et al., 2017). Factor loading and Average Variance (AVE) are two ways of calculating convergent validity (Hair et al., 201). The factor load, also known as the indicator reliability, is required to be statistically significant at 0.108 or higher (Hair et al., 2017). Although factor loading is usually weak when new scales are developed, it was advised that researchers should carefully examine the effect of such removal on the composite reliability and the content validity (Hair et al., 2017). The second measure of convergent validity is the average variance extracted. The AVE measures the grand mean value of the squared loadings of the scales related to a particular construct (Hair et al., 2017). The

general rule is that AVE should have a value of at least 0.50, which implies that more than half of the variance of its indicators are explained by the construct (Hair et al., 2017).

8.7.4. Management of errors: Content validity

Content validity measures the extent to which a scale represents the entire content involved in the systematised concept being measured (Adcock and Collier, 2001). Content validity for this study was considered from the questionnaire development stage, where each scale was developed from the literature. The piloting phase of the questionnaire still subjected the instrument to screening by academic professionals.

8.7.5. Management of errors: Reliability

Reliability is the measure of the consistency of a concept (Bryman and Bell, 2015). It is the extent to which the design and its procedure can be repeated and arrive at a similar conclusion about the relationships hypothesised (Shui et al., 2009). It has been argued by Babbie (2012) that increasingly attempt to achieve reliability, may reduce the scope of validity. However, since validity measures the extent of the truthfulness of the experiment (Shui et al., 2009), while reliability measures the extent of repeatability (Bryman and Bell, 2015), more attention is sometimes placed on validity (Babbie, 2012). Reliability is mostly related to random errors, i.e. when the inconsistent result is attained after repeating the application of a given instrument (Adcock and Collier, 2001). In contrast, validity involving error (bias), takes a natural form or direction (Adcock and Collier, 2001).

This study adopted a statistical approach to test for reliability. Cronbach alpha is commonly used to test of internal reliability, with a threshold of scores above 0.70, demonstrating the level of reliability (Garver and Mentzer, 1999; Bryman and Bell, 2015). Another test of reliability is Average Variance Extracted (AVE), and SEM construct reliability with their respective threshold values of 0.5, and 0.7 (Garver and Mentzer, 1999).

8.8. Strategy for quantitative data analysis

A quantitative analysis is usually influenced by the type of variable created in the research, the size, and nature of the sample (Bryman and Bell; 2015; Shui et al., 2009; Hair et al., 2017). Critical guidelines surround whether the sample size is small or large, the distribution is normal or not, the type of measurement scale used to measure the variable, and whether the study seeks to develop a new theory or validate an existing theory (Hair et al., 2017). Easterby-Smith, Thorp and Jackson, (2013) contended that all quantitative research carry out similar procedures: data summarisation, and making an inference. The purpose of data summarisation is to be able to ascertain the features that best describe "the story about the data" (Easterby-Smith, Thorp and Jackson, 2013). Further, quantitative researchers make inference "by looking for patterns in the data that can be used to draw conclusions about the research questions" (Easterby-Smith, Thorp and Jackson, 2013).

The strategy adopted for this research to make a statistical inference is Structural Equation Modelling (SEM), which is a second-generation technique for multivariate analysis used to analyse relationships amongst variables simultaneously (Hair et al., 2017; Schumacker and Lomax 2004). There are two key aspects of SEM: (1) the causal process under investigation, which may be signified by a series of regression, i.e. structural equations; and, (2) the structural relations can be modelled pictorially to allow a richer conceptualisation of the theory that is studied (Byrne, 2016). Elements involved in SEM include composite variables which are established by calculating a set of weights, multiplying the weights by the associated data and summing them (Hair et al., 2017). The second elements are the measurement which is achieved by assigning numbers to indicators of latent variables (Hair et al., 2017). Further, SEM requires coding, which is assigning numbers to categories in a way that enhances measurement (Hair et al., 2017).

There are two types of SEM: covariance-based SEM (CB-SEM) and the partial least squares SEM (PLS-SEM) (Hair et al., 2017). Covariance-based SEM has been the dominant method for analysing complex interrelationships between both latent and observed variables for many years (Hair et al., 2019). However, in recent years, partial least squares SEM has been widely used in many social science disciplines, including operations and supply chain management (Hair et al., 2019). PLS-SEM enables researchers to estimate complex models with many constructs, indicators, and variables, even when distributional assumptions on the data are not fully met (Hair et al., 2019). This is based on the rationale behind PLS-SEM, which is the '*causal-predictive approach to SEM that emphasises prediction in estimating statistical models, whose structures are designed to provide causal explanations'* (Hair et al., 2019). As a result, the emphasis is on the structures, and the resultant causal explanations and not necessarily on the previous academic research focus on explanation and prediction. PLS-SEM analysis can also be carried out using existing software packages: PLS-Graph and SmartPLS, which requires moderate technical knowledge about the method (Hair et al., 2019).

Other important features of PLS-SEM which makes it suitable are:

1. PLS-SEM is considered efficient when used to estimate path models which may comprise multiple constructs;
2. PLS-SEM is preferred in studies that have a small sample size; and
3. PLS-SEM is more flexible in handling moderator variables, hierarchical component models, and nonlinear relationships which are considered advanced (Sarstedt *et al.*, 2014).

Finally, the decision for selecting PLS-SEM for this thesis was based on points to consider when deciding PLS as suggested by Hair et al., (2019). It is recommended that PLS-SEM should be used when the analysis is concerned with testing a theoretical framework from a prediction perspective (Hair et al., 2019). In this instance, social capital theory and social exchange theory are the theoretical frameworks that explain why supply chains leverage informal relationships as a reason to share risk information.

Secondly, Hair et al. (2019) recommended PLS when the research objective is to understand increasing complexity by exploring theoretical extensions of established theories (exploratory research for theory development). Given the nature of this research which seeks to start by exploring relational behaviours that enhance supply chain risk information sharing, the PLS techniques are considered the appropriate technique for analysis. Furthermore, when the sample size is small, PLS-SEM can still be utilised; as it is in the case of this research (Hair et al., 2019).

Given that the alternative to PLS-SEM (i.e. CB-SEM) requires a substantially larger sample of over 100, PLS-SEM is, therefore, the right techniques since it accommodates a smaller sample size, which applies to this research. Furthermore, when distribution issues are a concern, such as lack of normality, Hair et al., (2019) observe that PLS-SEM is less stringent when working with nonnormal data as the algorithm in PLS transforms nonnormal data based on the central limit theorem. A preliminary assessment of the data collected for this research indicates normality may be a problem. Since the PLS algorithm uses the central limit theorem for non-normal data, it is, therefore, appropriates to adopt it as the technique for analysing the data for this study.

8.9. Summary of section

This section presented the quantitative design of this research. The main goal of the section is to state the considerations with their justification for the quantitative phase of this research; revealing the logical steps and the reasons why they are taken for quantitative data analysis. This does not only increase the validity and reliability of the result, but it ensures that if a different researcher applies the same procedure, a similar result can be found. Hence, this chapter starts by presenting the research design followed by instrumentation and questionnaire development. The chapter also presented the questionnaire design, sample framework, pilot testing of the questionnaire, data preparation and management of errors; where issues of validity and reliability were discussed. The chapter ends by stating the strategy used for quantitative data analysis.

9. Quantitative result and interpretation

This section builds on the previous section of this study by presenting the confirmatory quantitative data analysis and findings of the study. The section starts by elaborating on the hypothetical research model developed within the previous section with the objective of developing and testing the hypotheses of the research. The data analysed in this section were collected through a survey of supply chain members of CIPS Nigeria. The data purification procedure taken is presented, followed by the validated measurement model, and then the Structural Equation Model analysis is presented. The data purification was undertaken using the SPSS statistical software programme. Further, PLS-SEM was used to analyse the structural equation model.

9.1. Data purification

The first step taken to prepare the data for the quantitative data analysis was to transfer the questionnaire response collected electronically and physically to Microsoft Excel and subsequently to SPSS. The survey responses collected through the paper-based questionnaire were manually entered into Microsoft Excel. After entering the data in Microsoft Excel, the data were subsequently coded to numbers. A thorough check was carried out to ensure that wrong, and unreasonable values were not used. After the data was numerically transformed, statistical procedures were used to examine the variables and test the hypotheses of the research. The statistical procedures were used to establish whether the PLS-SEM technique could be carried out for the analysis. Given the nature of the data collection procedure where all participants are members of the CIPS, non-response bias and early vs late respondent test was not considered. However, as explained in the previously on the questionnaire response, a transparent strategy was employed to ensure that the data was a fair representation of the sample. These strategies include using multiple platforms (social media and conference) to administer the questionnaire, contacting officials of CIPS Nigeria to help administer the questionnaire and making follow-up reminders for the completion of the questionnaire. Nevertheless, other statistical procedures such as out-of-range value identification; missing data treatment; estimation of univariate and multivariate normality; assessment of outliers; multicollinearity and homoscedasticity diagnosis were conducted.

9.1.1. Out-of-range values

Out of range values can be described as values that are outside of the acceptable range of values for a particular study. For this study, the range of values was between 1 and 7 since it represented a response on a Likert scale. 1 represented strongly disagree, 2 moderately disagree, 3 disagree, 4 Neither disagree nor-agree, 5 agree, 6 somewhat agree, 7 strongly agree. Any other values were considered as out-of-range. Although Microsoft Excel was programmed to automatically transform the textual responses to numerical values, user error was possible example, inputting 9 when the highest value is 7. As a result, data-cleaning was undertaken to ensure the data were all within range.

9.1.2. Missing data

Missing data within survey research can be mostly attributed to a non-response by a respondent (Tabachnick and Fidell, 2012). Non-response is a common occurrence as the respondents are free to answer a particular question or not. In this research, there were cases of missing values as a result of non-response. Statistical procedures allow an examination of missing values in order to assess whether their presence was random. According to Pallant (2007), missing values can be treated using pairwise or listwise deletion. In treating the missing values identified, the Expectation Maximisation method, which is one of the most common methods of treating missing or unobserved values, was used (De Vaus, 2001).

However, before applying the Expectation Maximisation method for treating the missing values, the Missing Completely at Random (MCAR) method was used to test whether the missing values were completely random Little (1988). The Expectation Maximisation result indicated that significance level of the MCAR test was statistically insignificant (Chi-Square = 12.248, DF = 21, Sig. = .933), indicating that the missing values in the data occurred at random. Hence, the next analysis procedure could, therefore, be carried out on the data set. Since there were missing values in the data set, the Expectation Maximisation method was used to replace the missing value. This new data set without missing value was used for further statistical analysis in this study.

9.1.3. Statistical outliers

Outliers are a rare and extreme case of data that is typically far from the mean of the data set. It reflects a data score that is different from the rest of the remaining data set (Field, 2013). For a survey questionnaire, Tabachnick and Fidell, (2006) explained that researcher related causes of outliers might include: wrong entry; improper specification of missing data; and, entering a different score that is not from the population. An outlier could alternatively be an extreme value from the respondent, which differs from the mean response of other respondents (Tabachnick & Fidell, 2006). Respondents could, for example, be affected by several personal factors which could affect their response to the questionnaire (Cousineau and Chartier, 2010).

Standardise scores (Z-scores) of variables is one technique that can be used to check for outliers. Coakes (2005) noted that in the case where the standardised residual value exceeds the range of ±3.26 indicates that there might be an outlier, particularly where the sample data set has more than 80 cases. Hair *et al.*, (2019) however contended using ±2.58 for data sets that contained less than eighty cases. Other statistical tests suggested by De Vaus (2002) for checking outlier are the Mahalanobis Distance.

This study used the Mahalanobis distance test to detect multivariate outliers. In order to detect multivariate outliers, it is vital to determine the critical value for which the Mahalanobis distance must be greater than. The acceptable criterion of chi-square value of 0.001 with 21 degrees of freedom was used to ascertain the Mahalanobis distance (Tabachnick and Fidell, 2006). A regression method was used to

calculate the Mahalanobis distance of each variable case within the data set. Table 9-1 highlights 11 cases in relation to the Mahalanobis distance that was considered to be an extreme outlier from the sample of 108. In order to obtain high-quality data for this study, rather than input the mean score for each case, a decision was taken to delete cases with extreme values before proceeding to the next stage of the data screening. Consequently, a new data set with 97 cases are used. However, it is vital for the researcher to declare that in line with the argument for qualitative research, outlier creates useful space in quantitative research that can best be further investigated through qualitative research that seeks to understand in more in-depth detail and context, why outlier exists.

Variable case of outlier	Mahalanobis distance	Chi value > 0.001
66	.59959	.00000
7	.59801	.00000
37	.55738	.00001
44	.55167	.00001
28	.55148	.00001
1	.53540	.00002
25	.45761	.00031
92	.45567	.00033
86	.43246	.00074
100	.41632	.00127
18	.41338	.00140

Table 9-1 - Cases with extreme Mahalanobis distance

9.1.4. Normality test

Normality of data is one of the underlying assumptions that need to be fulfilled for CBSEM; however, for PLS-SEM analysis, it is not necessary (Hair *et al.*, 2016). Tests such as the Kolmogorov-Smirnov statistic, normal probability plot, and histograms are usually used to carry out normality tests on data (Pallant, 2011). Furthermore, a normal distribution may also be determined through skewness and kurtosis. Tabachnick and Fidell (2006) define skewness as the extent of symmetry of distribution, while kurtosis has to do with the peakedness of a distribution. For the univariate normality test of this study, the result indicated that most of the variables had values exceeding the acceptable range of ±2.5 for skewness and kurtosis. The skewness of the result was all the negatives to the agreeing part of the questionnaire. The poor skewness value was related to the extreme outliers to the right of the curve. Nevertheless, the poor skewness result did not prevent proceeding with the analysis, as the PLS-SEM is a nonparametric statistical method and "it does not require the data to be normally distributed" (Hair *et al.*, 2016).

An alternative method that was used to examine multivariate normality is Mardia's Coefficient (Kankainen, Taskinen and Oja, 2004). Mardia's normality test is based on standardised third and fourth moments, which are used to examine multivariate skewness and kurtosis statistics. The decision rule used for Mardia's normality test is 1 for skewness and 20 kurtoses. The significant value of the Mardia coefficient test for items in the thesis indicates skewness 127.8290 and kurtosis 401.9959. Although the

items are not normally distributed, it further strengthens the justification of adopting PLS-SEM carry out the data analysis (Hair *et al.*, 2016).

9.1.5. Multicollinearity

Homoscedasticity is the assumption that the residuals of the dependent variable are normally distributed and have constant variance across the number of the independent variables (Kline, 2011). Yet, multi-collinearity is referred to as having a high correlation between more than two formative indicators (Hair et al. 2016). One of the most severe forms of multicollinearity is caused by the inclusion of two or more formative indicators into the same block of indicators, having precisely the same information in them, and with nothing changed (Hair et al. 2016). As a result, high collinearity between formative indicators will have a serious impact on the estimation of weights and their statistical significance. One of the ways of detecting multicollinearity is by calculating the tolerance impact and Variance Inflation Factor (VIF) (Tabachnick & Fidell, 2000; Hair et al. 2016). In the context of PLS-SEM, Hair et al. (2016) recommend that a tolerance value less than 0.20 and a VIF value more than 5 indicates potential collin-earity between the variables. The VIF is a reciprocal of the tolerance. Although both VIF and tolerance carry the same information, VIF has become the standard practice of determining multicollinearity. This study measures the VIF of the four variables using Smart PLS while for individual item indicator, the SPSS software programme was used and is presented in Table 9-2.

Variable	VIF	Tolerance
Latent Variable 1_Risk	Constant	Constant
Latent Variable 2_Closeness	2.544	0.393
Latent Variable 3_Incentive	1.507	0.664
Latent Variable 4_Prosperity	2.524	0.396

Table 9-2 - VIF and tolerance value for each variable

Table 9-2 indicates that the variable relational closeness has a VIF of 2.544 and tolerance of 0.393, relational incentive has a VIF of 1.507 VIF and tolerance of 0.664, while collective prosperity has a VIF of 2.524 and tolerance of 0.396. In all cases, the independent variables have VIF and tolerance values lower than the thresholds of 5 and 0.20, respectively. This implies that the mean of each of the variables has no problem with collinearity (Hair et al. 2016). Additionally, the VIF for each item was examined using the SPSS software as summarised within Table 9-3.

Model		**Unstandardized Coefficients**		**Standardised Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-0.13	0.79		-0.17	0.87		
	Q1Risk	0.06	0.03	0.23	1.88	0.06	0.60	1.66
	Q2Risk	0.00	0.04	-0.01	-0.06	0.95	0.55	1.83
	Q3Risk	-0.05	0.03	-0.19	-1.57	0.12	0.63	1.59
	Q4Risk	-0.06	0.03	-0.21	-1.84	0.07	0.65	1.54

Model		Unstandardized Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-0.13	0.79		-0.17	0.87		
	Q5Risk	-0.03	0.04	-0.09	-0.66	0.51	0.47	2.13
	Q6Close	0.04	0.05	0.11	0.85	0.40	0.56	1.79
	Q7Close	0.00	0.04	0.00	0.01	0.99	0.53	1.90
	Q8Close	0.15	0.06	0.34	2.47	0.02	0.48	2.09
	Q9Close	-0.01	0.07	-0.02	-0.15	0.88	0.46	2.20
	Q10Close	0.08	0.07	0.16	1.14	0.26	0.46	2.19
	Q11Close	0.01	0.03	0.05	0.40	0.69	0.52	1.92
	Q12Close	-0.04	0.10	-0.05	-0.40	0.69	0.60	1.68
	Q13Close	-0.09	0.06	-0.24	-1.59	0.12	0.38	2.64
	Q14Inctv	0.01	0.04	0.04	0.26	0.80	0.47	2.13
	Q15Inctv	0.07	0.04	0.25	1.68	0.10	0.40	2.48
	Q16Inctv	-0.01	0.05	-0.04	-0.29	0.77	0.48	2.08
	Q18Pros	0.00	0.10	0.00	0.01	1.00	0.49	2.03
	Q19Pros	0.02	0.06	0.04	0.30	0.76	0.43	2.30
	Q20Pros	-0.05	0.05	-0.12	-0.96	0.34	0.61	1.64
	Q21Pros	-0.09	0.08	-0.15	-1.13	0.26	0.53	1.90
	Q22Pros	0.14	0.10	0.19	1.38	0.17	0.46	2.16
a. Dependent Variable: early vs late response								

Table 9-3 - VIF and tolerance value for each item

From Table 9-3, all item indicators have a VIF value below the threshold of 5 and a tolerance value higher than the threshold of 2. The results indicate that collinearity does not affect the data.

Summary of the data purification steps

This research demonstrates the application of a five-step process of data purification. The findings from the statistical tests conducted for the data purification indicated that the data is suitable for PLS-SEM modelling. In Table 9-4, the key findings of the data purification test are summarised. The next stage of the data analysis will be used to identify the dimensions of the latent constructs and is discussed in the following sections.

Topic	Summary of topic findings	Decisions
Out-of-range Values	Visual inspection in Excel indicated no out-of-range values.	No action needed.
Missing Data	Missing completely at Random test indicated values are missing at random.	Missing data were imputed with Expectation-Maximisation Method.
Outliers	Mahalanobis distance test revealed that 11 cases were identified as being extreme outliers.	Cases were identified and omitted from the dataset.
Normality test	Mardia's coefficient indicated significant multivariate kurtosis and skewness. Assumption of multivariate normality not met.	Normality is not a problem for PLS-SEM hence, proceed with PLS-SEM.

Topic	Summary of topic findings	Decisions
Multicollinearity	VIF and tolerance examination suggested that multicollinearity does not pose any threat.	Multicollinearity is not a problem; proceed with PLS-SEM.

Table 9-4 - Key findings of the data purification test

9.2. Sample characteristics

The discussions about the sample characteristics are general statements made about the sample. No hypothesis testing was carried on the sample characteristics data as its not the purpose of seeking the sample characteristics data. Instead, the sample characteristics information aims to provide more details and context of the respondents and their organisations. Also, not all respondents completed the general and socio-economic aspect of the questionnaire. As a result, selective words are used in describing the sample characteristics.

To begin, the majority of the respondents surveyed, carry out the operational and managerial function of procurement. Although supply chain management as a field of study is relatively new compared to other disciplines in business and management, in Nigeria, the practice of purchasing/procurement has been in existence for some time while supply chain management is still in its early stage. The survey respondents make supply chain decisions in their organisations, and they have several titles which are specific to their organisation such as procurement manager, procurement lead, head of purchase, supply delivery lead, purchaser, director of procurement, general manager, senior buyer, procurement analysts. The majority of the respondent's business functions are related to handling strategic procurement; sourcing all indirect and commercial goods and services; placing orders and renegotiating with vendors; buying; health commodities supply chain management; managing suppliers and clients; and, strategic procurement policies and planning.

Regarding the type of relationships maintained with supply chain partners, seven respondents indicated that they maintain an only formal relationship with their partners with the remaining respondent indicating they maintain both formal and informal relationships with their partners. Furthermore, the respondents indicated that the main type of informal event that they meet with their partners are at business forums, training and conference, end of the year gatherings, supplier summits, business preview, vendor forum.

In relation to the type of risk that is most common in the respondents' supply chains, the natural and environmental risk was cited amongst the majority of the respondent. Also, the respondents indicated that transport-related risk, demand and supply, economic and financial risk, foreign exchange risk, internal operation risk, strikes, and political risk were common within their supply chains.

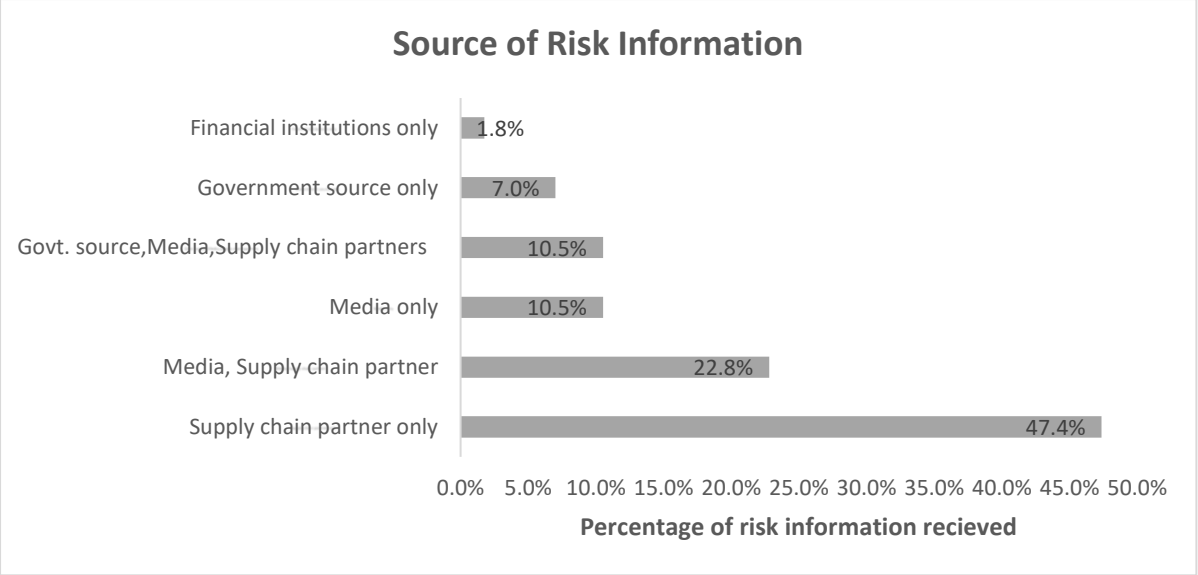

Figure 9-1 - Source of supply chain risk information

With respect to the source of risk information, Figure 9-1 presents the source of risk information as reported by the respondents. 47% of the respondents indicated that they rely only on their supply chain partners to receive supply chain risk information. This finding is important, as it underscores the use of informal relationships as the means of receiving supply chain risk information since supply chain contracts normally do not include the sharing of risk information. Although it is unclear why the respondents are not considering other sources of receiving risk information, it is outside the scope of this study, but could be a potential area for further investigation.

10.5% of the respondents indicated they rely on media only for risk information, 7% rely on a government source only, and 1.8% rely on financial institutions only. Although Nigeria is a less developed country, it would be insightful to investigate further why companies rely on media, government and media as the only source of supply chain risk information and not a supply chain member or a mix.

Nevertheless, 22.8% of the respondents indicated that they receive supply chain risk information from both media and supply chain partners. Also, 10.5% indicated that they receive supply chain risk information from government source, media and supply chain partners. Although receiving supply chain risk information does not automatically translate to sharing supply chain risk information, the social exchange theory (Section 3) discusses the nature of the exchange between social actors.

9.3. Evaluation of partial least squares-structural equation modelling results

This research follows the PLS-SEM modelling evaluation procedure suggested by Hair et al. (2019). The process in this thesis starts by assessing the reflective measurement models where the indicator loadings are examined. Next, after the indicator reflective measurement models assessment is the assessment of formative measurement models where the validity and reliability of the models are

assessed. The final step adopted for this research is the structural model assessment where the coefficient of determination, cross-validated redundancy measurement, and the statistical significance and relevance of the path coefficients are assessed. However, before the aforementioned evaluation, the hypothetical research model is presented in the next subsection.

9.3.1. Hypothetical research model

Based on the qualitative results and the subsequent propositions developed in Section 7, four hypotheses were developed and tested. The results are presented in section 8.5.2. The findings from the qualitative strand provided empirical justification to make predictions about the relationships between the constructs of relational closeness, collective prosperity, and relational incentive. Testing the hypotheses of latent constructs provided a basis to validate the qualitative strand of this mixed method study. The research hypotheses are presented in Table 9-5 and discussed in detail, subsequently. Due to the fact that the constructs have not been previously measured in supply chain management studies, literature from other fields such as psychology and marketing are used to discuss each construct. Although the context of this research is different, with ongoing interdisciplinary research, interesting insights can be gleaned.

Hypotheses:
H_1: There is a significant positive relationship between relational closeness and supply chain risk information sharing.
H_1a: There is a significant positive relationship between relational closeness behaviours and collective prosperity to supply chain risk information sharing.
H_2: There is a significant positive relationship between collective prosperity behaviours and supply chain risk information sharing.
H_3: There is a significant positive relationship between relational incentive and supply chain risk information sharing.

Table 9-5 - Summary of research hypotheses

Relational closeness behaviours and supply chain risk information sharing

Relational closeness is a construct that originates from the field of psychology that is usually associated with the strength of the emotional bond between people and the extent of the affection that each person has of the other person (Dibble, Levine and Park, 2011). Relational closeness also explains "the degree to which relationship partners are cognitively, emotionally, and behaviourally interdependent with one another" (Collins and Feeney, 2004). The construct of relational closeness is important, especially when investigating behaviours both in psychology and business. Feng and Magen (2016) investigated the extent to which relationship closeness predicts unsolicited advice and found that relational closeness and unsolicited advice were positively correlated.

Mende, Bolton and Bitner (2013) explained how relationship-specific attachment styles reflect customers' particular preferences for closeness and how they influence loyalty. Similarly, relational closeness was used by Paulin, Ferguson and Payaud (2000) to stressed that account managers who are close to their clients act as product experts and good financial advisors. Although relational closeness has not

previously been examined in the field of supply chain management, we build on the findings from the qualitative strand of this research together with the insight from other fields like disaster management, intelligence community; as presented in the literature section of this thesis (Mende, Bolton, and Bitner; 2013; Paulin, Ferguson and Payaud, 2000; Feng and Megan; 2016) to propose the following hypotheses:

H_1: There is a significant positive relationship between relational closeness and supply chain risk information sharing.

H_{1a}: There is a significant positive relationship between relational closeness behaviours and collective prosperity to supply chain risk information sharing.

Collective prosperity behaviours and supply chain risk information sharing

From general business collaborations and system theory, organisations need long-term and holistic strategies to managing relationships (Soosay, Hyland and Ferrer, 2008). In this regard, the concept of 'business community' depicting actors linked with a specific common interest (Colledge, 2005), which is extended to collective prosperity behaviours that promote specific interest such as supply chain risk information sharing to avoid disruption. This is due to understanding of collective prosperity between supply chain partners being more likely to produce a win-win solution to all parties (Colledge, 2005). Although collective prosperity has not been measured in supply chains, in a study by Bisung (2014) where communities face a common problem, collective action was found to be instrumental in addressing common environmental challenges. The collective action may not be conceived in the same way as collective prosperity in supply chain context, it can, however, be interpreted as an activity undertaken by a group of people or firms with similar interest for their collective benefit. Yet, the qualitative interviews conducted for this research revealed that the supply chain managers emphasised the importance of collective prosperity for the purpose of risk information sharing. As a result, the following hypothesis is proposed:

$H_{2:}$ There is a significant positive relationship between collective prosperity behaviours and supply chain risk information sharing.

Relational incentive and supply chain risk information sharing

Relational incentive is an important part of business relationships, especially in the context of Nigeria, as it provides an opportunity to extend business relationships beyond formal contracts. Norde, Ulas¸ Özen and Slikker (2016) observed that establishing the right incentive mechanisms helps in truthfully revealing private information. Levin (2003) however observed that incentives in a supply chain might take two forms: it may involve penalties for late delivery (as an example); or, a supply chain partner may be rewarded for being flexible in making the adaptation. The study by Sloof and Sonnemans (2011) found that available explicit incentive rightly does affect relational contracting. In the context of this study, the analysis of the data from the semi-structured interviews from the qualitative strand indicated

that relational incentive is an enabler to supply chain risk information sharing. Consequently, the following hypothesis is proposed:

H_3: There is a significant positive relationship between relational incentive and supply chain risk information sharing.

9.3.2. Indicator loadings

Based on the conceptual framework developed in section 7 of this thesis, three independent propositions are presented as hypotheses for testing in this section 8.17. The quantitative aspect of this study is aimed at investigating the extent to which relational behaviours enhance supply chain risk information sharing. The relational behaviours identified from the explorative aspect are represented as a latent construct of relational closeness, collective prosperity, relational incentive. These constructs, (Closeness, collective prosperity, inventive and supply chain risk information sharing) are measured using items from the questionnaire survey, which are known as indicators (Kock, 2015). The indicators of each of the constructs are presented in Table 9-6.

Construct	Indicator item	Code
Supply chain risk information sharing	It is expected that members in the supply chain keep each other informed about events or changes that may affect the other party	RISK_1
	Our partners keep us fully informed about issues that affect our business	RISK_2
	We provide information to our partner frequently and formally and not only according to the specific agreement;	RISK_3
	We share accurate risk-related information with our supply chain members; and,	RISK_4
	We are willing to share real-time information on demands with our suppliers.	RISK_5
Relational closeness	The relationship with our supply chain partners is close	CLOSE_1
	We and our supply chain partners disclose important information to each other	CLOSE_2
	We have a strong connection with our supply chain partners	CLOSE_3
	Our supply chain partners are our priority in our business	CLOSE_4
	We collaborate regularly with our supply chain partners	CLOSE_5
	We create informal events to meet with our supply chain partners	CLOSE_6
	Our relationship with our supply chain is important to our business;	CLOSE_7
	We consider our supply chain partners when making important decisions.	CLOSE_8
	Our business partners are likely to be awarded when they inform us about issues that affect our business;	INCNTV_1
	Our relationship with our partners would be negatively affected if they refuse to inform us about issues that would affect our business; and,	INCNTV_2

Relational incentive	When we work jointly or combine effort with our partners, we are happy to share the benefits between the two of us.	INCNTV__3
	Our business partners are likely to be awarded when they inform us about issues that affect our business	INCNTV_4
Collective prosperity	We consider the long-term benefit of our relationships;	PROS_1
	When making important decisions, we consider the going concern of our supply chain partners as well;	PROS_2
	We understand that a crisis that affects our partner's supply can be passed on to us;	PROS_3
	We are willing to inform our partner of dangers that can affect them; and,	PROS_4
	We are willing to collaborate with our partners to address a common issue related to our supply chain.	PROS_5

Table 9-6 Constructs items labelling

The responses to the indicators (questions), using the Likert scale, provided numerical data to proceed with the PLS-SEM analysis. According to Hair, Ringle and Sarstedt (2011), PLS-SEM estimates loadings of the items of indicator variables for the constructs using prediction of the endogenous constructs from the responses; which also contribute to the path coefficients. PLS-SEM use reflective indicators, and they are represented as single-headed arrows pointing from the latent construct, which is in a circle, outward to the indicator items in small rectangular boxes; the associated coefficients between the latent construct and the indicator item is called outer loadings in PLS-SEM (Hair, Ringle and Sarstedt, 2011).

In this research, all indicator items are reflective of the latent constructs. The indicator items all share a common theme of the latent construct, and as such, they can be interchangeable within the order they are presented as explained by Coltman *et al.*, (2008); "*adding or dropping an item does not change the conceptual domain of the construct"*. Furthermore, taking into account each indicator reliability is important in PLS-SEM, and as a result, Hair, Ringle and Sarstedt (2011) stress that indicator with outer loading less than 0.4 (low indicators loading) should be removed. Consequently, a decision was taken to delete indicators with loading below 0.4 in this research. The remaining items that are loading above 0.5 are presented in Figure 9-2. Interpretation of each construct, and the remaining outer loading of the reflective indicator are also discussed accordingly.

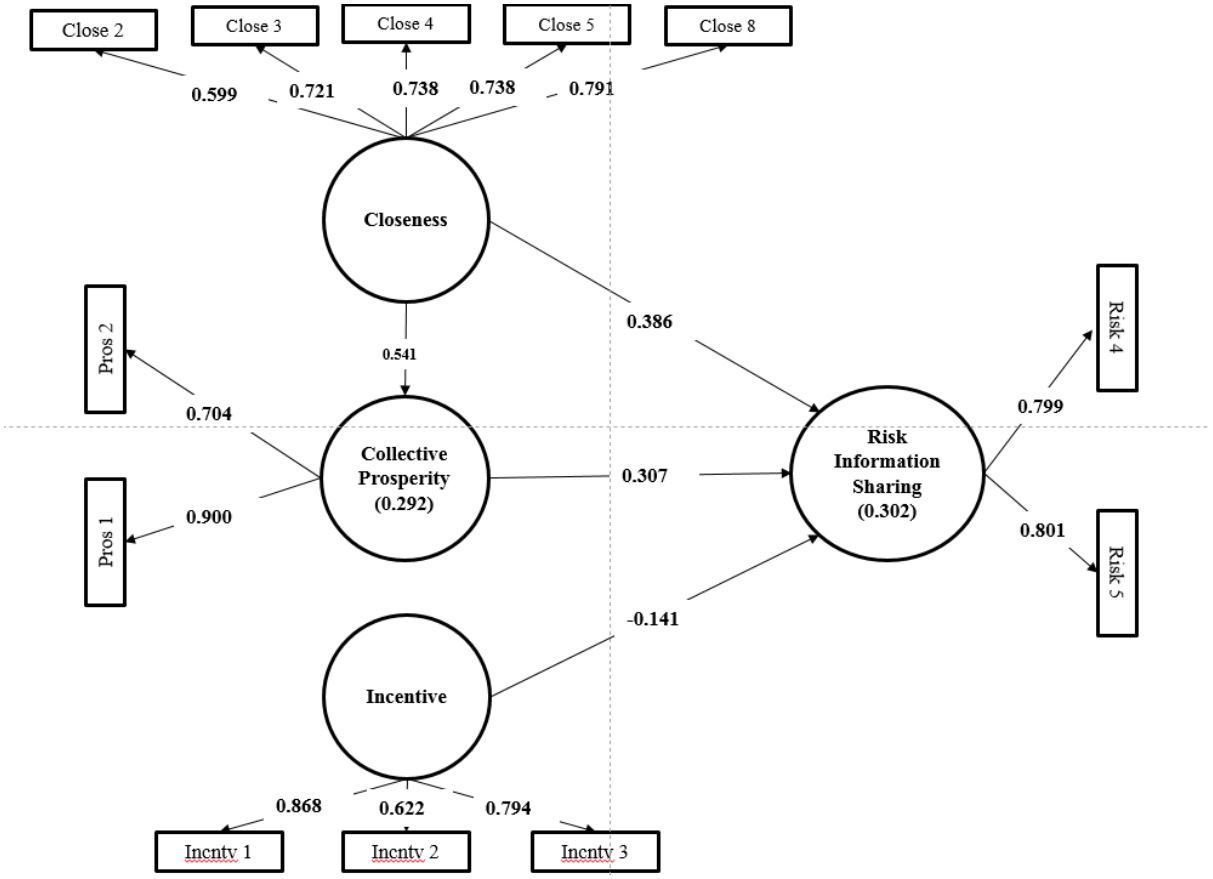

Figure 9-2 - Smart PLS-SEM result

Factor i: Risk information sharing

Two of the items of the reflective indicators for the latent construct RISK had outer loadings above .40 (RISK_4 and RISK_5) which each have outer loading of 0.799 and 0.801 respectively. In contrast, RISK_1, RISK_2 and RISK_3 had outer loading below 0.4. The initial computation identified item RISK_1 have loading less than 0.40. Consequently, the items were removed. RISK_4 and RISK_5 ask the respondent to chose in Likert scale whether they agree with the following statements: (RISK_4) We share accurate risk-related information with our supply chain members; and, (RISK_5) We are willing to share real-time information on demands with our suppliers. As mentioned earlier, Coltman et al., (2008) argued that Adding or dropping an item (RISK_4 and RISK_5 in the context of this research) does not change the conceptual domain of the construct.

Item	Risk information sharing	Factor Loadings
	Items (in Brief)	
RISK_1	It is expected that members in the supply chain keep each other informed about events or changes that may affect the other party	Dropped
RISK_2	Our partners keep us fully informed about issues that affect our business	Dropped
RISK_3	We provide information to our partner frequently and formally and not only according to the specific agreement;	Dropped
RISK_4	share accurate risk-related information	0.799
RISK_5	willing to share real-time information	0.801

Table 9-7 - Indicator loadings of supply chain risk information sharing construct

Factor ii: Relational Closeness

Relational closeness was measured using 8 reflective indicators. However, five items had outer loading above 0.40, while three items had low loadings. The five items with loading above 0.40 are presented in Table 9-8. The reflective indicators with low outer loading that were removed are CLOSE_1, CLOSE_6 and CLOSE_7. Relational closeness in this study is conceptualised as the extent of relational bond between supply chain members which increases risk information sharing. The relational closeness measurement was adapted from the Dibble, Levine and Park (2012) unidimensional relationship closeness scale.

Item	Relational Closeness	Item Loadings
	Items (in Brief)	
CLOSE_1	We have a strong connection with our supply chain partners	Dropped
CLOSE_2	supply chain partners disclose important information to each other	0.599
CLOSE_3	strong connection with our supply chain partner	0.721
CLOSE_4	supply chain partners are a priority in our business	0.738
CLOSE_5	regularly collaboration among supply chain partners	0.738
CLOSE_6	We create informal events to meet with our supply chain partners	Dropped
CLOSE_7	Our relationship with our supply chain is important to our business	Dropped
CLOSE_8	Consideration of supply chain partners when making important decisions	0.791

Table 9-8 - Indicator loadings of relational closeness construct

Factor iii: Relational Incentives

The concept of relational incentive used in this study is adapted from Maestrini *et al.*, (2018) as the extent to which risk information is shared due to increasing relational benefits and rewards provided by supply chain partners. After the running the PLS-SEM computation, three items were retained as presented in Table 9-9 while INCNTV 16 was removed due to low outer loading.

Item	**Relational incentive**	**Items Loadings**
	Items (in Brief)	
INCNTV_1	Partners are likely to be awarded when they inform	0.868
INCNTV _2	Relationship with partners would be negatively affected if they refuse to inform us about risks	0.622
INCNTV _3	working jointly or combine effort with partners promotes sharing the benefits between partners	0.794
INCNTV _4	Our business partners are likely to be awarded when they inform us about issues that affect our business	Dropped

Table 9-9 - Indicator loadings of relational incentive construct

Factor iv: Collective Prosperity

Collective prosperity construct is measured in this research using four reflective indicators. As presented in Table 9-10, the indicator item of PROS_1 and PROS_2 outer loading of 0.704 and 0.900, respectively. However, PROS_3 and PROS_4 have low outer loading and were subsequently removed. Collective prosperity construct was developed in this research to mean an obligation to carry out actions

in the interest of supply chain members. In the context of this research, collective prosperity is a relational behaviour that explains voluntary actions taken to share risk information for the benefit of mitigating supply chain disruption.

Item	Collective Prosperity	Factor Loadings
PROS_1	Consider the long-term benefit of relationships	0.704
PROS_2	Willingness to inform partner of dangers that can affect them	0.900
PROS_3	We understand that a crisis that affects our partner's supply can be passed on to us	Dropped
PROS_4	We are willing to inform our partner of dangers that can affect them; and,	Dropped
PROS_5	We are willing to collaborate with our partners to address a common issue related to our supply chain.	Dropped

Table 9-10 - Indicator loadings of collective prosperity construct

9.3.3. Assessment of formative measurement model validation

This section reports on the examination of the validity and reliability of the latent constructs of this study. The assessments of the validity and reliability precede the structural model in order to create a strong basis for the discussions afterwards. This study follows the steps suggested by Hair et al. (2016) to examine the validity and reliability of the measurement model, which requires the following:

- Examining internal consistency (Cronbach's alpha, and composite reliability),
- Examining convergent validity (indicator reliability and average variance extracted), and
- Examining discriminant validity

Measurement type	Rule
Reliability:	
Internal consistency reliability:	Composite reliability should be higher than 0.70 (in exploratory research, 0.60 to 0.70 is considered acceptable).
Indicators reliability:	The indicator outer loading should be higher than 0.70. Indicator with outer loadings between 0.40 and 0.70 should be considered for removal only if the deletion leads to higher AVE.
Validity:	
Convergent validity:	AVE should be higher than 0.50.
Discriminant validity:	Use HTMT criterion of 0.85 to assess discriminant validity in PLS-SEM.
Source: Hair et al. (2017: 122) and Henseler, Ringle and Sarstedt (2012).	

Table 9-11 - Rules for reflective model measurement evaluation

Following the rules suggested by Hair et al. (2019) as presented in Table 9-11, the internal consistency of the reflective model was examined using a composite reliability test. Results of the internal consistency alongside the entire reflective measurement model are presented in Table 9-12.

	RISK	CLOSE	PROS	INCNTV
Number of Items	2	5	3	2
Composite reliability	0.780	0.842	0.788	0.809
Cronbach's alpha	0.437	0.769	0.490	0.667
Joreskog rhô_a	0.437	0.788	0.565	0.750
AVE	0.640	0.653	0.519	0.590

Table 9-12 - Reliability and validity statistics

In Table 9-12, the estimates show that using composite reliability as the measure of internal consistency reliability; all the latent constructs are reliable with composite reliability estimates greater than 0.70. Although Cronbach alpha is one of the popular reliability tests, Hair et al. (2019) observed that it is a less predictive measure of reliability and explained that "*the items are weighted based on the construct indicators' individual loadings and, hence, this reliability is higher than Cronbach's alpha"* (Hair et al., 2019).

From Table 9-12, the composite reliability for all the latent indicators was above the threshold of 0.70. Relational closeness has the highest composite reliability value of 0.842, while risk information sharing has the lowest composite reliability value of 0.780. However, the Cronbach's alpha estimates and Joreskog rhô_a test for composite reliability for supply chain risk information sharing and collective prosperity were below the threshold of 0.6 (Hair et al., 2019). Notwithstanding the low-reliability score of the Cronbach's alpha estimates and Joreskog rhô test, the composite reliability test is a well-established and acceptable measure of reliability (Hair et al., 2019).

The next result of the reflective measurement models is the convergent validity test. The convergent validity measures the extent to which the latent constructs of the model converges to explain the variance of its items that are measured (Hair et al., 2019). The Average Variance Extracted (AVE) was the metric used to evaluate convergent validity. The acceptable AVE is 0.50 or higher, which implies the variance of the item is at least 50% of the constructs. From Table 9-12, the AVE is 0.640 for risk information sharing, 0.653 for relational closeness, 0.519 for collective prosperity, and 0.590 for relational incentive behaviours.

The next test after the convergent validity test is the discriminant validity test. The discriminant validity test - which is *the extent to which a construct truly differs from other constructs by empirical standards* (Hair et al., 2019). The discriminant validity test was conducted using the Heterotrait-Monotrait Ratio (HTMT). The rule of thumb for the HTMT is 0.90 (Hair et al. 2019). Table 9-13 presents a matrix of the HTMT test. The results of applying the test indicated that collective prosperity is not empirically distinct from risk information sharing, while collective prosperity is not empirically distinct from the relational incentive. Notwithstanding, the items used in measuring the risk information sharing was adopted from Li et al., (2005), while those of collective prosperity and relational incentive where developed from the qualitative interviews and literature.

Heterotrait-Monotrait Ratio (HTMT)				
	RISK	PROS	CLOSE	INCNTV
RISK				
CLOSE	0.830			
PROS	0.919	0.816		
INCNTV	0.294	0.985	0.535	

Table 9-13 - Heterotrait-Monotrait Ratio (HTMT)

9.3.4. Assessment of structural model result

Path coefficient

Path coefficient is the estimate obtained after applying the PLS-SEM algorithm, and it represents the hypothesised relationships amongst the constructs (Hair et al. 2019). This study thereby estimated the individual path coefficient using PLS-SEM. The standardised values of path coefficients are approximately between ±1, with +1 representing strong positive relationships, and strong negative relationships for values of -1 (Hair et al. 2017). Values close to 0 indicate weaker relationships. Empirical *t* values and *p* values were computed using the bootstrap standard error. The guidelines according to Hair et al. (2019), is that the coefficient is statistically significant at a significance level of 1.65 (significance level =10%), 1.96 (sig. level= 5%), and 2.57 (Sig. level = 1%).

Coefficient of Determination (R^2)

The Coefficient of Determination (R^2) is the most commonly used measure of examining a structural model (Hair et al., 2017). R^2 is a measure of the predictive power, and it represents the amount of variance in the endogenous constructs, which are explained by all the related exogenous constructs (Hair et al., 2017). R^2 values range between 0.0 to 1.0, with higher levels indicating higher levels of predictive accuracy. Although the rule of thumb of 0.75, 0.50, 0.25 indicating strong, moderate and weak is popular in fields such as marketing, in other disciplines such as consumer behaviour, values of 0.20 are considered high (Hair et al., 2019). This study used the Coefficient of Determination to assess the structural equation models.

Effect size (f^2)

Another estimate that can be carried in addition to the Coefficient of Determination in evaluating values of all endogenous constructs is the effective size – referred to as the f^2 test, which can be carried out to specify the effect when an exogenous construct is omitted from a structural model. Guidelines for assessing f^2 according to Hair et al. (2019) are the values of 0.02, 0.15, and 0.35 representing small, medium and large effects respectively. This study estimates the effective size using the Smart PLS and considers the guideline values suggested by Hair et al. (201).

Predictive Relevance (Q2)

The Stone-Geisser's Q^2 is another means of assessing the PLS path model's predictive accuracy, which is based on sample re-use technique called blindfolding (Hair et al., 2017). The Stone-Geisser's predictive relevance test combines out-of-sample prediction and sample explanatory power, rather than measuring only out-of-sample prediction. In order to serve as an indicator of predictive accuracy, the guideline is that Q2 should be larger than zero for a specific endogenous construct (Hair et al., 2019). The rule of thumb is that Q2 values should be higher than 0.0, 0.25 and 0.50, which indicates small, medium

and large predictive relevance of the PLS-path model. This study assessed the predictive relevance of the models while interpreting the structural model.

Structural model analysis

This section examines the relationship between the latent construct in order to report the findings of the structural analysis. According to Hair et al. (2019), the significance of path coefficients and R^2 and are the main criteria for evaluating the structural model. Nevertheless, this study adopted the five steps for assessing PLS-SEM structural model set by Hair et al. (2019) which are:

- Assessment of the structural model for collinearity issues;
- Path coefficient, i.e. assessment of significance and relevance of the structural model relationship;
- Assessment of the level of R^2;
- Assessment of the effect size f^2; and,
- Assessment of predictive relevance Q^2.

Assessment of collinearity has been previously discussed in the data purification stage when the test for normality was conducted. The collinearity test indicated that none of the latent constructs or their items has a problem of multicollinearity. In the next subsection, the factor loading is presented and analysed.

Assessment for collinearity

To assess the Smart PLS result, it starts by analysing the structural model for collinearity issues by assessing the VIF values of all the sets of the endogenous constructs in the model. From the results in Table 9-14, all combinations of the predictor (endogenous) construct presented alongside their VIF values. Specifically, the study assesses the following collinearity between the constructs: PROS, CLOSE and INCNTV as predictors of RISK; CLOSE as a predictor of INCNTV. As shown in Table 9-14, all VIF values are below the threshold of 5; indicating the absence of collinearity among the predictor constructs in the structural model, and the examination of the result can continue.

Inner VIF Values				
	RISK	PROS	CLOSE	INCNTV
RISK	-	-	-	-
PROS	1.646		-	-
CLOSE	1.463	1.000	-	-
INCNTV	1.400	-	-	-

Table 9-14 - VIF values in the structural model

Significance testing results of structural path coefficients

Statistical significance testing is essential in assessing the indicator weights. However, since PLS-SEM is a nonparametric method, bootstrapping is used to ascertain the statistical significance of the structural

path coefficients (Hair et al., 2019). Sometimes indicator weights may be statistically insignificant, according to Hair et al., (2019) this, does not completely indicate poor measurement model quality. Instead, outer loadings should be considered in such an instance. Figure 9-3 presents the bootstrapping results showing the significance of the structural path coefficients.

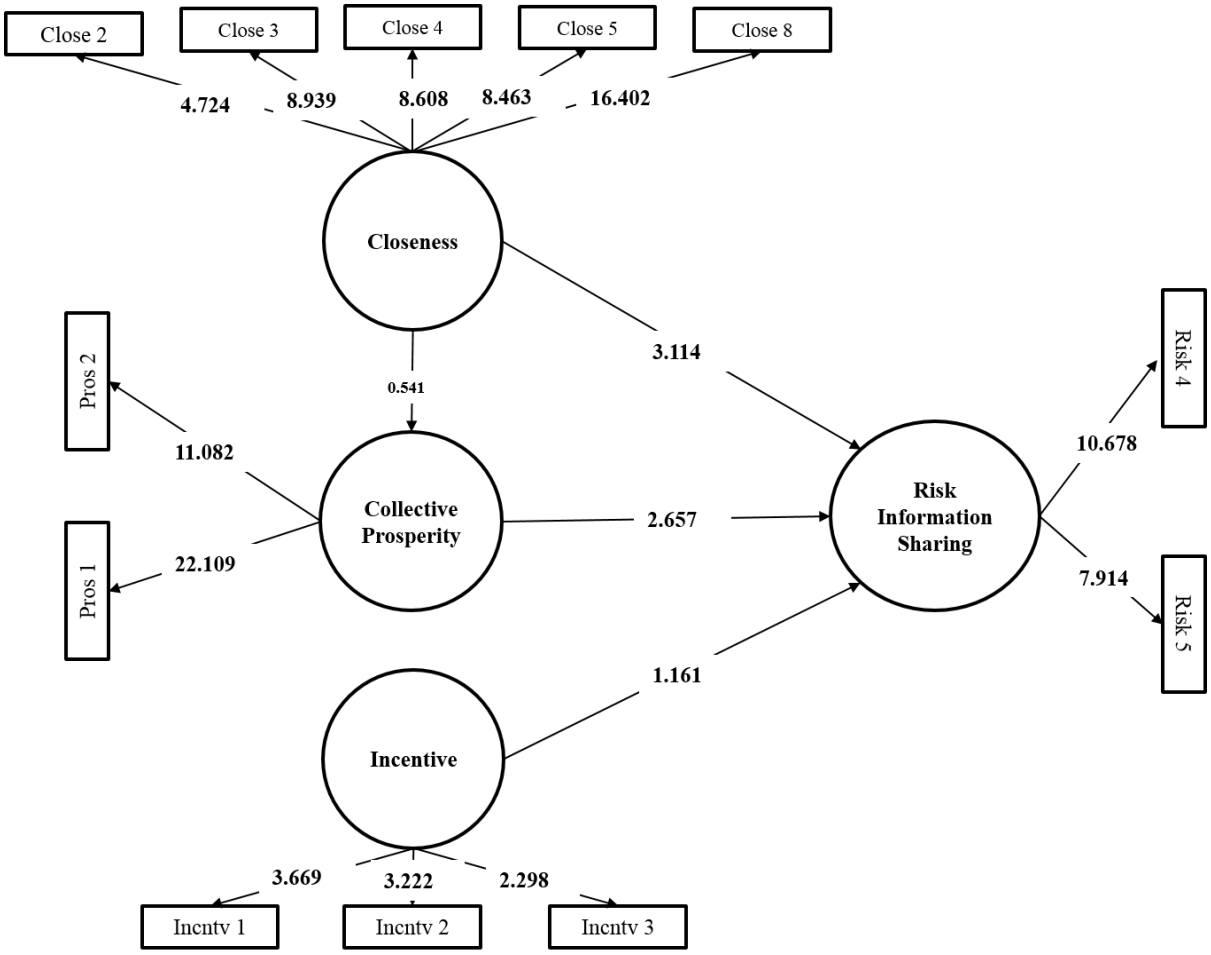

Figure 9-3 - Bootstrapping result in the modelling window

The path coefficient is the numbers on them (the lines), and they reveal how strong the effect of one variable on the other (Wong, 2013). In order to assess the statistical significance of the number on the arrows (structural path coefficient), a procedure called Bootstrapping is carried out. Bootstrapping is a procedure that randomly draws subsamples with replacement from the original data set (Hair et al., 2017). Some path coefficient had low values (e.g., PROS→RISK); however, the Bootstrapping will establish whether they are statistically significant or not. Table 9-15 and Table 9-16 present a summary of the path coefficient estimates t values, p values, and confidence intervals of the structural models total and indirect effects. At 5% significance, this study finds that all the relationships in the structural model are significant, except INCNTV→RISK (0.246). Otherwise, PROS→RISK was significant with a *p*-value of 0.008, CLOSE→PROS was significant with *p*-value 0.000, and CLOSE→SCRIS was significant with *p*-value 0.002.

Total effect

The total effects examination evaluates how strongly each of the formative constructs (CLOSE, PROS and INCNTV) influences the main target variable (RISK), as well as the total effect of CLOSE on PROS. From Table 9-15, the variable CLOSE has the strongest effect on PROS (0.552) followed by the total effect of CLOSE on SCRIS (0.541). Also, the total effect of PROS on SCRIS was 0.307 while there was a negative total effect of INCNTV on RISK.

Code	Relationships	Total effect	97% Confidence interval	t Value	p Value	Significance ($p < 0.05$)
H_1	CLOSE → SCRIS	0.541	0.736	4.490	0.000	Yes
	CLOSE → PROS	0.552	0.675	7.909	0.000	Yes
H_2	PROS → SCRIS	0.307	0.479	2.659	0.008	Yes
H_3	INCNTV → SCRIS	-0.144	0.173	2.659	0.244	No

Table 9-15 - Total effects results

Indirect (Mediating effect)

The indirect result is based on the analysis of the mediating relationship that collective prosperity has between relational closeness and supply chain risk information sharing. From the result in Table 9-16, the empirical *p*-value CLOSE-> PROS-> RISK is significant ($p = 0.008$) confirming that PROS mediate CLOSE and RISK. Consequently, the indirect effect CLOSE-> PROS-> RISK is 0.166.

Code	Relationship	Indirect effect	97% Confidence interval	*t* Value	*p* Value	Significance ($p < 0.05$)
H_{1a}	CLOSE->PROS-> SCRIS	0.166	0.266	2.641	0.008	Yes

Table 9-16 - Specific indirect effect

Assessment of the level of R^2

Further, an examination of the R^2 of the endogenous latent variable is presented in Table 9-17. The R^2 measures the variance, which provides a measure of the model's explanatory power and as a result, it explains each of the endogenous constructs. Following the rules of thumb by Hair et al. (2017), an R^2 value for RISK (0.302) is considered weak. Also, R^2 for the effect of CLOSE on INCNTV (0.292) will be considered weak. Although the R^2 supply chain risk information sharing is statistically weak, Hair et al., (2019) contended that R^2 is influenced by the number of predictor constructs and that the acceptable R^2 values are based on the context.

Code	R Square	R Square Adjusted
RISK	0.302	0.279
CLOSE	0.292	0.285

Table 9-17 - Coefficient of determination result

Assessment of effective size of f^2 and predictive relevance Q^2

The f^2 effect size is used to measure the effect of removal of a particular predictor construct and how it affects the endogenous construct's R^2 value (Hair et al., 2019). The f^2 effect size ranks the order of which the predictor constructs are relevant in explaining the exogenous constructs (Hair et al., 2019). The rule is that 0.02 indicates a small effect, 0.15 a medium effect, and 0.35 a large f^2 effect. From Table 9-18, the largest effect is between CLOSE-> PROS with f^2 value of 0.413. However, the relationship between CLOSE -> RISK is considered small with f^2 value of 0.146. Similarly, the relationship between PROS -> RISK and INCNTV -> RISK are all considered small with f^2 value of 0.082 and 0.021, respectively.

Relationship	f^2	Q^2
CLOSE->PROS	0.413	-
CLOSE -> RISK	0.146	-
PROS -> RISK	0.082	-
INCNTV -> RISK	0.021	-
PROS	-	0.170
RISK	-	0.159
CLOSE	-	-
INCNTV	-	-

Table 9-18 - Construct predictive relevance

To calculate the Q^2 value, a blindfolding procedure was conducted, which is a resampling technique that systematically deletes data points and provides prognosis by predicting every data point of the indicators (Hair et al., 2019). Table 9-18 presents the model predictive relevance with respect to each endogenous construct in the structural model. As shown, the Q2 value of INCNTV and RISK are above zero thresholds (Hair et al., 2019). This implies that the path model has predictive significance for a selected reflective endogenous construct (Hair et al., 2019).

9.4. Summary of chapter

This chapter presents the quantitative data analysis, hypotheses testing together with the discussions of the results. Data purification on the cases was carried out using SPSS. The outcome of the data purification procedure indicated that the data was skewed and had a problem of kurtosis, which made the data unsuitable for the application of a covariance-based structural equation modelling technique. As a result, since PLS-SEM techniques accommodate data that does not meet the normal distribution criteria, it is, therefore, chooses as the best technique that suits the nature of data of this research. Missing data test was conducted using the Little's (1988) Missing Completely at Random while expectation

maximisation was used to replace missing values. Mahalanobis distance test indicated 11 cases from the original 108 had extreme values from the mean score, and they (11 cases) were deleted from the data set, bringing the cases suitable for analysis to 97. Test for multicollinearity indicated that the data had no problem of collinearity.

In the second part of the quantitative data analysis, the PLS structural model analysis was performed, and the research hypotheses were evaluated. Mediating effects were also discussed. Although the relationships between some constructs were supported, the relationship between relational incentive and supply chain risk information sharing was not supported. The relationship between relational closeness and supply chain risk information sharing was, however, supported. Furthermore, the relationship between relational closeness and relational incentive was found to be significant and supported. Additionally, the relationship between collective prosperity was also supported.

The results presented insight and empirical evidence into the extent to which relational behaviours of closeness, incentive and collective prosperity enhance supply chain risk information sharing from both the quantitative results and mixed method discussions. In the next chapter, the discussion of the mixed method results is presented.

10. Discussion

This section presents the discussion, which focuses on the mixed method result. As a mixed method study, it is vital to present the discussion of the mixed method result, which explains the extent to which the quantitative result generalised to the qualitative findings. The qualitative phase was designed in section 7, and the findings were presented in section 8. Additionally, the quantitative phase was designed in section 9 and presented in section 10. Next, the mixed method discussion is hereby presented in this current section. Also included in the section is a brief discussion of the research methodology and method, the research outcome, limitation, and areas for future work.

10.1. Research methodology and methods

This research is aimed at investigating relational behaviours and supply chain risk information sharing. The research problem of this thesis which concerns the gap in the literature on how relational behaviours enhance supply chain risk information is further necessitated by the context of this research which ultimate goal is to provide new and valuable knowledge to the discipline of supply chain management. As a result, the pragmatism philosophy is considered appropriate as it guides the researcher to focus on the research problem whilst making a choice of the method to use for this research. Thus, a definition of methodology which raises all sorts of philosophical questions about what is possible for researchers to know and how valid their claims to knowledge might be is essential in achieving the aim of this research.

The salient philosophical questions of what is possible for the researcher to know about relational behaviours beyond the Nigerian context and how valid are the claims that will be presented are important questions in the mind of the researcher. With resource constraints, the choice of methods and depth of valid knowledge that can be created by the researcher is further justified with the philosophy (pragmatism) adopted by the researcher which focus on solving the problem. Consequently, mixed method research which starts with an exploratory strand that seeks in-depth knowledge from selected supply chain managers in Nigeria on how relational behaviours enhance supply chain risk information. A follow-up confirmatory quantitative strand was conducted by surveying members of the Chartered Institute of Procurement and Supply Nigeria branch.

10.2. Research outcome

The research outcome of the qualitative exploratory strand found three new relational behaviours that enhance supply chain risk information. The relational behaviours are relational closeness, collective prosperity and relational incentives. Research propositions were then developed in the light of the three relational behaviours. In line with the mixed method exploratory design adopted for this research, the quantitative strand was carried out. The Findings from the quantitative strand reveals that two of the constructs, relational closeness and collective prosperity have a significant influence on supply chain

risk information. However, the relationship between relational incentive and supply chain risk information sharing was not supported. In the next sub-section, the mixed method result is discussed.

10.3. Analysis of the quantitative result

PLS-SEM was used to investigate the research question of this thesis and test the hypotheses. A bootstrapping procedure was conducted after evaluating the structure measurement and the structure model. Although Chin (2010) suggests 500 re-sampling during bootstrapping, Hair et al. (2019) stressed that "re-sampling should not be less than 5000 sample". This research followed the suggestion by Hair et al. (2019).

The SmartPLS software was used to examine the structural equation model. From the PLS Result, three out of the four hypotheses were supported. In the following sections, the discussions of the PLS findings are elaborated.

H1: There is a significant positive relationship between relational closeness behaviours and supply chain risk information sharing.

The PLS bootstrapping results demonstrated that relational closeness is found to have a significant positive relationship with supply chain risk information sharing. The score is as follows (p-values=0.000, t-values=4.490); therefore, hypothesis H1a was supported. The result can be interpreted as follows; supply chain decision-makers surveyed are of the view that the closer they are to their supply chain partners, the more they will be willing to share supply chain risk information. Although there is no study in the field of supply chain management that has investigated the association between relational closeness and supply chain risk information sharing, the study of Nielson (1998) found a positive relationship between supplier closeness and information sharing. Equally, the result of this research supports the finding of Feng and Megan (2016), which reported that relationship closeness increases unsolicited advice (Feng and Megan, 2016).

Furthermore, since most supply chain risk information sharing is a voluntary act that is not bound by a formal contract but by an informal social relationship, an increase in the level of relational closeness can positively affect the level of risk information sharing among supply chain members. Also, in the field of marketing, the concept of closeness is popular –marketing managers advised of getting closer to their customer (Nielson, 1999). The results from this research are consistent with the social capital theory and social exchange theory where closeness can promote social bonds which, according to Wilson (1990), "are the glue that holds individuals together". In the argument put forward by Wilson (1990), closeness is associated with self-disclosure. In the findings of this research, supply chain risk information sharing can be regarded as a form of self-disclosure about an event, that has the potential to disrupt a supply chain, and thus, the closeness between supply chain members enhance "disclosure" about risky events.

H1a: There is a significant positive relationship between relational closeness behaviours and collective prosperity behaviours to supply chain risk information sharing.

Supply chain risk necessitates all members in the supply chain to deploy strategies that will mitigate the risks or reduce the impact of disruptions. The proposition from the qualitative strand argued that the closer supply chain partners are, the more they strive to work for their collective prosperity so that they can enhance supply chain risk information sharing. The PLS result indicated that collective prosperity mediates the relationship between relational closeness and supply chain risk information sharing (p-value=0.008, t-value= 2.641). Therefore, the hypothesised mediation relationship of relational closeness through collective prosperity to supply chain risk information sharing was supported. The positive relationship could be attributed to the shared understanding of supply chain partners risk information needs as a result of the closeness of the relationship which is underscored by the indirect effect that can be caused by a disruption to a partner. Hence, for partners that are close to each other, they understand each other's risk information needs. Also, they understand that their supply chain will be indirectly affected by a disruption; they will support supply chain risk information sharing with their partners.

H2: There is a significant positive relationship between collective prosperity behaviours and supply chain risk information sharing.

The PLS result indicated that there is a positive relationship between collective prosperity and supply chain risk information sharing (p-value=0.008, t-value= 2.659). Therefore, the hypothesised relationship between collective prosperity and risk information sharing is supported. The interpretation of this result is that supply chain managers with a view of collective prosperity will share risk information with their supply chain partners. The result of this research is consistent with the findings of Bisung et al. (2014). In their study, they found that investment in building social capital benefits for collective action to address common challenges. Similar to this research, a sense of collective prosperity between supply chain members was found to enhance risk information sharing, which can play a role in mitigating supply chain disruption. In addition, the results support the social capital argument of a "collective good" between actors at the individual and community/organisational level. In order for firms to mitigate disruption in their supply chain, risk information sharing is enhanced due to the expectation of collective prosperity when supply chain partners work together. Further, Rahn and Transue (1998) observed that collective economic expectations become better as pessimism declines. This may imply, in the context of this research findings, that collective prosperity may have the potential to reduce pessimism in sharing supply chain risk information.

H3: There is a significant negative relationship between relational incentive and supply chain risk information sharing.

The hypothesised relationship between relational incentive and supply chain risk information sharing indicate a non-significant negative relationship. The result shows the path coefficient p-value and t-

value of as (path coefficient -0.116, p-value=0.244, t-value 2.659). The result is negative and not significant in supporting the hypothesis.

10.4. Discussion of mixed method results

Creswell (2014) recommends that interpretation of mixed method results should be in the discussions and should be preceded by the qualitative findings, the use of qualitative findings (e.g. development of new quantitative instrument) and then the quantitative findings. Creswell (2014) further warned against comparing the two results; rather, the strategy is to assess if the qualitative themes can be generalised to a larger sample. In this thesis, whilst attempting to implement the mixed method strategy, the first point of contact between the qualitative findings and the quantitative strand was when the qualitative result was used to develop the quantitative instrument (Section 6). In this current section, the purpose of presenting the mixed method findings is to explain the relative prevalence of the qualitative themes in the lager quantitative sample, thereby discussing the importance of different dimensions of the research findings (Creswell and Clark, 2011). As a result, the mixed method approach allows the creation of findings, which the individual approaches (i.e. qualitative or quantitative) may not reveal individually.

Additionally, for the purpose of the mixed method findings, a meta-inference was conducted to examine "whether the follow-up quantitative strand provides a more generalised understanding of the problem than the qualitative database alone" (Creswell and Clark, 2011). Consequently, two discussions are made:

1. Assessment of the extent to which the quantitative findings generalised the qualitative result; and,
2. Examining how the problem is better understood from the qualitative and quantitative results.

10.4.1. How does the quantitative result generalise the qualitative result?

The qualitative result of this research originated from semi-structured interviews aimed at investigating how relational behaviours enhance supply chain risk information sharing. The interview was transcribed and coded in patterns and was further analysed to bring out themes that explain how relational behaviours enhance supply chain risk information sharing. Subsequently, propositions were developed based on qualitative data and past empirical literature. Yet, instruments were developed from the qualitative results and past literature in order to carry out the quantitative aspect of this research. The instruments were then administered to members of the Chartered Institute of Procurement and Supply in Nigeria. Partial least squares structural equation modelling was used to analyse the results. To answer the mixed method question, how does the quantitative result generalise the qualitative result, three of the propositions from the qualitative strand are discussed alongside the hypothesis test from the quantitative strand.

Relational closeness

This research found that relational closeness enhances supply chain risk information sharing. The theme "relational closeness" emerged from the semi-structured interviews with supply chain managers. On the quantitative phase, questionnaire items were used to measure relational closeness which asked the respondent to choose on a scale of 1 to 7 the level which they disclose important information about each other, the level of connection between them and their supply chain partners, the level which their supply chain partners are their priorities, the level of collaboration, the extent which they create an event to meet with their supply chain partners and the extent which they consider each other when making important decisions.

The result of the total effect of the structural model showed that 54% of the respondents supported that proposition that relational closeness enhances supply chain risk information sharing (p-values=0.000, t-values=4.490). This research provided additional information in relation to the context of relational closeness. For example, the qualitative data highlighted how supply chain partners are open to informal options that will bring them closer to their partners to gain benefits. As a result, relational closeness is not only for the purpose of risk information sharing but also as a tactic that will increase the outcome of the relationship – both financial and non-financial.

Additionally, dimensions such as obligation (an element of social exchange theory) were better understood after the qualitative interviews, as it demonstrated that relational closeness could create an obligation to share risk information. Although the concept of obligation was not directly asked in the questionnaire, for the purpose of mixed method analysis, it could be argued that the extent of the relational closeness effect on risk information sharing may have arisen due to obligation.

Furthermore, despite a larger sample size with the diverse business structure being used in collecting data for the quantitative phase as compared to the qualitative phase, the quantitative findings with regards to relational closeness can be generalised to all the samples of qualitative strand despite the differences of the sample cases. This indicates that both cases (qualitative and quantitative) agree on the role of relational closeness in enhancing supply chain risk information sharing in Nigeria. With insecurity as the leading event that disrupts supply chains in Nigeria, this finding underscores efforts carried out by the firms interviewed, and an affirmation of the behaviour by the larger sample from the quantitative strand.

Collective prosperity

In the context of this research, collective prosperity is a relational behaviour (construct) that explains voluntary actions taken to share risk information for the benefit of mitigating supply chain disruption. The themes that emerged both from the qualitative and quantitative data suggest that establishing a sense of collective prosperity does enhance supply chain risk information sharing. The quantitative data

supported the hypothesis (p-value=0.008, t-value= 2.659). In the factor loading of the items measuring collective prosperity, the item measuring long-term benefits of relationship loaded strongly at 88%. However, the total effect was weak at 29%. The qualitative result further strengthened the quantitative results by bringing more context into the result. For instance, the long-term benefit in one of the cases implies that a partner is willing to incur some short-term loses or forfeit windfall profit to maintain long-term relationships (interview with Company 5). Yet, one of the interviewees stressed the importance of making partners see the relationship as a system and as a project – all of which indicates collaboration to succeed by sharing risk information. As a result, from the mixed method discussions, both results indicated that collective prosperity enhances risk information.

Further, the mixed method discussions provide a basis to assess collective prosperity from both qualitative and quantitative data. For instance, while the qualitative data presented evidence that supply chain managers consider the long-term prosperity of their relationships, which enables them to share risk information, the quantitative phase provided an opportunity to examine the qualitative data explicitly within a larger study. Notwithstanding, the quantitative result does not provide information about the reasons for the weak effect between the two relationships.

Relational incentives

The result from the qualitative phase indicated that relational incentives are an enabler of supply chain risk information sharing. However, the quantitative result did not find any statistical significance of the relationship between relational incentives and supply chain risk information sharing. The subject of relational incentive can be considered a "grey area" that several ethical and legal aspects which may otherwise be subject to abuse. As a result, the reasons for the lack of support for the hypothesis may not be known from this research alone. However, it is clear that the qualitative interview provided an opportunity for the supply chain managers to explain how they perceive the risks that affect their supply chains and the relational incentives they give to receive risk information about their supply chain. Yet, the quantitative survey only provides items which require respondents to choose among options. The opportunity to probe further was lacking in the quantitative strand. However, it provides interesting opportunities for future investigations.

Furthermore, the instrument used to measure relational incentives measures the level of award, the level that the relationship might be affected if the information is not shared, and the extent to which supply chain members are happy to share benefits with their partners. However, the context of the qualitative results, indicated some physical gestures, such as "smile", and can serve as an incentive. Additionally, the qualitative results highlight relational incentives at the interpersonal level, which the quantitative instrument may not be able to capture. Therefore, for the mixed method interpretation, it could be explained that although the quantitative result did not generalise to the qualitative result, there could be underlying circumstances both in the qualitative (issues relating to inter-personal relationships) and

quantitative (complex issues surrounding incentive) results that only a mixed method analysis is able to highlight.

10.4.2. How the problem is better understood from the qualitative and quantitative results

This research set out to investigate relational behaviours and supply chain risk information sharing in Nigeria. The underlying problem relates to the challenge of sharing supply chain risk information due to the nature of supply chain contracts and the unclear role and effect that social relationships can play. The qualitative data provided in-depth knowledge of how supply chain managers use their relational closeness, collective prosperity and relational incentives to enhance supply chain risk information sharing. This finding was achieved by analysing the experiences the managers revealed during the semi-structured interviews. Furthermore, the qualitative data also identified some new relational constructs such as relational closeness, collective prosperity and relational incentives which were identified as enablers to supply chain risk information sharing.

The quantitative data provided a broad, statistically tested result in relation to the extent to which social relationship enhances supply chain risk information sharing. Although the construct examined was derived from the qualitative strand and supported by the literature, the quantitative result however provided evidence of the extent to which each of the relational constructs could enhance supply chain risk information sharing. The quantitative results, therefore, bring to light that the relational enablers tested (trust, relationship length, commitment and reciprocity) by past scholars are not the only relational enablers that enhance the supply chain risk information sharing. Rather, other variables such as relational closeness and collective prosperity can enhance supply chain risk information sharing in the Nigerian context. As a result, the mixed method approach of this research has provided an opportunity to examine the problem from both the qualitative and quantitative strand.

The qualitative result of this research also reveals several relational strategies that each individual firm practice. However, the qualitative analysis reveals only three behaviours of relational closeness, collective prosperity and relational incentives. Hence, based on the qualitative results, the firms sampled in the quantitative phase can implement strategies that will enable them to identify more relational behaviours which can be useful for risk information sharing in their supply chain. Especially given the nature of supply chain risks in Nigeria where trigger events can spread or move from one state or region to another. As a result, firms with the knowledge of such relational behaviours can start practising them in their supply chains.

10.5. Limitations

Similar to all academic research, this research has some limitations which should be taken into consideration. The limitations are discussed below.

Firstly, limitation related to sampling method: The tradition for quantitative research requires the collection of large data by adopting a probability random sampling procedure. This is usually achieved through adequate data collection planning. This is because quantitative research has stringent criteria for assessing the appropriateness of the data. However, because of the nature of the country where the data for this research is situated, it was impossible to carry out a probability sampling for data collection of this research. As a result, non-probability sampling was used to collect quantitative data for this research which limits the ability to generalised the findings beyond the sample, impossible.

Secondly, the number of sample for the research may be considered small compared to other studies carried out in the area (Ha, Park and Cho, 2011). This was because there was no database which supply chain managers can be identified directly. The Chartered Institute of Procurement and Supply was the only organise associate which have a database of members. Unfortunately, it was impossible to get access to its member's database directly due to the UK data protection law that is applied by CIPS for its Nigeria members.

Thirdly, limitation relating source of data: The data source of this research is mainly from Nigeria even though the problem of the research was corroborated by past studies and preliminary discussion with some supply chain experts in the UK. However, with the inability to collect data from the UK for a comparative study, it became necessary to only source data from the researcher's country of origin - Nigeria.

Fourth, the size of the companies which the qualitative interviews were conducted in small and medium scale companies based on the company classification in Nigeria. This can be considered a bias of findings of the qualitative strand. The output of the qualitative strand played a role in the development of the instrument used in the quantitative strand. In order to reduce the potential effect of using an instrument from SMEs in the qualitative strand, the instrument was piloted with independent experts both in the UK and Nigeria and the instrument was deemed appropriate by the experts.

Fifth, in terms of relational behaviours, it must be noted that this research only analysed data relating to new relational behaviours such as relational closeness, relational incentives and collective prosperity. It should be stressed that there are other relational characteristics such as trust, relationship length, reciprocity and commitment, which can enhance supply chain risk information sharing. Nevertheless, the findings do not undermine the relevance of previously known relational behaviours; rather, it uncovers new ones which have been proven to have statistical significance on supply chain risk information sharing.

10.6. Future work

The generalisability of the findings of this research can be enhanced by future research that can be carried out in other countries – especially countries that face a different type of human-made supply

chain risks. For instance, counties that face political risk where the political leader can advise businesses not to trade with another country (Example is the on-going US-China trade war). Also, where there is strong national identity or protectionism, future studies can investigate whether supply chain managers/organisations will still share risk information because of relational closeness or collective prosperity or will they submit to political pressure?

Secondly, since this research is exploratory and was structured to identify new relational behaviours that enhance supply chain risk information sharing, future research can test for combine effects of all the relational behaviours identified so far. This includes combining relation length, trust, commitment, reciprocity and the new variables identified in this research; relational closeness and collective prosperity. Apart from examining the combined effect, future research can assess the effect of each of the factor on supply chain risk information sharing.

Thirdly, it is a fact that social relationships may differ from person to person, organisation to organisation and country to country. This is because organisations are made up of people who are social beings that influence and are influenced by their environment. New insight and result may be generated if the research is carried out in countries that have unique, different social behaviours from the domain of this research -Nigeria. This is based on the suggestion Park *et al.*, (2012), Nishimura, Nevgi and Tella (2008) that countries with low context may have little disposition towards social relationships. It will be interesting to find out whether supply chain managers in such countries will alert each other about threats that will affect their collective prosperity.

Future research can also investigate the direction of the influence of risk information sharing and trust. The literature review of this research found several studies investigating how trust affects information sharing in the supply chain (Newell, Ellegaard and Esbjerg, 2019; Firouzi, Jaber and Baglieri, 2016; Li et al., 2015; Ha, Park and Cho (2011). Yet, some studies investigated how supply chain information sharing affects trust (Klei and Rai, 2009; Nyaga, Whipple and Lynch, 2010; Wang, Ye and Tan, 2014). Future research can focus on understanding which comes first 'trust or information sharing' or whether the issue should be left alone.

11. Conclusion and recommendation

This thesis was conducted with the aim to investigate relational behaviours and supply chain risk information sharing. Based on an empirical investigation, it demonstrated evidence of the effect of relational behaviours through closeness and collective prosperity behaviours, and they have a significant influence on supply chain risk information sharing. The research conducted an exploratory study with seven supply chain managers providing evidence of the phenomena which lead to the development of three propositions. As a mixed method study, the propositions were converted to hypotheses to test the extent which the constructs; relational closeness, relational incentives and collective prosperity enhance supply chain risk information sharing using a quantitative approach. Data was then collected from 97 respondents of the Chartered Institute of Procurement and Supply Nigeria branch through online, and self-administered questionnaires. The findings from both the qualitative and quantitative strand were further discussed within the mixed method results section. Of the three propositions developed (with respect to the relational behaviours of closeness, incentives and collective prosperity), one of the propositions from the qualitative strand – relational incentives – was not supported in the quantitative strand. A mixed method discussion was then provided to assess the extent to which the quantitative strand generalised the qualitative strand. Whereas the quantitative results generalised to two relational behaviours of relational closeness and collective prosperity, the mixed method discussion was used to further explain the lack of statistical support for relational incentive. It is believed that there could be underlying circumstances both in the qualitative (issues relating to inter-personal relationships) and quantitative (complex issues surrounding incentive) that are better understood in the mixed method discussion.

11.1. Theoretical contributions to supply chain management literature

In considering the need for supply chains to be able to sense and prepare against risks, this research identified the importance to enhance supply chain risk information sharing through social relationships. The research has been designed from the onset to contribute to the literature in the field of supply chain management.

The significant contribution of this thesis is that it identifies and provides empirical evidence of the effect of two previously unknown (to the field of supply chain management) relational behaviours of closeness and collective prosperity and their effect on supply chain risk information sharing. This research contributes to the literature by identifying and validating two relational attributes that are important in enhancing supply chain risk information sharing based on the data from Nigeria. No other supply chain management research within or outside Nigeria has identified or used these two constructs in the past. Previous studies in the field focused on relational antecedents such as trust, relationship length, commitment and reciprocity are enablers to information sharing (Li et al., 2015; Ha, Park and Cho, 2011; Klei and Rai, 2009; Nyaga, Whipple and Lynch, 2010; Wang, Ye and Tan, 2014). However, the qualitative exploratory interview approach adopted in this research provided an opportunity to

identify these new constructs (relational closeness, relational incentives and collective prosperity) while the quantitative survey provided a basis to prove two of the constructs (which ones) and reject relational incentives based on statistical insignificance. Although the context of this research is in Nigeria, future studies could be carried out in other countries which could in principle provide a different result, due to the possibility that social relationships may be influenced by context and culture.

Other areas where this research stands out includes:

Extends the social exchange and social capital theory by providing a new finding that highlights how relational incentives can be used for a negotiated exchange

The findings of this research have some implication on the social exchange theory. The literature on social exchange theory discuss earlier in section two highlights forms of exchange such as the negotiated exchange (Molm, Takahashi and Peterson, 2000; Molm, 1994). Although the literature only argues that about both parties in the negotiate exchange agreeing at the same time, the qualitative strand of this research, however, finds that the negotiation can be carried out through relational incentives to exchange or share supply chain risk information. This facilitates supply chain partners to agree on the benefit and consequence of sharing and not sharing risk information at the same time.

Further, this study contributes to social capital theory. As the social capital theory argues on resources embedded in social relationships (Andriani and Christoforou, 2016; Nahapiet and Ghoshal, 1998; Bourdieu, 1986), the findings of this research contribute to the understanding of the theory by highlighting relational behaviours that enhance supply chain risk information sharing from the social capital perspective. For example, the argument on collective good which the findings from this research have a significant positive relationship (collective prosperity) with supply chain risk information sharing.

The first empirical research conducted to seek the experience of supply chain managers in order to identify how relational behaviours enhances supply chain risk information sharing.

This research adds to the literature by exploring relational behaviours and supply chain risk information sharing from a qualitative perspective which reveals how supply chain managers are leveraging on their social relationship for risk information sharing. As a result, the research approach strengthens qualitative research in the field of supply chain management and proves it can bring new knowledge of risk management practice that was not considered in past literature. Achieving this contribution was only possible because in-depth data was collected from managers through interviews, rather than prescribing an established instrument and ranking their opinion without understanding the context of their actions and other factors that are not included in a quantitative instrument. This is essential for supply chains in countries like Nigeria, where several human-made risks are common. In this context, some supply

chain risk mitigating strategies are sometimes unpopular in other countries or multinational companies; hence, risk management strategies can be better explained through a qualitative research strategy.

Presents a systematic literature review that identifies three broad categories of the literature of researchers conducted on relational behaviours and supply chain risk information sharing.

A limited number of studies (Kembro, Selviaridis, Näslund, 2014; Colicchia, Creazza, Noè and Strozzi, 2019) systematically published reviewed the literature on supply chain risk information sharing. None of the past literature examined supply chain risk information sharing and relational behaviours. Similar to the unique work of Gligor *et al.* (2019) who systematically reviewed information sharing risk in supply chains, this thesis also contributes to the field of supply chain management by systematically reviewing the literature on relational behaviours and supply chain risk information sharing and identifying three broad categories which the literature can be classified under. This ultimately increases our understanding of the areas that most of the past researchers are focusing on and can inspire new studies to examine the subject from other perspectives.

Presents a literature review that assesses supply chain risk information sharing from different perspectives and proposes a new definition of the concept

This thesis presents the first detailed multidisciplinary review of the concept of supply chain risk information sharing. The concept originated from Mohr and Spekman (1994) and was brought into the field of supply chain management by Monczka *et al.*, (1998). Instead of relying solely on the popular definition of Monczka *et al.*, (1998) which was primarily based on general business (demand and supply related) risk, this research considers that it is vital to explore outside the supply chain literature to provide a comprehensive understanding of risk information in supply chains. Although there is nothing wrong with borrowing concepts from other disciplines, understanding the origin of concepts provides an opportunity to consider the concept from other perspectives that might also be using similar concepts. Further, with the increase in interdisciplinary research, examining the concept of risk information from multidisciplinary perspectives contributes to the field of supply chain management as it provides literature that indicates how a concept in supply chain management is linked to other disciplines. This can provide an avenue to increase collaborative research into the disciplines identified.

Presents an empirical mixed method finding that builds from qualitative and quantitative studies

The methodological uniqueness in the supply chain management literature lies in the application of the mixed method approach to investigate relational behaviours and supply chain risk information sharing. From the 141 articles reviewed, none of the past researchers adopted a mixed method approach. Majority of the studies were quantitative, which all had a different purpose from this research. As a result, the risk information sharing enablers were mostly developed by the studies and tested on the participants. However, the mixed approach adopted by this research provided qualitative, quantitative and mixed

method findings. While the qualitative method was instrumental in understanding the problem and ways which it can be mitigated through previously unknown strategies in the supply chain management literature; the quantitative method was able to validate the strategies for a larger population.

11.2. Managerial implications

This research has several practical implications for managers. Considering the desire to make supply chains more resilient by establishing measures that will enable an organisation to anticipate and sense threats before they escalate into disasters, the findings of this research will enable organisations to invest more on their relational assets. Although past literature has found that relational trust, relationship length, commitment and reciprocity are enablers of risk information sharing and organisations are investing in increasing these assets, the two new relational assets identified in this research can also be enhanced for overall increase risk information sharing among supply chain members.

From the findings of this research, an organisation can structure their front-line staffs that are involved in supply chain-related activities to establish or increase social relationships with supply chain members. This is because frontline staffs in a focal organisation are usually in contact with frontline staffs of other organisation, and they tend to have social relationships. One practical way is by encouraging frontline staff to increase conversation with other supply chain members and earn their trust; this will increase relational closeness, thereby increasing supply chain risk information sharing.

Similar to the practice of relational closeness in the field of marketing, for the purpose of receiving supply chain risk information, frontline staffs can be trained on how to establish closeness, maintain closeness with other supply chain members. Further, a recognition system can be created for supply chain staffs that have to establish relational behaviours of closeness and collective prosperity, which has translated to increase risk information sharing.

Also, the mixed method findings of relational incentives imply that supply chain managers should assess the context which they can use relational incentives for supply chain risk information sharing. This is evident in the qualitative literature that indicated that social gestures could serve as relational incentives that enhances supply chain risk information sharing. While in contrast, unclear reward or punishment may not serve as a relational behaviour that enhances supply chain risk information sharing.

Further, multinational and foreign companies operating or considering expanding their supply chain operations to Nigeria may find the results of this research useful, especially if the organisational culture or policy does not facilitate social relationships for risk information sharing. The general norm is that all organisation will want to receive risk information about threats to their supply chains. However, some organisations with strict information sharing policy may not encourage sharing risk information. Where such an attitude is prevalent, it is critical to encourage relational behaviours in order to enhance supply chain risk information sharing. The attributes identified by this research – relational closeness

and collective prosperity – provides a practical basis for an organisation to foster risk information sharing among its supply chain partners.

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APPENDIX 1: List of Articles from Systematic Literature Review

Authors	Title	Journal name
Hallikas, et al (2004)	Risk management processes in supplier networks	International journal of production economics
Ojala and Hallikas (2006)	Investment decision-making in supplier networks: Management of risk	International journal of production economics
Stewart, Kolluru and Smith (2009)	Leveraging public-private partnerships to improve community resilience in times of disaster	International journal of physical distribution & logistics management
Wu et al (2017)	Toward sustainability: using big data to explore the decisive attributes of supply chain risks and uncertainties	Journal of cleaner production
Short, Toffel and Hugill (2016)	Monitoring global supply chains	Strategic management journal
Yao, Kurata and Mukhopadhyay (2008)	Incentives to reliable order fulfillment for an Internet drop-shipping supply chain	International journal of production economics
Fu, Dong, Liu and Han (2016)	Trust based decisions in supply chains with an agent	International journal of production economics
Yoo, Rand, Eftekhar and Rabinovich (2016)	Evaluating information diffusion speed and its determinants in social media networks during humanitarian crises	Decision support systems
Tao, Lee and Chew (2016)	Quantifying the Effect of Sharing Information in a Supply Chain Facing Supply Disruptions	Journal of operations management

Saak (2016)	Traceability and reputation in supply chains	Asia-pacific journal of operational research
Shen and Li (2015)	Market disruptions in supply chains: a review of operational models	International transactions in operational research
Brunninge and Fridriksson (2017)	"We have always been responsible": A social memory approach to responsibility in supply chains	European business review
Durach and Machuca(2018)	A matter of perspective – the role of interpersonal relationships in supply chain risk management	International journal of operations and production management
Ziegler, Ylitalo and Mäki (2016)	Transformational challenges of a collaborative relationship in a context of a complex demand-supply chain	2006 ieee international technology management conference, ice 2006
Singh and Albores (2013)	Balancing push and pull information management within the supply chain	Proceedings - kim 2013, knowledge and information management conference: sustainable quality
Comyns and Franklin-Johnson (2018)	Corporate Reputation and Collective Crises: A Theoretical Development Using the Case of Rana Plaza	Journal of business ethics
De Oliveira and Handfield (2017)	An enactment theory model of supplier financial disruption risk mitigation	Supply chain management-an international journal
Wang, Tiwari and Chen (2017)	Communicating supply chain risks and mitigation strategies: a comprehensive framework	Production planning & control
Kurniawan, Zailani, Iranmanesh and Rajagopal (2017)	The effects of vulnerability mitigation strategies on supply chain effectiveness: risk culture as moderatorThe effects of vulnerability mitigation strategies on supply chain effectiveness: risk culture as moderator	Supply chain management-an international journal
Nguyen, Nguyen, Deligonul and Cavusgil (2017)	Developing visibility to mitigate supplier risk: the role of power-dependence structure	Asia-pacific journal of business administration
Mandal (2015)	Towards an Empirical-Relational Model of Supply Chain Flexibility	International journal of information systems and supply chain management
Urciuoli (2015)	Cyber-Resilience: A Strategic Approach for Supply Chain Management	Technology innovation management review
Boyes (2015)	Cybersecurity and Cyber-Resilient Supply Chains	Technology innovation management review
Benedek, Lubloy and Vastag (2014)	The Importance of Social Embeddedness: Churn Models at Mobile Providers	Decision sciences
Markmann, Darkow and von der Gracht (2013)	A Delphi-based risk analysis - Identifying and assessing future challenges for supply chain security in a multi-stakeholder environment	Technological forecasting and social change
Kumar and Havey (2013)	Before and after disaster strikes: A relief supply chain decision support framework	International journal of production economics
Wieland and Wallenburg (2013)	The influence of relational competencies on supply chain resilience: a relational view	International journal of physical distribution & logistics management
Johnson, Elliott and Drake (2013)	Exploring the role of social capital in facilitating supply chain resilience	Supply chain management-an international journal
Cheng, Yip and Yeung (2012)	Supply risk management via guanxi in the Chinese business context: The buyer's perspective	International journal of production economics

Bandyopadhyay, Jacob and Raghunathan (20100	Information security in networked supply chains: impact of network vulnerability and supply chain integration on incentives to invest	Information technology & management
Degeneffe, Kinsey, Stinson and Ghosh (2009)	Segmenting consumers for food defense communication strategies	International journal of physical distribution & logistics management
Richey (2009)	The supply chain crisis and disaster pyramid A theoretical framework for understanding preparedness and recovery	International journal of physical distribution & logistics management
Blos, Quaddus, Wee and Watanabe (2009)	Supply chain risk management (SCRM): a case study on the automotive and electronic industries in Brazil	Supply chain management-an international journal
Wiengarten and Longoni (2018)	How does uncertainty affect workplace accidents? Exploring the role of information sharing in manufacturing networks	International journal of operations & production management
Li, Pedrielli, Lee andChew (2017)	Enhancement of supply chain resilience through inter-echelon information sharing	Flexible services and manufacturing journal
Fan, Li, Sun and Cheng (2017)	An information processing perspective on supply chain risk management: Antecedents, mechanism, and consequences	International journal of production economics
Anderson, Baskerville and Kaul (2017)	Information Security Control Theory: Achieving a Sustainable Reconciliation Between Sharing and Protecting the Privacy of Information	Journal of management information systems
Banerjee and Golhar (2017)	Economic analysis of demand uncertainty and delayed information sharing in a third-party managed supply chain	Production planning & control
Shamir (2017)	Cartel Formation Through Strategic Information Leakage in a Distribution Channel	Marketing science
Fan, Cheng, Li, and Lee (2016)	The Effectiveness of Supply Chain Risk Information Processing Capability: An Information Processing Perspective	Ieee transactions on engineering management
Firouzi, Jaber and Baglieri (2016)	Trust in supply forecast information sharing	International journal of production research
Heese and Kemahlioglu-Ziya (2016)	Don't ask, don't tell: Sharing revenues with a dishonest retailer	European journal of operational research
Yang and Fan (2016)	Information management strategies and supply chain performance under demand disruptions	International journal of production research
Hennelly and Wong (2016)	The formation of new inter-firm relationships: a UK offshore wind sector analysis	International journal of energy sector management
Tran, Childerhouse and Deakins (2016)	Supply chain information sharing: challenges and risk mitigation strategies	Journal of manufacturing technology management
Riley, Klein, Miller and Sridharan (2016)	How internal integration, information sharing, and training affect supply chain risk management capabilities	International journal of physical distribution & logistics management
Diedrichs, Phelps and Isihara (2016)	Quantifying communication effects in disaster response logistics A multiple network system dynamics model	Journal of humanitarian logistics and supply chain management
Chen, Sohal and Prajogo (2016)	Supply risk mitigation: a multi-theoretical perspective	Production planning & control
Sharma and Routroy (2016)	Modeling information risk in supply chain using Bayesian networks	Journal of enterprise information management
Sarkar, S; Kumar, S	A behavioral experiment on inventory management with supply chain disruption	International journal of production economics

Gao (2015)	Long-Term Contracting: The Role of Private Information in Dynamic Supply Risk Management	Production and operations management
Li, Fan, Lee and Cheng (2015)	Joint supply chain risk management: An agency and collaboration perspective	International journal of production economics
Scholten and Schilder (2015)	The role of collaboration in supply chain resilience	Supply chain management-an international journal
Gumus (2014)	With or Without Forecast Sharing: Competition and Credibility under Information Asymmetry	Production and operations management
Brandon-Jones, Squire, Autry and Petersen (2014)	A Contingent Resource-Based Perspective Of Supply Chain Resilience And Robustness	Journal of supply chain management
Altay and Pal (2014)	Information Diffusion among Agents: Implications for Humanitarian Operations	Production and operations management
Yu and Goh (2014)	A multi-objective approach to supply chain visibility and risk	European journal of operational research
Ganesh, Raghunathan and Rajendran (2014)	The value of information sharing in a multi-product, multi-level supply chain: Impact of product substitution, demand correlation, and partial information sharing	Decision support systems
Cheng, Chen and Chen (2013)	Exploring how inter-organizational relational benefits affect information sharing in supply chains	Information technology & management
Alfalla-Luque, Medina-Lopez and Schrage (2013)	A study of supply chain integration in the aeronautics sector	Production planning & control
Trkman and Desouza (2012)	Knowledge risks in organizational networks: An exploratory framework	Journal of strategic information systems
Wakolbinger and Cruz (2011)	Supply chain disruption risk management through strategic information acquisition and sharing and risk-sharing contracts	International journal of production research
Ha, Park and Cho (2011)	Suppliers' affective trust and trust in competency in buyers Its effect on collaboration and logistics efficiency	International journal of operations & production management
Eurich, Oertel and Boutellier (2010)	The impact of perceived privacy risks on organizations' willingness to share item-level event data across the supply chain	Electronic commerce research
Yigitbasioglu (2010)	Information sharing with key suppliers: a transaction cost theory perspective	International journal of physical distribution & logistics management
Bakshi and Kleindorfer (2009)	Co-opetition and Investment for Supply-Chain Resilience	Production and operations management
Xiao and Yang (2009)	Risk sharing and information revelation mechanism of a one-manufacturer and one-retailer supply chain facing an integrated competitor	European journal of operational research
Girotra and Tang (2009)	Strategic Behavior in Supply Chains: Information Acquisition	Consumer-driven demand and operations management models: a systemic study of information-technology-enabled sales mechanisms
Johnson (2008)	Information risk of inadvertent disclosure: An analysis of file-sharing risk in the financial supply chain	Journal of management information systems
Chopra and Sodhi (2004)	Managing risk to avoid supply-chain breakdown	Mit sloan management review
Kumar and Dissel (1996)	Sustainable collaboration: Managing conflict and cooperation in interorganizational systems	International journal of production economics
Castka and Balzarova (2008)	ISO 26000 and supply chains-On the diffusion of the social responsibility standard	Journal of cleaner production

Ciliberti, et al (2011)	CSR codes and the principal-agent problem in supply chains: Four case studies	The international journal of logistics management
Williams, Ponder and Autry (2009)	Supply chain security culture: Measure development and validation	Journal of professional issues in engineering education and practice
Loosemore and McCarthy (2008)	Perceptions of contractual risk allocation in construction supply chains	Journal of cleaner production
Li et al (2016)	Schedule risks in prefabrication housing production in Hong Kong: a social network analysis	Supply chain management
Yang et al (2013)	The effect of supply chain security management on security performance in container shipping operations	Journal of risk research
Merz, Hiete, Comes and Schultmann (2013)	A composite indicator model to assess natural disaster risks in industry on a spatial level	Engineering, construction and architectural management
Das, Cheng and Law (2015)	An ontology-based web service framework for construction supply chain collaboration and management	Journal of operations management
Harvey (2016)	Professional service supply chains	Supply chain management
Petersen and Lemke (2015)	Mitigating reputational risks in supply chains	Construction management and economics
Loosemore and Lim (2015)	Inter-organizational unfairness in the construction industry	Journal of marketing channels
Thorne and Quinn (2016)	Private Governance in the Supply Chain	Proceedings - 3rd international conference on information management, innovation management and industrial engineering, iciii 2010
Wang and Huang (2010)	Research on efficiency of disaster supply chain based on collaborative management	Journal of manufacturing technology management
Truong and Hara (2018)	Supply chain risk management: manufacturing- and service-oriented firms	Handbook of research on intelligent techniques and modeling applications in marketing analytics
Kabra and Ramesh (2017)	An Analysis of the Interactions among the Enablers of Information Communication Technology in Humanitarian Supply Chain Management: A Fuzzy-Based Relationship Modelling Approach	Journal of islamic marketing
Tieman (2017)	Halal risk management: combining robustness and resilience	European business review
Brunninge and Fridriksson (2017)	We have always been responsible A social memory approach to responsibility in supply chains	International journal of logistics management
MacKenzie and Apte (2017)	Modeling disruption in a fresh produce supply chain	Supply chain management-an international journal
Urciuoli, Mohanty, Hintsa and Boekesteijn (2014)	The resilience of energy supply chains: a multiple case study approach on oil and gas supply chains to Europe	Amfiteatru economic
Mazareanu (2013)	Considerations On Risk In Supply Chain Management Information Systems Implementation	Journal of operations management
Hora and Klassen (2013)	Learning from others' misfortune: Factors influencing knowledge acquisition to reduce operational risk	Safety science
Bevilacqua, Ciarapica and Paciarotti (2012)	Business Process Reengineering of emergency management procedures: A case study	International journal of project management

Meng (2012)	The effect of relationship management on project performance in construction	International journal of production economics
Chakravarty (2012)	A contingent plan for disaster response	Technological forecasting and social change
Wang, Stosslein and Wang (2010)	Designing knowledge chain networks in China - A proposal for a risk management system using linguistic decision making	Industrial marketing management
Christopher and Gaudenzi (2009)	Exploiting knowledge across networks through reputation management	Mit sloan management review
Slobodow, Abdullah and Babuschak (2008)	When supplier partnerships aren't	Technovation
Kumar and Budin (2006)	Prevention and management of product recalls in the processed food industry: a case study based on an exporter's perspective	Internet research
Li, Tryfonas and Li (2016)	The Internet of Things: a security point of view	Journal of the operational research society
Pazirandeh and Maghsoudi (2018)	Improved coordination during disaster relief operations through sharing of resources	Management science
Cui and Shin (2018)	Sharing Aggregate Inventory Information with Customers: Strategic Cross-Selling and Shortage Reduction	Academy of management journal
Ballesteros, Useem and Wry (2017)	Masters of disasters? An empirical analysis of how societies benefit from corporate disaster aid	Annals of operations research
Zhu (2017)	Outsourcing management under various demand Information Sharing scenarios	Production and operations management
Toyasaki, Arikan, Silbermayr and Sigala (2017)	Disaster Relief Inventory Management: Horizontal Cooperation between Humanitarian Organizations	International journal of operations & production management
Li, Wu, Zong and Li (2017)	Supply chain collaboration for ERP implementation An inter-organizational knowledge-sharing perspective	International journal of production economics
Baruah, Chinnam, Korostelev and Dalkiran (2016)	Optimal soft-order revisions under demand and supply uncertainty and upstream information	International journal of production economics
Bogataj, Aver and Bogataj (2016)	Supply chain risk at simultaneous robust perturbations	Management science
Huang, Boyaci, Gumus, Ray and Zhang (2016)	United We Stand or Divided We Stand? Strategic Supplier Alliances Under Order Default Risk	Revue internationale pme
Pellegrin-Romeggio (2016)	Dynamic management of relational risk by SMEs in the travel industry in France	International journal of shipping and transport logistics
Li, Chen, Liao and Shi (2016)	The impact of information sharing and risk pooling on bullwhip effect avoiding in container shipping markets	Advances in managing humanitarian operations
Privett (2016)	Information Visibility in Humanitarian Operations: Current State-of-the-Art	International journal of operations & production management
Fredendall, Letmathe and Uebe-Emden (2016)	Supply chain management practices and intellectual property protection in China Perceptions of Mittelstand managers	International journal of production economics

DeYong and Pun (2015)	Is dishonesty the best policy? Supplier behaviour in a multi-tier supply chain	Journal of electronic commerce research
Liu, Shang and Lai (2015)	Incentive Mechanism For Knowledge Sharing In E-Commerce Service Supply Chain: Complementarity, Integration And Risk Attitude	Technology innovation management review
Khan and Estay (2015)	Supply Chain Cyber-Resilience: Creating an Agenda for Future Research	Naval research logistics
Jain and Sohoni (2015)	Should Firms Conceal Information When Dealing with Common Suppliers?	Production and operations management
Gao, Li and Shou (2014)	Information Acquisition and Voluntary Disclosure in an Export-Processing System	Decision support systems
Schrodl and Turowski (2014)	Risk management in hybrid value creation	International journal of production research
Mogre, Wong and Lalwani (2014)	Mitigating supply and production uncertainties with dynamic scheduling using real-time transport information	Management accounting research
Dekker, Sakaguchi and Kawai (2013)	Beyond the contract: Managing risk in supply chain relations	Industrial marketing management
Rajaguru and Matanda (2013)	Effects of inter-organizational compatibility on supply chain capabilities: Exploring the mediating role of inter-organizational information systems (IOIS) integration	European journal of operational research
Egri and Vancza (2013)	A distributed coordination mechanism for supply networks with asymmetric information	International journal of production economics
Deng, Xie and Xiong v	Manufacturer-retailer contracting with asymmetric information on retailer's degree of loss aversion	Outsourcing management for supply chain operations and logistics service
Tsiakis and Tsiakis v	Managing the Risks of Outsourcing IT Security in Supply Chain	International journal of production economics
Sun, Matsui and Yin (2012)	Supplier risk management: An economic model of P-chart considered due-date and quality risks	Journal of business & industrial marketing
Kumra, Agndal and Nilsson (2012)	Open book practices in buyer-supplier relationships in India	Journal of supply chain management
Thomas, Fugate and Koukova (2011)	Coping With Time Pressure And Knowledge Sharing In Buyer-Supplier Relationships	Iie transactions
Xia, Ramachandran and Gurnani (2011)	Sharing demand and supply risk in a supply chain	European journal of industrial engineering
Lehoux, D'Amours and Langevin (2010)	A win-win collaboration approach for a two-echelon supply chain: a case study in the pulp and paper industry	Mis quarterly
Klein and Rai (2009)	Interfirm Strategic Information Flows In Logistics Supply Chain Relationships	European journal of operational research
Dernirkan and Cheng (2008)	The risk and information sharing of application services supply chain	Iie transactions
Ganesh, Raghunathan and Rajendran (2008)	The value of information sharing in a multi-product supply chain with product substitution	Decision support systems
Guo, Fang and Whinston (2008)	Supply chain information sharing in a macro prediction market	International journal of production economics
Chen, Chen and Chen (2006)	A coordination mechanism for a supply chain with demand information updating	Management science

APPENDIX 2: Consent Form

Consent Form

Name of department: Department of Design, Manufacturing and Engineering Management
Title of the study: Social Relationships and Supply Chain Risk Information Sharing

- I confirm that I have read and understood the information sheet for the above project and the researcher has answered any queries to my satisfaction.
- I understand that my participation is voluntary and that I am free to withdraw from the project at any time, without having to give a reason and without any consequences.
- I understand that I can withdraw my data from the study at any time.
- I understand that any information recorded in the investigation will remain confidential and no information that identifies me will be made publicly available.
- I consent to being a participant in the project
- I consent to being audio and video recorded as part of the project [delete which is not being used] Yes/ No

[Where human biological samples are taken eg blood samples or biopsy samples then the following wording should be included:

I consent to the taking of biological samples from me, and understand that they will be the property of the University of Strathclyde.
Yes/ No]

[Where it is proposed to carry out DNA analysis of material in any samples then the following statement should be included in the consent form:

I consent to DNA in the samples being analysed.
Yes/ No]

[For investigations where it has been decided that "no fault compensation" cover will be provided the following wording needs to be included:

In agreeing to participate in this investigation I am aware that I may be entitled to compensation for accidental bodily injury, including death or disease, arising out of the investigation without the need to prove fault. However, such compensation is subject to acceptance of the Conditions of Compensation, a copy of which is available on request.
Yes/ No]

(PRINT NAME)	
Signature of Participant:	Date:

APPENDIX 3 Qualitative interview guide and case study protocol

a. Interview guide

Questions

Section 1: Supply Chain Risk

1. Can you tell me about the types of supply chain risk you face or are common in your organisation?

2. How do you go about receiving information about external risk? who do you first contact?

3. Tell me about a time when an external risk-triggering event occurred, who informed you and what actions were taken? (Does the firm have structure or procedures for reporting risk information? Were SC partners informed?)

Section 2: Social relationships and supply chain risk information

1. Describe the type of informal relationship you have with your suppliers and customers (does it encourage risk information sharing)?

2. Do you share risk information with your partners?

3. Do your SC partners firms share risk information with you (focal firm)?

4. How do you think social relationships will affect the way supply chain risk information is shared between you and your partners?

5. Do you have a personal relationship with your customer, and how do you think it enhances risk information sharing in your supply chain?

6. How do go about determining the quality of supply chain information that is gotten as a result of social relationships?

Section 3: Structure of organisation and operations for SC risk information sharing

1. Do you first report risks to your organisation or to the partners you have social relationships?

2. In which areas of your operation (logistics, marketing, operations) do you think there are potentials for you to gain more information about the supply chain risk information in your network?

3. What internal and external factors would

b. Study protocol

1. **Research Question:**
   - How do social capital (relational behaviours) enhance supply chain risk information sharing?
2. **Research Background:**
   - Review literature on social capital theory and supply chain risk information sharing
   - Clarify emerging questions with supply chain manager (Long Lane Logistics)
3. **Preliminary proposition:** Social capital is an enabler of supply chain risk information sharing.
4. **Design**
   - Create study research design with support of theory
   - Identify articles to use as guide
5. **Data collection:**
   - Define the which type of data to be collected
   - Identify the appropriate company and how to locate the companies
   - Develop interview guide
6. **Data analysis**
   - Transcribe interview recording
   - Understand each company data
   - Probe where necessary
   - Code interview data
   - Analyse individual company and multiple companies
   - Establish whether research question has been answered
7. **Construct Validity – Supply Chain Risk Information Sharing**
   - Define supply chain risk information sharing
   - Identify operational measures that match the concept (from past studies), identify known shortcomings, state how the shortcomings will affect the findings of the study. Multiple sources, chain of evidence, and probe for clarity from key informants.
8. **Internal Validity –**
   - Take response that will affect the inference
9. **External Validity**
   - Generalize the results to the broader theory.
10. **Reliability**
    - Document the procedures followed.
    - Use study protocol. Develop study database.
    - Conduct research with a lot of self-scrutny.

APPENDIX 4: Paper Questionnaire

Are you a member of The Chartered Institute of Purchasing and Supply (CIPS) Nigeria branch?

☐Yes ☐No

Part 1: Please fill in the following information about your organisation

Risk information Sharing

Q1. It is expected that members in the supply chain keep each other informed about events or changes that may affect the other party.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q2. Our partners keep us fully informed about issues that affect our business.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q3. We provide information to our partner frequently and informally, and not only according to the specific agreement.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q4. We share accurate risk related information with our supply chain members.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q5. We are willing to share real-time information on demands with our suppliers.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Relational Closeness

Q6. The relationship with our supply chain partner is close.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

○	○	○	○	○	○	○

Q7. We and our supply chain partners disclose important information to each other.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q8. We have a strong connection with our supply chain partners.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q9. Our supply chain partners are a priority in our business.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q10. We collaborate regularly with our supply chain partners.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q11. We create informal events to meet with our supply chain partners.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q12. Our relationship with our supply chain is important to our business.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q13. We consider our supply chain partners when making important decisions.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Information Sharing Incentives

Q14. Our business partners are likely to be awarded when they inform us about issues that affect our business.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q15. Our relationship with our partners would be negatively affected if they refuse to inform us about issues that would affect our business.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q16. When we work jointly or combine effort with our partners we are happy to share the benefits between the two of us.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q17. We are likely to provide other incentives to our supply chain partners

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Collective Prosperity

Q18. We consider the long-term benefit of our relationships.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q19. When making important decisions, we consider the going concern of our supply chain partners as well.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q20. We understand that a crisis that affects our partner's supply can be passed on to us.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q21. We are willing to inform our partner of dangers that can affect them.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q22. We are willing to collaborate with our partners to address a common issue related to our supply chain.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Q23. There are other reasons why we want our supply chain partner to succeed

☐Yes ☐No

If yes please specify

…….

Part 2. Please fill in the following general information about yourself

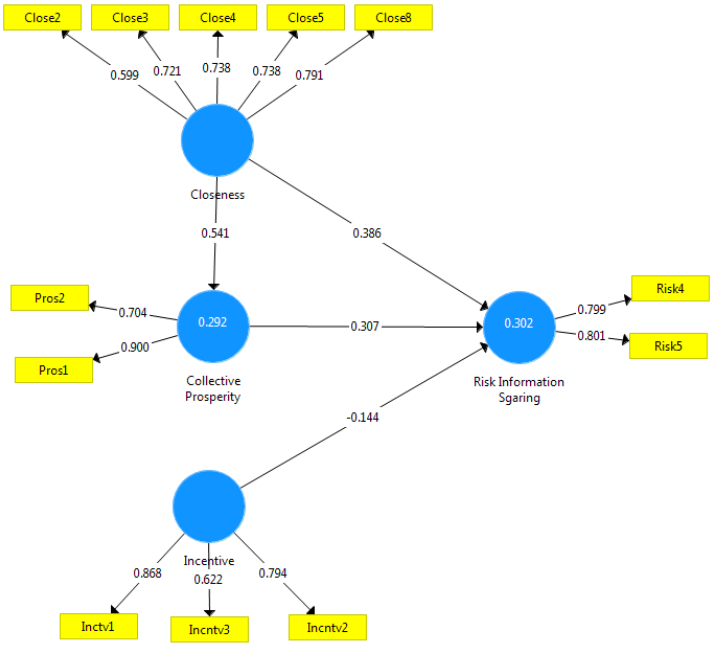
1. What is your title/position at your company?.....
2. How long have you been in your current position?.....
3. What type of relationship do you keep with the people in your partners firm
   ☐Strictly Formal ☐ Both formal and informal ☐ others……..
4. At what type of informal event(s) does your company meet with your partners?
   ☐ End of the year gathering ☐ Training and conference
   ☐ Others (please specify) ……
5. What types of risks are common in your supply chain? (please choose as many as appropriate)
   ☐Natural and environmental risk ☐Demand and supply related risk
   ☐Transport related risk ☐Political risk
   ☐Strikes ☐Economic and financial risk
   ☐Internal operation risk ☐Others (please specify) ……..
6. Which one is your most frequent source of receiving supply chain risk information
   ☐Government source ☐Media ☐Supply chain partners

☐Others (please specify) …….

7. Did you previously complete the online version of this survey?

☐Yes ☐No

APPENDIX 5: Smart PLS-SEM Result



APPENDIX 6: Bootsstrapping Result