An Empirical Study on the Building Blocks of Resilience in British Food Supply Chains

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Abstract

Food is, of course, essential to the continuation of human life, and today's food supply networks or as they are also known "farm to fork" are becoming more diverse and dynamic. It is an undeniable fact that the changing climate has resulted in more extreme weather conditions than before. Simultaneously, the world has become more interconnected, and the population continues to grow and get richer, thus demand for food is increasing, whilst natural resources are depleting quickly. Risks due to considerable environmental degradation have the potential to spread through the food system and adversely affect access and availability of food. According to the UK Government (2014), food supply chains play a significant role in the country's economy, accounting for seven percent of the Gross Domestic Product (GDP), and food manufacturing is still the largest manufacturing sector in the United Kingdom (UK Government, 2014). It is a sector which is making an important contribution to growth, including through the expansion of exports. However, to fulfil the demand for food by its growing population, the UK also relies significantly on imported food. The aim of this study is to investigate *"resilience"* as a form of capability for risk mitigation within food supply chains. This research identifies the influencing factors, that can affect supply chain resilience, such as building blocks and their interactions. To achieve this aim, three major food companies, that have an active presence in British food supply chains, have contributed to this study.

This empirical research adapted a multiple case study approach and used qualitative data to interpret answers to the research questions. The main sources of evidence were the interviewee responses to the semi-structured interview questions. The interviewee's answers relating to each case study company were analysed through a qualitative data pattern matching analysis technique. Furthermore, the findings of the case study companies were compared against each other. To increase the credibility and validity of the research findings, observational studies and document archival reviews were conducted and their findings were triangulated against the findings of interview responses. Finally, this research drew a theoretical framework for resilient food supply chains in which the drivers of resilience and their interactions in food supply chains were identified. It also sheds light onto the common misconceptions between risk management and resilience, and provides an unambiguous definition for resilient food supply chains.

Chapter One:
Introduction to Research

Food is, of course, essential to the continuation of human life, and today's food supply networks, or as they are also known "*farm to fork*" or *"plough to plate"* networks, are becoming more multifarious and vigorous (Mena & Stevens, 2010; Tommi, Natalia, & Petri, 2009; Weir, 2009). It is a well-known fact that historically commercial trade in food has existed within human communities (mostly local to their place of habitat) for many centuries. However, in the present day, *"farm to fork"* networks are regarded as highly complex, particularly as supply networks have expanded globally to deliver food to the end customer.

There are many types of supply chains that affect human lives, and yet, food supply chains are distinct from other product supply chains (Mena & Stevens, 2010). The first fundamental difference between food supply chains and other supply chains, is the continuous and often significant change in the quality of food products throughout the entire supply chain until the points of final consumption (Yu & Nagurney, 2013). This is especially the case of fresh produce supply chains where increasing attention is placed on both freshness and safety. Clearly, many consumers prefer the freshest product at a fair price (Ltke Entrup, 2005; Wilcock, Pun, Khanona, & Aung, 2004; Yu & Nagurney, 2013). Second, is the seasonality of a food supply chain in both demand and supply which forces organisations to structure their supply chains around these changes. Third, is the impact of food supply chains on the health, nutrition and wellbeing of society. Finally, the environmental impact, as even though all industries have an impact on the environment, food has a disproportionate effect. This is because of its extensive use of resources like water, energy and land leading to emissions such as carbon dioxide, which is considered a major differentiator of food supply chains (Mena & Stevens, 2010).

According to Trienekens, Wognum, Beulens, and Van der Vorst (2012), the reason for food supply chain complexity is two-fold. Firstly, it relates to the increasing product proliferation necessary to serve ever diversifying and globalising markets. As a form of mass customisation, with resulting global flows of raw materials, ingredients and products. Secondly, there is the need to satisfy changing and variable consumer and governmental demands with respect to food safety, animal

welfare, and environmental impacts. Accordingly, 21st century customers require products that are safe, healthy and of a high and consistent quality. They demand reassurances relating to food characteristics, which require transparency and effective responses if a problem arises (Manning & Soon, 2016; Trienekens et al., 2012). Moreover, public focus on these issues has also grown due to increasing consumer concerns, with consequential costs imposed on the public purse (Fearne, Hornibrook, & Dedman, 2001). This has led to food supply chains becoming heavily regulated, whilst increasingly, any breach at any level and stage of the food supply networks are being put under the spotlight.

It is believed that the afore-mentioned characteristics of food supply chains, is causing them to become highly brittle. Therefore, in the case of any possible materialisation of risk, the side effects can quickly spread across its different tiers. For instance, the latest cases of salmonella poisoning in peanut butter, the British horsemeat incident and the reported cases of melamine poisoning in Chinese milk have all demonstrated the destructive impact of risk within food supply chains (Cavallaro et al., 2011; Dani & Deep, 2010; Elliott, 2014; Fearne et al., 2001; Government, 2014). The second chapter of this thesis explores various breaches within farm to fork networks, as well as their causes and how they are shaping customer perceptions and policies (2.4.3.1).

As reported by the UK Government (2014), food supply chains play a significant role in the country's economy, accounting for seven percent of its Gross Domestic Product (GDP), with food manufacturing accounting for the largest manufacturing sector in the United Kingdom (UK Government, 2008). It is a sector which makes an important contribution to growth, including through expanding exports. British food is renowned throughout the world for its quality and the high welfare standards applied in its production. However, to fulfil the demand for food by its growing population, the UK also relies significantly on imported food (Bhunnoo & Benton, 2012). At the same time, a broad range of factors may affect the food supply chains on which British society is highly dependent. Such factors include the effects of climate change, crop and animal diseases and price rises, amongst others. These factors are likely to affect the ability to import sufficient levels of food in the future. Subsequently, as the intensity and range of these pressures increase, the security of supply chains and food safety may come under threat.

This research is conducted at a time when, in the UK, there is an abundant supply of all types of food and after a sharp price rise of 11.5%, between the years 2007 to 2012, the prices for food are gradually decreasing. Nevertheless, food prices have not returned to the low-price levels of pre-2007. At the same time, Oil prices also rose over this period, and inflation was historically higher, but food prices have risen above inflation.
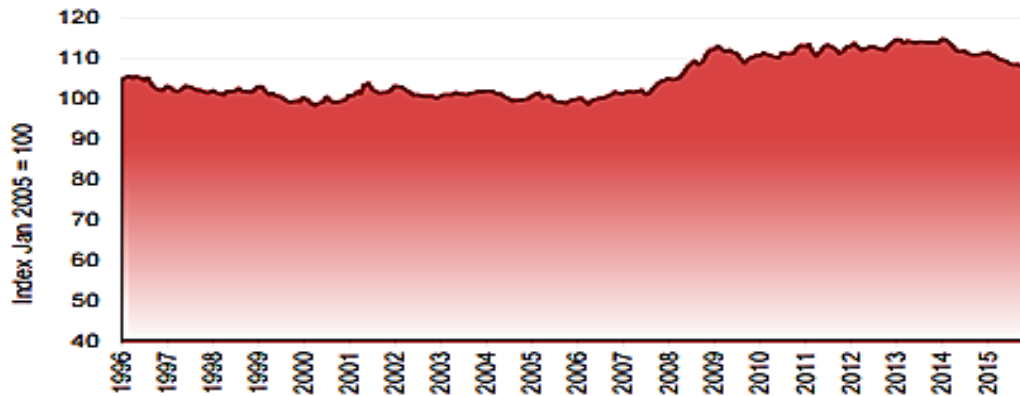
Figure 1 UK trend in food prices in real terms, January 1996 to 2015.
Sourced from: (Rumsey, Lee, Riley, Hayes, & ScaifeAndrew, 2015, p. 15)

In their study on the risks and resilience of an Agri-food supply chain, Leat and Revoredo-Giha (2013) report that, the risks outlined above, are compelling companies to pay considerable attention to risk management as they are obliged to follow legislative compliance. Examples of this compliance, are the legislations that are in relation to; food security, the health and safety of workers and waste disposal. There is also a widening interest in supply chain "*resilience*"- which is the ability to endure, adjust and grow after an unexpected crisis - as an essential component of business continuity (Kamalahmadi & Parast, 2016; Kristianto, Gunasekaran, Helo, & Hao, 2013; Leat & Revoredo-Giha, 2013; Park, Seager, & Rao, 2011; Ponomarov & Holcomb, 2009; Sáenz & Revilla, 2014).

In recent years, academics and professionals who work within the field of supply chain management have concentrated their interest on resilient supply chains (Aven, 2011; Bhamra, Dani, & Burnard, 2011; Bhatia, Lane, & Wain, 2013; Blackhurst, Dunn, & Craighead, 2011; Kamalahmadi & Parast, 2016; Peck et al., 2003; Pettit, 2008; Ponomarov & Holcomb, 2009; Roberta Pereira, Christopher, & Lago Da Silva, 2014; Sáenz & Revilla, 2014). However, many prominent researchers in this field argue that, the topic of supply chain resilience has received little attention and is still

nascent (Bhamra et al., 2011; Bhatia et al., 2013; Blackhurst et al., 2011; Dani, 2015; Kamalahmadi & Parast, 2016; Roberta Pereira et al., 2014; Sheffi, 2015a, 2015b). Park et al. (2011, p. 396), report that *"the development of practical methods to implement resilience in an engineering context is still in an incipient stage"*. Such a perception is shared by Ponomarov and Holcomb (2009, p. 124) who believe that *"key elements of supply chain resilience and the relationships among them, the links between risks and implications for supply chain management, and the methodologies for managing these key issues are poorly understood"*.

In their research paper, Pettit, Croxton, and Fiksel (2013, p. 46) report that *"the immediate and lingering effects of natural disasters, and the subsequent supply chain disruptions, have spurred renewed concerns about supply chain resilience"*. It is believed that resilient capability within the farm to fork networks enhances the security and sustainability of societies (Prosperi, Allen, Padilla, Peri, & Cogill, 2014).

The second chapter of this thesis, highlights that, most of the studies on resiliency in food supply chains are concentrated on selected components of food supply chain (mainly agriculture) and do not tend to account for complex cross-level interactions. Furthermore, specifically in the overall context of food supply chains, there is a gap in our understanding of the conceptual meaning of resilience and its operation contributions to food supply chains (Tendall et al., 2015).

In addition, the literature review of this research has identified that, as mentioned above, the research on resilient supply chains is receiving more attention by researchers and professionals. However, the level of investigation into an explicit understanding on the part of resilience, its enablers and inhibitors, and its importance for their businesses, is rather more limited, particularly within the components and industries involved with food supply chains (Tendall et al., 2015).

In line with this, it is unclear, whether a single definition of resilience can be a normative or if there are multiple meanings of resilience (Keessen, Hamer, Van Rijswick, & Wiering, 2013). It is believed that the ambiguity of resilience has increased its popularity amongst researchers in different disciplines. Accordingly, this vagueness may result in the use of the concept of resilience in a subjective

manner or as Kirchhoff, Brand, Hoheisel, and Grimm (2010) argue it might be used as the backing of an argument for supporting the status quo.

1.1.　　Research Questions

This research has been conducted to obtain answers to the following research questions:

- ➢ What is the explicit definition of Supply Chain Resilience and how does it differ from Supply Chain Risk Management?

- ➢ What are the main enabling factors for a food supply chain to become resilient? How do these factors interact and how are they mitigated?

- ➢ To what extent (and why) do these enablers exist within British food supply chains in empirical scenarios?

- ➢ What strategies are more advantageous in creating a resilient food supply chain?

1.2.　　Research Aim

Food supply chains, like other supply chains, consist of multiple actors and stages that are responsible for adding value to the final product. The aim of this study is to investigate "*resilience*" as a form of capability for risk mitigation within them. This research identifies the influencing factors that can affect supply chain resilience, for example, its enablers, SC vulnerabilities and their interactions. The overall goal of this study is to identify the most influential food supply chain capabilities as well as the pertinent organisational competences, which can enable companies to bounce back and grow with minimal recovery time in the case of unexpected disruption scenarios.

1.3.   Research Objectives

I.   To undertake a comprehensive and critical review of the most relevant literature, including academic publications, white papers, and professional body periodicals on the current understanding of an emerging strategy in supply chain management, "resilience".

II. To define and draw the conceptual framework, that encompasses all elements of resilience for resilient food supply chains.

III. To explore the components of "resilience":

   ➢ In specific industrial contexts.
   ➢ Conceptualising the linkage between the enablers of resilience.

IV. To conceptualise the understanding of, and linkage between, supply chain resilience, organisational capabilities and sourcing strategies, within the major UK food supply networks.

Based on the above, and the ever-changing business environment that can produce uncertainty and disruption in food supply networks, this research investigates the concept of "*resilience*" within British food supply networks. The case study companies that took part in this empirical research are some of the market leading enterprises within their sector. The first case study company, is a multi-national company with over fifty years' presence in British food supply chains. The other two participating companies, were founded in Britain, and originated from the Lancashire region. All the case study companies, have an active presence in different stages of the British food chain, and have a large market share within the food industry in the United Kingdom (UK).

More importantly, this research identifies the building blocks of resilience from these evidently resilient companies, that have not previously been captured in academic/ practitioner literature. Food supply chains are responsible for the delivery of food to humans, as well as animals such as pets and farm animals. However, this research solely investigates the concept of resilience, within companies, that are specialized

in producing, procuring, processing and delivering high quality nutrients, through food supply networks for daily human consumption.

To obtain answers to the research questions and achieve the research aim and objectives, the researcher followed an interactive model (Figure **3**) for research design, where the research questions are the central binding point. This design map, enabled the researcher to display the core parts of the research and their interrelatedness. This model illustrates that the components of research are not linked in a linear way, rather, they are integrated and interconnected. The research questions function as the centre of the research design, to which all other components of research are directly connected. Maxwell (2012, p. 4) states that, *"research questions not only have the most direct influence on the other components, but are also the component most directly affected by other components; they should inform, and be sensitive to all other components".*

Research Questions

> What is the explicit definition of 'Supply Chain Resilience' and how does it differ from 'Supply Chain Risk Management'?

> What are the main enabling and inhibiting factors for a food supply chain to become resilient? How do these factors interact and how are they mitigated?

> What strategies are more advantageous in creating a resilient food supply chain?

Quest: Resilience enabling factors in UK Food Supply Chains

Farm

Processing/ Packaging

Distribution

Catering/ Retail

Consumers

Farm to Fork Network

Findings

Contribution to Theory

Contribution to Practitioners

Figure 2 Research aim and expected contribution to knowledge

1.4.   Research Contribution

The contribution of this research is as follows. First, the *theoretical contribution*. This research identifies the most pertinent enablers and deterrents of resilience within food supply chains. With the literature review identifiying the building blocks of the concept; more specifically the most pertinent to farm to fork networks. As "*it is noticed that both capabilities collaborate to facilitate or hamper the creation of supply chain resilience*" (Pereira, Christopher, & Silva, 2014, p. 631). Therefore, by identifying the enablers of resilience in the UK food supply chains, it is possible to construe that a lack of these facilitators can inhibit the extent of the resilience of a company's supply chain. Consequently, the literature review focuses on the enabling capabilities of resilience. In this aspect, the research develops a theoretical framework that illustrates how these contributors are linked and interrelated. This is achieved by considering various proposed theoretical frameworks for resilience (various industrial contexts) and critically examining their identified components and the findings of up to date literature.

Since resilience is still regarded as a novel field of research for academics active in the field of supply chain management. The resilience frameworks, identified in the literature review, are predominately related to manufacturing supply chains or organisational resilience. At the time of writing this thesis, little research had been conducted on the identification of resilience enablers. Moreover, no resilience framework had been developed for food supply networks, more specifically in British food supply chains. Furthermore, in this empirical study, the extent of applicability of the identified constituents of resilience, is evaluated against the case study companies, that play an active role in the different stages of British food supply networks, while the incongruous elements are eliminated. Finally, this research draws a line between two commonly misunderstood concepts amongst practitioners and academicians, which are the differences between supply chain risk management and supply chain resilience.

The second impact of this research is the *practical contribution*. To achieve this, the literature review plays an important role. It is used as a foundation for the development of the interview questions and the theoretical framework. In this empirical research, the interview questions are put forward to senior directors and managers of case study companies. As mentioned earlier, the case study

organisations that have contributed to this research, have an active presence within the UK food market and operate widespread, supply and distribution chains across the UK. Consequently, their responses will illuminate the elements of resilience on the British food supply networks. Notably, the findings of this research, could allow governmental authorities, practitioners and academics to focus and invest on the most important capabilities, that are pertinent to the creation of resilient food supply networks.

1.5.   Research Methodology Outline

The third chapter of this empirical research, justifies the choice of methodological approaches, by providing an in-depth literature review on various types of research, philosophies and approaches. To provide reliable answers to the research questions, as well as fulfilling the aims and objectives of the research, it followed a phenomenological research philosophy with an inductive approach. The researcher was required to have a clear understanding of the case study companies, their processes and different actors within their supply chains.

Chapter four discusses the data collection methods applied in this thesis, for instance; semi-structured face to face interviews, observational studies, documentation and archival records review. Furthermore, the advantages and limitations of each data collection method are explored and the processes that added to the validity of the findings of this qualitative empirical study explained. The process of triangulation of data collection methods, and the reasoning behind the number of interview participants and their respective case study companies, were also explored.

Seasoned researchers and writers on qualitative case research recommend that two to ten participants or research subjects are sufficient to reach saturation. Along these lines, Creswell (2009) recommends long interviews with up to ten people for a phenomenological study as an appropriate number of interview participants. In this empirical research, the investigator has conducted (excluding the pilot interviews) a total number of ten interviews with senior directors and managers, who gave a detailed and complete insight on the topic of this study. The interviewees were chosen due to their extensive work experience in food supply chains, and their direct role and responsibility in creating resilience, for the three case study companies that contributed to this research.
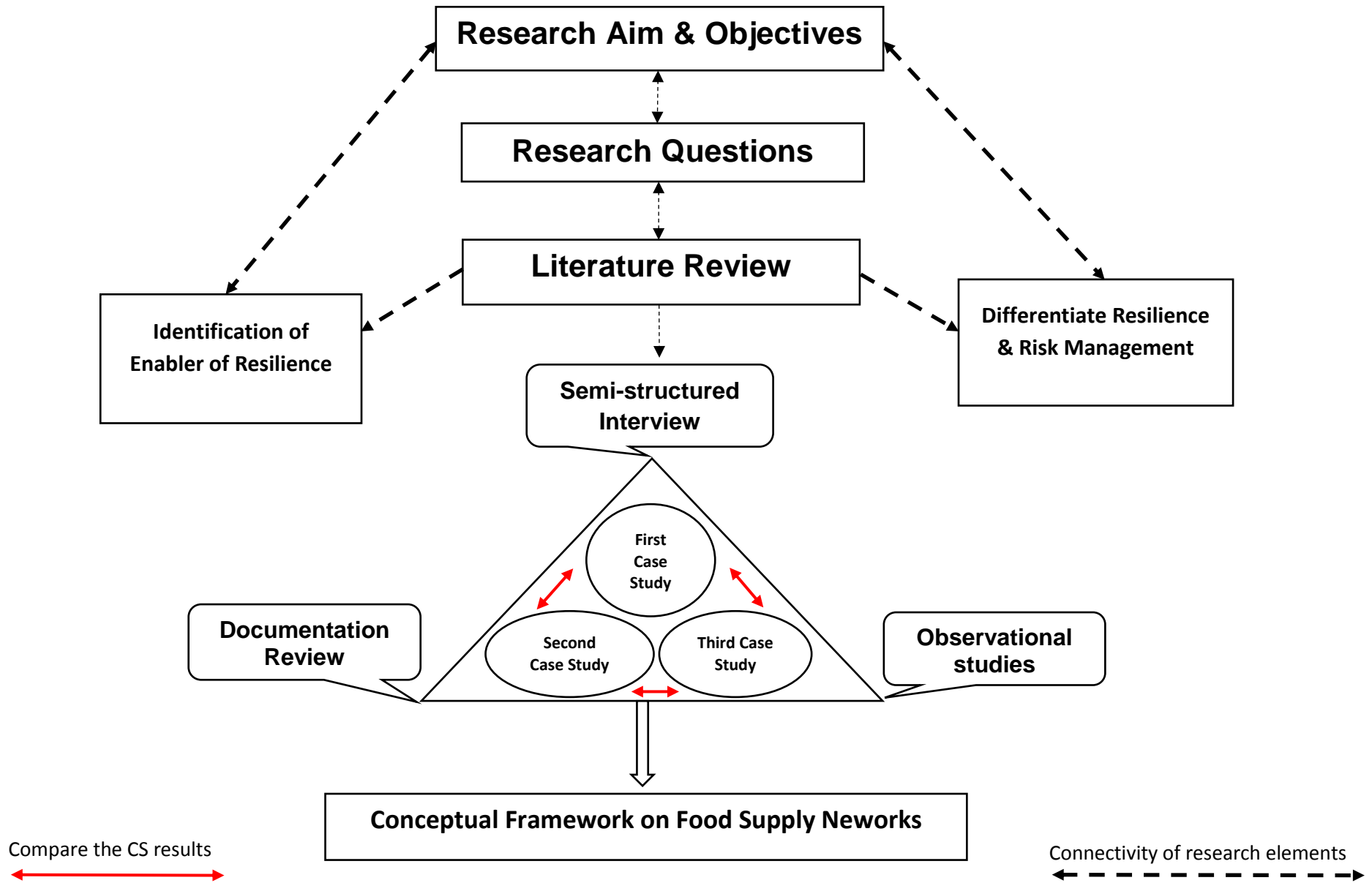
Figure 3 Research Design Flowchart

1.6.   Thesis Overview

Chapter 1 introduces the aims and objectives of this research. Additionally, it provides a summary of the necessity for conducting such research, by describing how the findings have contributed to the current body of knowledge.

Chapter 2 presents a comprehensive literature review. Within this chapter, different notions are introduced along with definitions of supply chain and organisational resilience. The literature review will identify gaps in the literature and, accordingly, in prior research studies. By the end of this chapter, the author develops a conceptual framework that will then be taken into the case study companies for further verification.

Chapter 3 discusses the various methods used for obtaining data. The benefits and limitations of the different approaches are evaluated, and conclusions are drawn regarding the selection of methods most appropriate to the aims and objectives.

Chapter 4 explains the research methodology. Furthermore, this chapter justifies the advantages and explores the limitations of each data collection method applied in this research.

Chapter 5 summarises the empirical results achieved through each research method and analyses the research findings. The case study companies, along with their business structure and market position, are presented. The viewpoints of senior and middle management were obtained and recorded using semi-structured in-depth interviews.

Chapter 6 discusses the findings of this empirical research. Whilst taking into consideration the literary sources, that were reviewed earlier in the second chapter of this thesis.

Chapter 7 summarises the novel results and reaches conclusions. In this final chapter, in line with the objectives of the study, the author presents practical recommendations based on the empirical research conducted to identify the building blocks of resilience within food industry.

Chapter Two:
Literature Review

2.1 Introduction

In their book, Business Research: A Practical Guide for Undergraduate and Postgraduate Students, Collis and Hussey (2009) describe a literature review as the process of exploring the existing literature to ascertain what has been written or otherwise published on a specific research topic. It is believed that a good literature review ensures that, firstly, important variables that are likely to influence a problematic situation are not left out of the study. Secondly, a clearer idea emerges as to what variables will be the most important to consider, why they are considered important, and how they should be investigated to solve the problem. Thus, the literature review helps with the development of the conceptual framework and hypotheses for testing. Thirdly, the problem statement can be made with greater precision and clarity. Fourthly, testability and replicability of the findings of the current research are enhanced and the investigated problem is perceived by the relevant scholarly community as relevant and significant. Finally, the researcher does not run the risk of *"reinventing the wheel which is considered a waste of time and effort to rediscover what is already known"* (Sekaran, 2010, p. 39).

Following the above guidelines, and in line with Jesson, Matheson, and Lacey (2011) and definitions of different types of literature reviews, the researcher conducted a scoping literature review. A scoping literature review *"sets the scene for a future research agenda and allows the researcher to understand what is already known, and then, using a critical analysis of the gap of knowledge"* (Jesson et al., 2011, p. 76). This type of literature review has helped the investigator to refine the research questions, concepts and theories. Furthermore, it has enabled the researcher to point the way to future research. The results of these methods are demonstrated in Table 9. A systematic literature search on the topic of supply chain resilience was also used, to ensure that no relevant research was overlooked and any bias was avoided. This approach guaranties thoroughness, replicability and consequently relevant results (Tranfield, Denyer, & Smart, 2003).
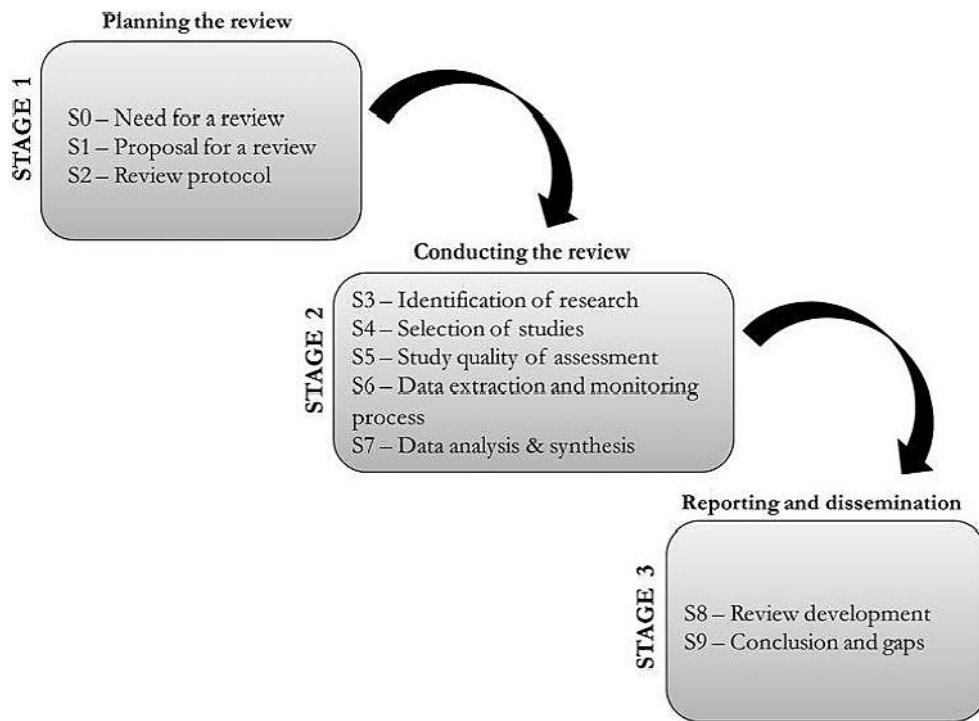
Figure 4 Stages for conducting a systematic literature review
Source: Adapted from (Tranfield et al., 2003)

This PhD research uses an inductive approach (3.4.1 below) therefore, the literature review is not used to identify and define themes and hypotheses, but to explicate the need and motivation of the study. This literature review critically examines the current state of the body of knowledge on resilience within supply chains and identifies its major enablers. Moreover, the extent and importance of resiliency for food supply chains and the enterprises that are involved throughout the farm to fork networks is also being scrutinized. To achieve this goal, key words from the research topic were used to run an initial quick online search. Words such as *"resilient supply chain"*, *"resilient organisation"* and *"risk in food supply chain"*, were investigated using Boolean searches to run the initial quick online search. Furthermore, the investigator looked at numerous diverse information sources; such as library catalogues, to find relevant printed journals or books in the libraries. In addition to this, digital/electronic library search engines form the University of Salford Search Our Library's Academic Resources (SOLAR) and the University of Northampton Electronic Library Search ONline (NELSON) were used. The websites enabled the researcher to obtain direct access to a vast number of individual full-text journal databases.

In a few cases, the desired article or book was not found in the library search engine, even so, the afore mentioned libraries have supported the author to obtain them through an inter library loan system. By using these services, the researcher ordered various books and articles from the British Library. Moreover, Google Scholar® search engine and CORE (COnnecting REpositories) website which indexes over 20 million Open access articles from the Universities repositories worldwide were used.

To obtain more information, unpublished doctoral research that was relevant to the topic of this empirical doctoral research at the University of Salford and the University of Northampton libraries, were reviewed. Additionally, as the context of this empirical research is British food supply chains, the researcher was keen to find out about the current unpublished relevant research available. Therefore, websites such as www.theses.com, which enabled the researcher to search the theses in Great Britain and Ireland was used. Another useful source of information that was used during the literature review process was the British Library's Electronic Theses Online Service (EthOS) that provided the researcher with a wider range of international relevant research. Finally, the author, as a full member of two highly renowned professional bodies that are highly active in research in the fields related to the topic of this empirical doctoral study (The Chartered Institute for Procurement and Supply and The Chartered Institute for Logistics and Transport) had the privilege to obtain direct access to their knowledge centres that are only accessible to members.

The systematic selection of the sources was conducted through several shortlisting phases. First, screening the title and the abstracts: in the initial step 594 sources were found. These were imported to Endnote referencing software, the duplicated references were eliminated, and the total number of sources reached 538. Second, reading the introduction and conclusion besides hovering over the paper's content refined the number of subject related sources to 276. Third, assessing the quality of the sources (journals, books and conference papers) and language accessibility, theoretical and empirical content analysis. The Endnote software has enabled the researcher to rate the sources from one to five stars. By the end of this phase, 63 sources were rated four and five stars. In the final step, guidelines by Miles and Huberman (1994) for the application of quality appraisal criteria were followed. Therefore, the researcher examined the sources research questions, methods and

execution of research, methodological rigour and contribution to knowledge. By the end of this systematic literature review, 32 sources (Table 10) were identified to answer the research questions (Section 1.1).

2.1.1 Literature Review on Conceptual Framework

As mentioned in the research objectives of this study (Section 1.3), the main objectives of this research are to prepare a conceptual framework for resilient food supply chain.

Chicksand, Watson, Walker, Radnor, and Johnston (2012) argue that, theoretical approaches enable the researchers, to obtain an in-depth insight into the complex working environment of today's organisations. This approach allows the researcher to have a wider view on the investigated phenomenon, while the information is detailed rather than obtained through simple observation and description of the phenomena. These theoretical approaches or theories are used to help researchers explore in-depth, how the phenomenon of interest behaves from a theoretical basis (Chicksand et al., 2012).

In addition, Maxwell (2012, p. 39) reports that, conceptual frameworks or theoretical frameworks *"are the actual ideas and beliefs that you hold about the phenomena studied, whether these are written down or not"*. Meanwhile, Sekaran (2010) gives a more detailed definition for conceptual frameworks. By considering that conceptual frameworks represent the researcher's beliefs on how certain phenomena (or variables or concepts) are related to one another (a model) and an explanation of why one believes that these variables are associated with each other (a theory); both the model and the theory follow logically from the documentation of previous research in the problem area. Therefore, *"Integrating a researcher's logical beliefs with published research, while taking into consideration the boundaries and constraints governing the situation, is pivotal in developing a scientific basis for investigating the research problem"* (Sekaran, 2010, p. 69). Furthermore, other scholars such as Huberman and Miles (1994, p. 18) define a conceptual framework as a visual or written product, one that "*explains, either graphically or in narrative form, the main things to be studied, the key factors, concepts, or variables and the presumed relationships among them*".

Sekaran (2010) adds that generating testable hypotheses is not necessarily obligatory to a research study, "*but a good theoretical framework is central to examining the problem under investigation*" (Sekaran, 2010, p. 69). After taking all this information into consideration, this thesis follows Sekaran's (2010) proffered guidelines in building a conceptual framework as follows:

In the first place, the author commences by introducing the definitions of concepts or variables inherent in resilient food supply chains. Therefore, the closely related concepts that are central to the main topic of the thesis (resilience) are reviewed and their centrality to supply chain resilience is explored. Accordingly, the body of knowledge on resilient supply chains is examined. Furthermore, the importance of resilient supply chains is highlighted. Then, the writer moves towards the identification of the enablers of resilience identified in the literature. Subsequently, the literature on resilient food supply chains and the importance of achieving such resilience is investigated.

In summary, the body of knowledge on the resilient supply chains and resilient organisations are examined, and the importance of this strategic (resilience) capability is highlighted. Considering the current state of research and in line with the study's research aims and objectives, the shortfalls within the literature on resilient food supply chains and enterprises is also addressed. Finally, a conceptual model that provides a descriptive representation of the theory is developed. This theory provides an explanation of the relationships between the variables that have a direct effect on the food supply chain and food enterprise resilience.

Before reflecting on the topic of this study, Supply Chain Resilience, it is necessary to clarify the stance of this thesis regarding the terms Supply Chain, Logistics and Supply Chain Management (their definition and differences).

2.2 Supply Chain, Logistics and Supply Chain Management

By reviewing the literature on a range of aspects of SC, it soon becomes clear that different terms are being utilised, or the same term (SC) is defined in different ways (Waters, 2011). In the paper, Reconciling Supply Chain Vulnerability, Risk and Supply Chain Management, Peck (2006, p. 128) notes that "*just as there are many takes on what constitutes a supply chain, there is confusion over the scope of Supply Chain Management (SCM), not least its ambivalent relationship with logistics*". Some scholars argue that this is because the term SC is a relatively new one in the lexicon of management. They report that this term was first used in academic papers in the early 1980s (Christopher, 2005; Christopher & Holweg, 2011; Emmett, 2010). Specifically, according to Melnyk, Narasimhan, and Decampos (2014) the term was first invented in 1982 when Keith Oliver, a consultant at Booz Allen Hamilton, used it in an interview with the Financial Times.

Christopher (2005) focuses on the value in describing SC as a network of organisations that are linked, through upstream and downstream relationships in different processes and activities, that produce value in the form of products and services in the hands of the ultimate customer. Along the same lines, Chopra and Meindl (2013) believe that the objective of every SC is to maximize the generated value. For instance, the difference between what the value of a final product is to the customer, and the costs the SC incurs in fulfilling the customer's requirements. In addition, it is observed that in some of the literature, the terms logistics and SC are sometimes used interchangeably. Although Harrison (2010, p. 7) draws a distinction between the two and describes: "*a SC as a network of partners who collectively convert a basic commodity into finished product that is valued by end-customers, and manages returns at each stage; whereas, logistics is defined as the task of coordinating material flow and information flow across the SC to meet end-customer needs*".

Moreover, SCM and other similar terms, such as network sourcing, supply pipeline management, value chain management, and value stream management have become subjects of increasing interest in recent years, to academics, consultants and business management (Croom, Romano, & Giannakis, 2000). All in all, authors such as Christopher and Peck (2004) have proposed the term supply networks could

be a more realistic term than supply chains. Equally, Sheffi (2005, p. 82) considers the term SC as a *"simplification of the terms supply network of suppliers, manufacturing plants, retailers and the myriad supporting, storing, shipping, selling and servicing goods"*. Therefore, the author believes that there is no dichotomy between these terms and in this thesis, they could be used interchangeably.

In his doctoral thesis, Pettit (2008) reports that there are many definitions of SCM. Some writers on the topic of supply chain resilience argue that the term SCM has been used by those who claim that *"logistics"* does not provide a broad enough feel for the subject and believe that logistics is a narrower subject concerned only with the movement of material within a single organisation (Waters, 2011). In a similar way, Zokaei and Hines (2007) claim that there is no one single definition of either SC or SCM. While Skjoett-Larsen (1999) suggests that, one reason for this is because the supply chain has been viewed and studied from different theoretical perspectives. Nevertheless, Croom et al. (2000) caution that a quest for a universal, homogenous definition may lead to unnecessary frustration and conflicts, and also highlight the fragmented nature of the field of SCM, drawing as it does on various antecedents including industrial economics, systems dynamics, marketing, purchasing and inter-organisational behaviour.

Despite definitional uncertainty, this thesis adopts Slack's (2009, p. 212) understanding of SCM, where it is defined as: *"the management of the relationships and flows between the string of operations and processes that produce value in the form of product and services to the ultimate customer"*. Where Slack (2009) distinguishes the objective of SCM as satisfying the end customer: each part of the SC must consider the end customer, no matter the distance between the operation and the final customer.

2.2.1   Aims and Objectives of Supply Chain Management

It is a proven fact for both practitioners and academicians, that for a capitalist business which is working in a competitive market, in order to survive, evolution is an imperative, not an option (Gordon & Rosenthal, 2003; Sheffi, 2015a). Significantly, supply chain management does play an important role for a business to grow. According to Emmett and Crocker (2006) the benefits of SCM come as the

levels of inventories are reduced and the on time in full (OTIF) delivery of products is made and profits, therefore, increase. They, along with other authors on SCM, recognise five crucial areas in any organisation of successful SCM, which are: lead time (Bruneau et al., 2003), customer service, adding value, trade-offs and information. As mentioned earlier, the main objective of SCM is to fulfil the end customer's needs by supplying the appropriate products and services, at the right time and at a competitive cost. Different authors report that the main objectives of SCM are to achieve appropriate levels of operations performance in terms of quality, speed, dependability, flexibility and cost (Chopra & Meindl, 2013; Emmett, 2010; Emmett & Crocker, 2006; Slack, 2009). While managing the flows in the SC can become a source of competitive advantage and lead to the concept of effective SCM.

SCM is believed to be responsible for a significant element of competitive advantage between companies. Cristopher (2005) recognises that the source of competitive advantage can be found, firstly, in the ability of the organisation to differentiate itself from its competitors in the eyes of the customer. Secondly, it allows the company to operate at a lower cost and hence at a greater profit (Christopher, 2005). However, Bourlakis and Weightman (2004) do not completely concur with Christopher, and argue that other factors rather than cost and price can be considered as winning order criteria. They believe that in more affluent communities, in general, customers want quality and lower prices.
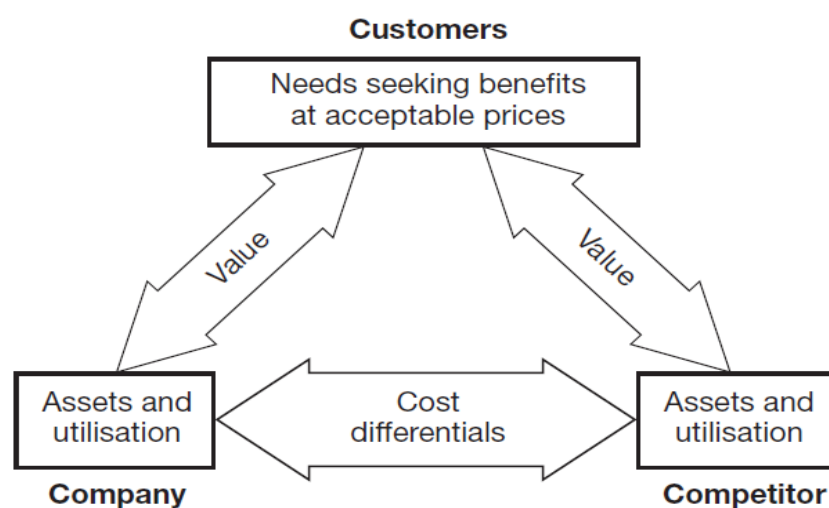
Figure 5 Competitive advantages and 3 C's
Source: Adapted from (Christopher, 2005)

Bearing in mind the previous comments, it has been observed that different writers, managers and consultants use different terms and concepts when explaining the importance of competitive advantage. Competitive advantage can be considered as part of a strategic capability and can be defined *"as the resources and competences of an organisation needed for it to survive and prosper"* (Johnson, Scholes, & Whittington, 2008, p. 95).

Table 1 shows the elements of strategic capabilities that are employed by companies to achieve competitive advantage. They categorise organisational resources in two sets: tangible resources (the physical assets of an organisation such as plant, people and finance) and intangible resources or non-physical assets (such as information, reputation and knowledge). In *Table 1*, Johnson et al. (2008) define competences as the skills and abilities by which resources are deployed effectively, through an organisation's activities and processes.

	Resources	Competences
Threshold Capabilities	**Threshold Resources** • Tangible • Intangible	**Threshold Competences**
Capabilities for Competitive Advantage	**Unique Resources** • Tangible • Intangible	**Core Competences**

Table 1 Strategic capabilities and competitive advantage
Source: (Johnson et al., 2008, p. 95)

The dynamic capability or *"the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments"* (Teece, Pisano, & Shuen, 1997, p. 509) is another method used to investigate the organisational capabilities, to overcome the ever-changing environments. It is believed that the dynamic capabilities of an organisation can: firstly; ensure a source of sustainable competitive advantage (Pereira et al., 2014). Secondly, by recognising that their *"processes rely on quickly created new knowledge and iterative execution to produce adaptive, but unpredictable outcomes"* (Eisenhardt & Martin, 2000, p.

1106) and thirdly, it allows the usage of an organisation's competences in a more efficient and effective manner toward value creation (Castaldi et al., 2011). The foundation of dynamic capability is based on the distinct skills, processes, procedures, organisational structures, decision rules and disciplines of an organisation (Eisenhardt & Martin, 2000; Pereira et al., 2014; Teece, 2009). Therefore, based on the above, it is evident that the dynamic capability approach is a suitable method for the topic of this research, which is the identification of the enablers and inhibiting capabilities that allows it to become resilient.

The definitions of SC, logistics and SCM within the realm and scope of this thesis were defined, and their importance is highlighted. The following sections examine literature on the current situation of supply chains (with greater emphasis on food supply chains) and the challenges which enterprises (in general) and food organisations (in specific) face to survive and grow.

2.2.2 Supply Chains and their Challenges

Globalisation has affected the world's economy and thus the pace of transformation has been significant (Chopra & Meindl, 2013; Cox, Chicksand, & Yang, 2007; Melnyk, Narasimhan, et al., 2014; Mena & Stevens, 2010; Oehmen, Ziegenbein, Alard, & Schönsleben, 2009). The industrial revolution of the eighteenth and nineteenth centuries heralded a major turning point in the evolution of the human species (Dhingra, Kress, & Upreti, 2014). At the same time, the global population has now increased from a few hundred million before the industrial revolution, to an estimated 7.3 billion today (Census, 2016). In a recent United Nations report in 2015, titled "*World Population Prospects: the 2015 revision*," it was predicted that the human population will reach 9.7 billion by the year 2050. Therefore, the need for boosting productivity and increasing profitability in the capitalist west has gone hand in hand with demographic growth and the implementation of effective SCs is central to such need.

Major area	Population (millions)			
	2015	2030	2050	2100
World	7 349	8 501	9 725	11 213
Africa	1 186	1 679	2 478	4 387
Asia	4 393	4 923	5 267	4 889
Europe	738	734	707	646
Latin America and the Caribbean	634	721	784	721
Northern America	358	396	433	500
Oceania	39	47	57	71

Table 2 POPULATION OF THE WORLD AND MAJOR AREAS, 2015, 2030, 2050 AND 2100
Source: United Nations, Department of Economic and Social Affairs, Population Division (2015).

Modern SCs are becoming increasingly complex to satisfy customer needs, by delivering the *"right product"*, at the *"right time"* and at the *"right cost"* (Carvalho, Barroso, Machado, Azevedo, & Cruz-Machado, 2012a). The three flows within SCs (information, physical distribution and money transfers) act to form large parallel shape chains (Jüttner, 2005). To satisfy the demand created by the population, in today's global business environment, supply chains have increased in both length and complexity (Blackhurst, Craighead, Elkins, & Handfield, 2005; Kamalahmadi & Parast, 2016; Reyes Levalle & Nof, 2015; Sheffi, 2015b).

Global supply chains and transport networks form the backbone of the global economy, fuelling trade, consumption and economic growth. Therefore, supply chains are stretched throughout the globe and business environments have become an international playing-field (Chen, Liu, & Yang, 2015; Chopra & Meindl, 2013; Mangan, 2012; Melnyk, Closs, Griffis, Zobel, & Macdonald, 2014). It is estimated that as many as 25 different entities participate (***Figure 19***) in an average global supply chain (Voss & Whipple, 2009).

To gain competitive advantage, organisations must outclass their competitors through their logistics performances. In other words, today's customers require full responsiveness, high quality products, and high reliability of supply, in small time windows at the lowest cost (Bourlakis & Weightman, 2004; Dong, 2006; Kleindorfer & Saad, 2005; Vlajic, Van der Vorst, & Haijema, 2012). Thus, organisations have turned their attention to their SCs and are trying to improve the efficiency by eliminating most of their non-value adding activities. To achieve this objective,

companies try to re-engineer their supply networks, to reduce their none-value added activities (strategies such as lean manufacturing practices), which leads them into higher levels of supply chain risk (Blackhurst et al., 2011; Deane, Craighead, & Ragsdale, 2009; Kleindorfer & Saad, 2005; Sheffi, 2015a). This approach causes them to become *"leaner"*.

Lean thinking is based upon a mind set of *"continuous improvement",* aimed at reducing waste and eliminating activities that do not add customer value (Schonberger, 2007; Stecke & Kumar, 2009). Accordingly, lean production is one of the initiatives that many major businesses around the world have been trying to adopt, to remain competitive in an increasingly global market (Carvalho, Duarte, & Machado, 2011; Dhingra et al., 2014; Winston, 2014; Zarei, Fakhrzad, & Jamali Paghaleh, 2011). It is argued that, by applying this strategy, the likelihood of disruption that could have a major impact on their supply chain performance increases (Blackhurst et al., 2005; Wagner & Bode, 2008; Zsidisin, Melnyk, & Ragatz, 2005).

Nevertheless, some authors have argued that lean SCs are more vulnerable to logistical disturbances and are less robust and consistent in their performances (Dhingra et al., 2014; Dong, 2006; Kleindorfer & Saad, 2005). Consequently, companies with vulnerable SCs will be ousted by their competitors, because of a lack of competitive power (Christopher, Mena, Khan, & Yurt, 2011). In addition, Asbjornslett and Rausand (1999) claim that organisations are more vulnerable, when management is not fully aware of the threats and vulnerabilities, which their supply chain is facing in their day to day operations. Although the elimination of all the sources of vulnerability and risk in the supply network is highly unlikely, academics and practitioners have explored different measures, that can minimise such vulnerability and risks as well as, and, accordingly, the likelihood of disruptions.
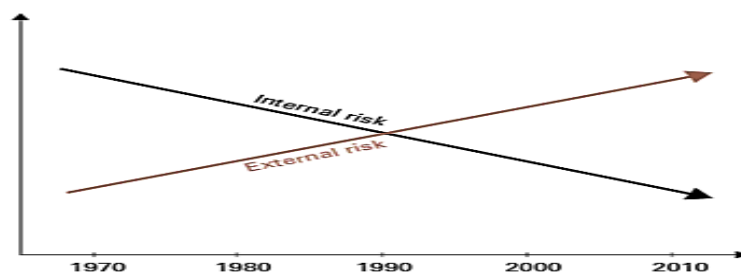
Figure 6 Rebalance of types of risks in supply chains
Source: Adapted from: (Manners-Bell, 2014)

Meanwhile, Manners-Bell (2014) reports that, in the wake of the development of new business strategies, such as lean production and outsourcing business functions, the number of internal business risks have decreased. But at the same time, there was a sharp rise in the number of external sources of risk. The following sections will scrutinise the different types of risks that affects business operations and their effect on food supply chains.

In recent years, many events that have led to disturbances in SC processes have been reported, including, for example, supplier failures caused by natural disasters or fires in warehouses, delivery delays due to traffic accidents, and product recalls due to a lack of fulfilment of quality or safety requirements (Jüttner, 2005; Sheffi, 2005, 2015a; Vedel & Ellegaard, 2013). Disruptions to supply chains can prove costly, and it has been reported that supply chain disruptions have a direct effect on share prices, which could cause the affected company share value to drop on average by seven percent (Bhatia et al., 2013). Furthermore, it has been reported that both the frequency and the intensity of "disasters" (disruptions) is on the rise (Day, 2014). Figure **7** shows the total number of disaster and emergency declarations in the United States of America between 1953 until April 2016 (FEMA, 2016).
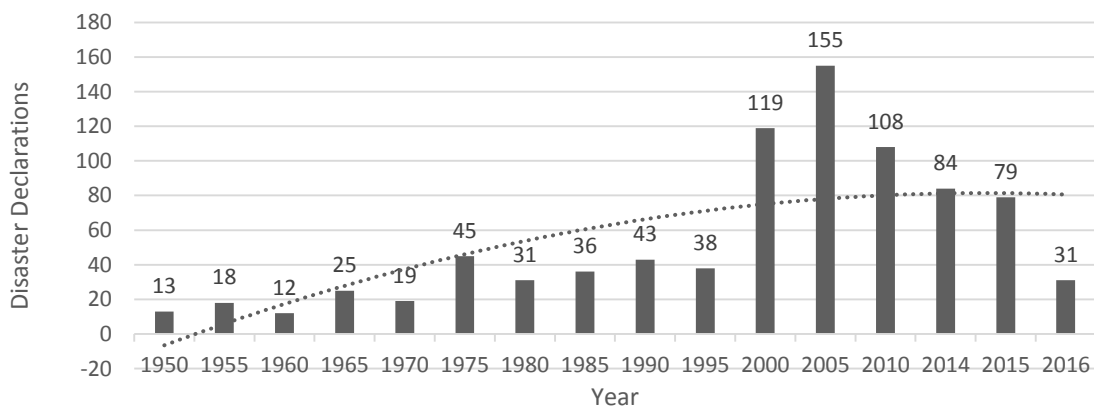
Figure 7 US Federal Disaster Declarations, 1953-2016 with trend line.
Source: Adapted from (FEMA, 2016)

It is reported that, the effect of disruptions on the companies' operations and performances, consistently have a negative correlation. Additionally, examples of companies that were forced to leave the market due to disruption have been reported by various authors (Blackhurst et al., 2011; Munoz & Dunbar, 2015; Rice, 2013; Sheffi, 2005, 2015a) and will be discussed further in the following chapters.

2.3   Supply Chain Risks

The existence of change and uncertainty in life have been well-understood facts for many centuries: as Heraclitus, the 6th Century B.C. Greek philosopher stated, *"The only constant in life is change"*. Yet, many of us do take change for granted, and because of this feel unprepared to adjust ourselves to the changing environment. This section explores the term risk, its forms and various classifications of supply chain risks.

The word risk derives from the early Italian word *"Risicare"* which originally meant *"to dare"* and, in this sense, risk is perceived as a choice rather than a fate (Massingham, 2010). The early literature on entrepreneurship discussed risk as a good thing and risk-taking was deemed a positive action leading to market innovation (Schumpeter, 1934 cited in Massingham, 2010). The most common contemporary view, however, is that risk infers the possibility that something may go wrong. The Stanford Encyclopaedia of Philosophy (2007) explains that risk is an unwanted event with negative consequences. In one of the early books on risk and uncertainty, Knight (1921) argues that the terms *"risk"* and *"uncertainty"* are terms that, in practice, are often used interchangeably; however, Knight believes that, in the technical sense they are two quite different concepts. Risk and uncertainty are separated by the suggestion that if one does not know for sure what will happen, but knows the odds, that is risk, and if one does not even know the odds, that is uncertainty. Hence, uncertainty is, the *"realm of judgement"*. This highlights Vorst, Beulens, Wit and Beek's (1998) defininition of uncertainty, as a condition in the SC where the decision-maker lacks information about the supply network and the environment; he/she is, therefore, unable to predict the impact of the uncertain event on SC.

The literature shows that, modern supply networks are constantly under the threat of disruptions. Moreover, Marchese and O'dwyer (2014) call attention to a survey conducted by Deloitte on large international manufacturing and retail companies, which revealed that SC risk is a troubling issue for managers. Among the executives surveyed, 48% reported an increase in the frequency of SC risk events, that had had negative outcomes in the last three years, compared to only 21% who reported a decrease. Furthermore, not only are these risks becoming more frequent, they are

also becoming costlier, as 53% of the survey's respondents stated. With the three costliest outcomes of SC risk events revealed as; the erosion of margins (54% of respondents), shifts in demand that elude effective management (40%), and disruptions in the flow of physical products (36%). From restaurants, to pharmaceuticals, to consumer products, SC risks increasingly permeate a wide range of sectors (Marchese, Paramasivam, O'Dwyer, & Sopher, 2013).

Whilst the consequences of disruptions created by risks (Section 2.3.5 below) might be; financial losses, a negative corporate image or a bad reputation, eventually accompanied by a loss in demand, as well as potential damage to security and health (Jüttner, Peck, & Christopher, 2003; Marchese & O'dwyer, 2014; Thun & Hoenig, 2011). It is noted that, disruptions that affect one part of a SC, can reverberate throughout the chain and create disastrous effects in other parts of the supply network (Jüttner, 2005; Park et al., 2011; Vespignani, 2010).

As mentioned in Section 2.2 above, the application of certain production strategies, those based on lean thinking to make supply networks more efficient, has also made them more susceptible to disruptions (Christopher & Holweg, 2011; Christopher & Lee, 2004; Pettit, 2008). It is, therefore, crucial for companies to have an effective SC Risk Management programme (2.3.6 below) in place (Diehl & Spinler, 2013). These concerns are especially relevant in the fast-moving consumer goods (FMCG) industry, which is characterised by low margins, high pressure for product availability, innovation and large marketing investments.

2.3.1 Classification of Risks

Risk infiltrates in every dimension of our lives, both personal and professional. In every element of our daily routine, risks are encountered and managed. Supply chain risks can be as wide-ranging and different as the industries that are affected. Increased supply chain risks have been the major unintended consequence of two of the most significant business trends of recent decades: globalization and lean production (DHL, 2015; Diabat, Govindan, & Panicker, 2012). Driven by the quest for lower manufacturing costs or access to specialist capabilities, the increasing willingness of companies to source materials and components from around the world, has greatly increased the potential points of supply chain weakness, especially as some key production sites are now located in regions more vulnerable to natural disasters (Harrington, 2015; Zsidisin & Ritchie, 2008).

In addition, Rao and Goldsby (2009) report that, supply chain risks can be classified in various ways: *primarily* by source of the risk, *secondly* by the nature of its impact and *lastly* by the extent of its influence. Indeed, diverse classifications of SC risks can be found in the literature. Risk itself has been termed differently by different authors or used interchangeably with alternative terms. The following are some of the most common words used for risk in the literature: disturbance (Mason-Jones & Towill, 1999), disruption (Blackhurst et al., 2005), vulnerability (Svensson, 2000), uncertainty (Carvalho, Barroso, Machado, Azevedo, & Cruz-Machado, 2012b; Vorst et al., 1998), disaster (Boin, Kelle, & Clay Whybark, 2010), and risk (Chopra & Meindl, 2013). It is notable that, "*no consensus is shown among authors about these concepts*" (Carvalho, Barroso, et al., 2012b, p. 330).

The academic literature within the domain of SC, has sought to differentiate between the various forms of risk. On the one hand, by focusing on the availability of information, and on the other hand, by the intensity of the events resulting from risk (Oehmen et al., 2009). At the same time, some authors differentiate and classify risks based on the level of their predictability and their impact, ranging from completely unknown risks to completely known risks, and in terms of serious and immediate danger (Ghadge, Dani, & Kalawsky, 2012). Ponomarov and Holcomb (2009), argue that all activities in each SC are potentially subject to inherent risks. For instance, an unexpected disruption from external sources such as a natural

disaster or internal sources such as a failure to integrate all functions in SC may occur. Others categorise supply chain risk into two dimensions: operational risk or disruption risk. Tang (2006) describes operational risks as the inherent uncertainties, such as the uncertainties in demand, supply and costs. While describing disruption risks as, interruptions in the business flow, that are materialised by natural and man-made disasters. Such as earthquakes, floods, hurricanes, terrorist attacks, or economic crises, namely currency evaluation or strikes.
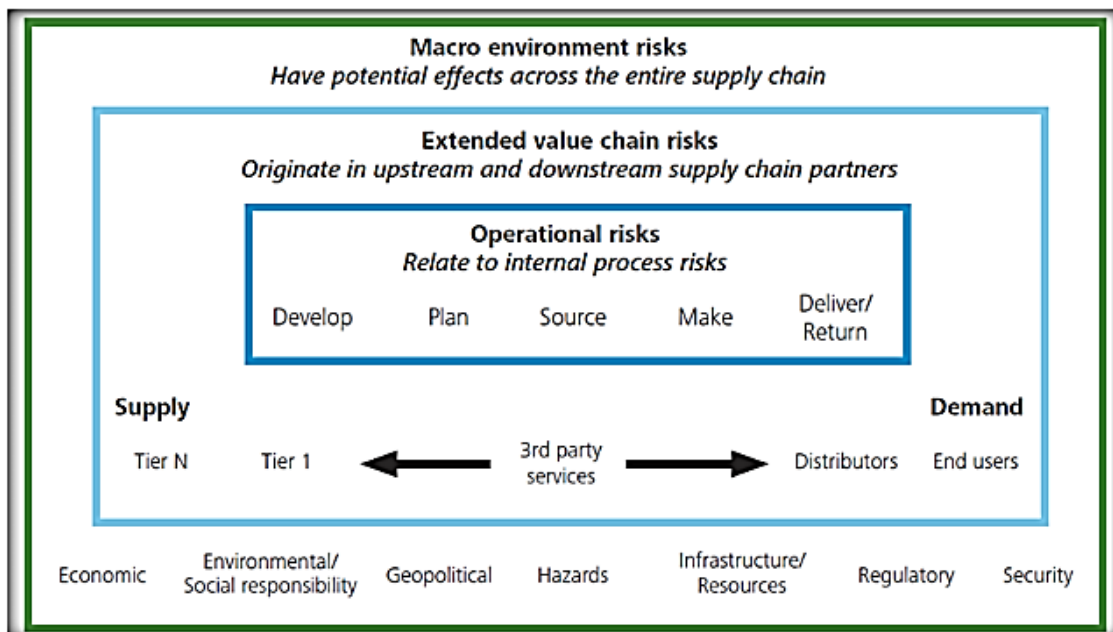
Figure 8 Supply Chain Risks
Source: Adapted from (Deloitte, 2012, p. 3)

Figure **8** illustrates how SCs are under constant threat from four types of risks: macro- environmental, extended value chain, operational and functional. The following bullet points are drawn from (Deloitte, 2012, p. 5) and explain each risk in more detail:

Macro-environmental risks relate to the external forces that affect all the elements of the supply network. Such risks are generated by changes in global business, most especially globalisation. That on the one hand, has added value by giving access to less expensive labour and materials, and, on the other hand, has contributed to the complexity of supply networks.

Extended value risks are those that companies face in their supply networks (up and down stream), and relate to practices such as out-sourcing or reduction of the supplier base. Again, although these can add to a company's efficiency, they could increase the risk of major supply disruption.

Operational risks are those that relate to a company's product development, manufacturing and potential disruption to such operations. Despite the efficiencies created by lean production, just in time inventories and capacity rationalization. Again, these practices have reduced the margin of error and made SCs susceptible to potential disruptions.

Functional risks are related to the risks that support day to day activities, such as finance, human resources and legal and informational factors.

Pointedly, Christopher and Peck (2004) categorize SC risks into three categories: internal to the firm, external to the firm but internal to the SC network and, finally, external to the network. Similarly, other prominent academics in the field of SC risks, consider them as organizational, network or comprising of natural or man-made disasters (Ghadge et al., 2012; Jüttner et al., 2003; Lockamy & McCormack, 2010; Wagner & Bode, 2006). These risks are then grouped, based on similarity and their interdependent nature as follows:

Organizational risks commonly comprise of inventory risk, process/operational and management risk.

Process or operational risk can be defined as risks initiated by operational events, disrupting material or information flow within the SC.

Management risk is the type of risk that arises from management's inability to anticipate and react to market demands. According to Ghadge et al. (2012), SCRM literature lacks the identification of management risk as a critical factor contributing to a business's success.

Network-related risks arise from interactions between organizations within the SC network. According to Ghadge et al. (op.cit), supply and demand risks are the most studied risks in the dicipline of SC risk management.

Environmental risks are defined as events driven by external forces, such as the weather, earthquakes and political, regulatory and market forces. For manufacturing companies, it is natural catastrophe risks that have served to focus the most attention on supply chain risks in recent years – notably the Thailand floods and the Tohoku earthquake, both in 2011 (Sheffi, 2015a). These risks had a significant impact on various industries, especially the automotive and electronics sectors, where they clearly demonstrated the fragility of existing supply chains.

Reputational risks are the risks that occur due to quality issues in the supply chain. Quality issues if not detected in a timely manner can easily escalate and lead to reputational risk. In some industry sectors, quality risks have become a primary priority for senior leaders. In the pharmaceutical industry, for example, one of the most critical risks is the so-called "*regulatory shutdown*" imposed by regulators such as the U.S. Food and Drug Administration in response to quality issues (DHL, 2015).

Cyber risks have faced the biggest change in recent years, with the speedy growth in digital communication and the increasingly interconnected nature of products, companies and supply chains. The rise in the frequency of severe cyber attacks has been staggering, and it can be expected that this will increase even further in the future (Mikkelsen & Khan, 2015). Cyber risks can cause reputational damage, operational disruption, intellectual property loss (Degun, 2013; Khan & Sepulveda Estay, 2015) and impacts all industries from finance to healthcare (Verzion, 2016).

2.3.2 Frequency and top 10 Supply Chain Risks

Figure 9 shows top SC disruption pressures which have been indicated by managers around the globe.
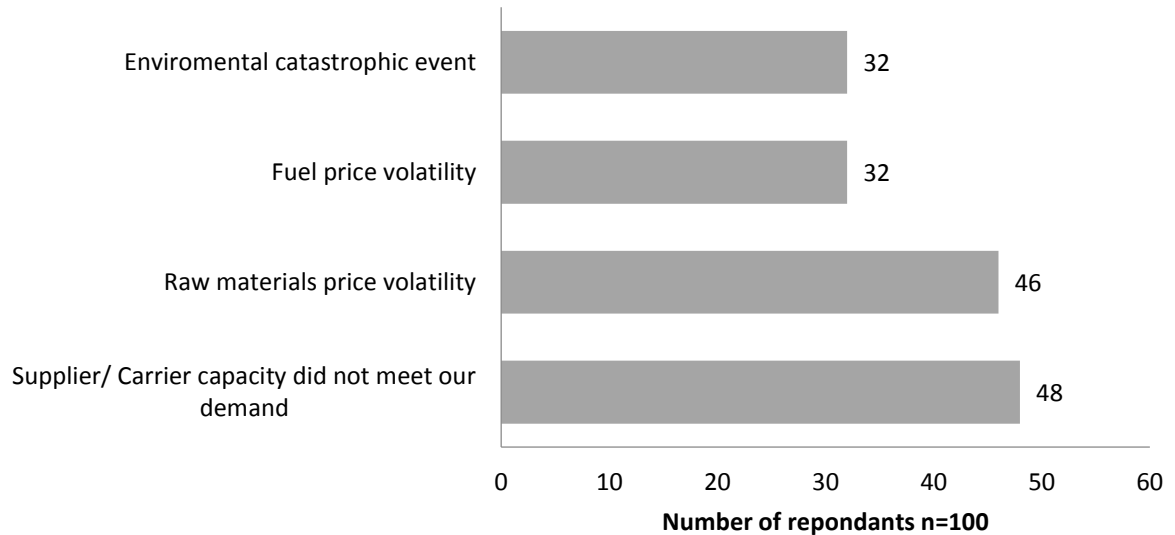
Figure 9 Supply chain disruption pressures
Source: Adapted from (Ball, 2012)

In a recent survey by DHL, of more than four hundred companies participating, more than 70% reported suffering at least one instance of supply chain disruption in the previous year (DHL, 2015). With the rise of risks such as natural disasters, socio-political turmoil and many other risks, it is extremely important that companies can detect, monitor, and plan in advance, for events capable of damaging productivity, destroying profit and disrupting the supply chain.

DHL overcomes this strenuous task with the collaboration of its red of partners around the globe, being active in 220 countries and territories. It is reported that DHL has more 'eyes on the ground' than most organizations, operating 24 hours a day, seven days a week. This important resource enables DHL to continuously track, collate and analyze the world's most disruptive events, using this data to inform its innovative supply chain risk management platform, Resilience360®. To achieve better outcomes and greater supply chain resilience, DHL Resilience360® platform also partners with the world's leading risk intelligence data providers and delivers relevant disruption data to customers, providing alerts in near-real time along with detailed, regularly updated reports. Assessing over 258,000 records from the

Resilience360® platform in 2015, DHL analysts have identified (Figure **10**) the top 10 disruptive events (DHL Resilience 360, 2016).

Figure 10 Major Sources of Disruption on SCs
Source: Adopted from: (DHL Resilience 360, 2016)

A study by Supply Chain Management World (SCMWorld) has identified that the second biggest level of concern in the eyes of SC professionals, was over potential natural disasters. Therefore, practitioners view extreme weather as a rising worry in their businesses (O'Marah, 2015a). Figure **11** shows the percentage changes in perceptions of external risk from 2013 to 2014:
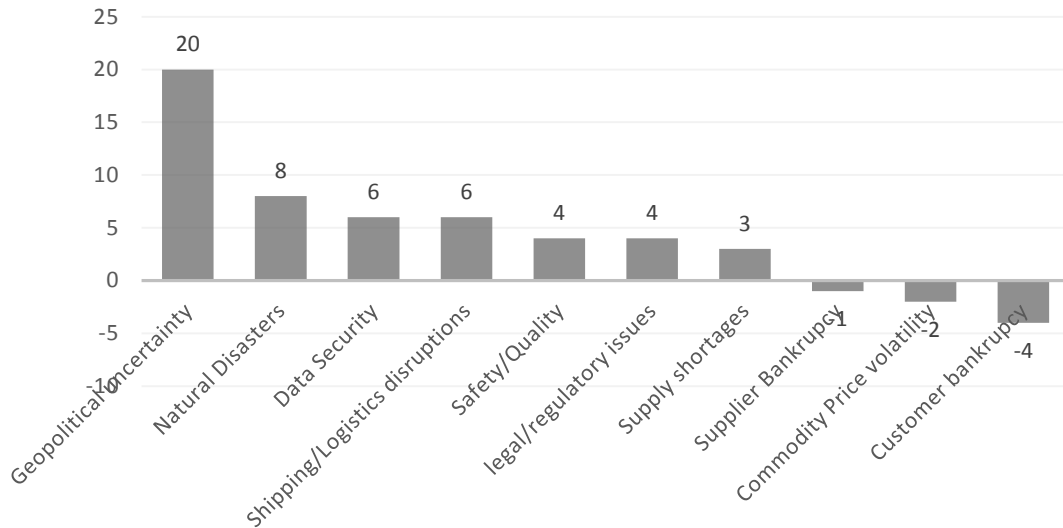
Figure 11 External threats percentage change from 2013 to 2014
Source: Adapted from: (O'Marah, 2015a)

2.3.3   Risk and Company Performance

It is suggested that any serious disruption from each of the sources of risk (2.3.1 Classification of Risks), can or will affect the performance of a company in predictable ways. Figure **12** shows the sequence of actions and the metrics of any relevant performance over time and in eight distinct phases:
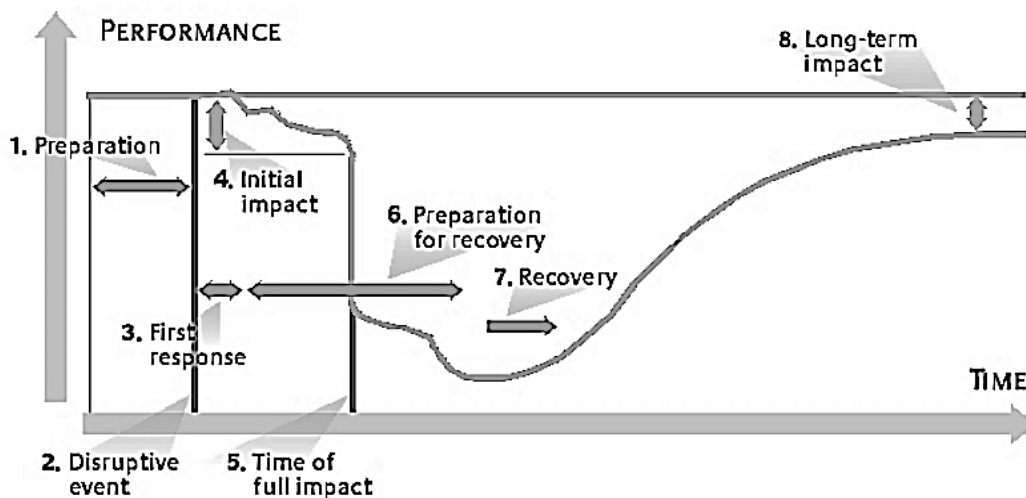
Figure 12 Disruption Profile
Source: Adapted from (Sheffi & Rice, 2005)

Preparation: in some cases, a company can foresee and prepare for disruption, thus minimizing its effects.

The Disruptive Event Itself: this may be of a different kind, including, for example, tornado hits, terrorist attacks, a supplier going out of business, or a union calling a "*wildcat*" strike.

First Response: whether there is physical disruption, labour disruption, or an information technology disruption. The first response is aimed at controlling the situation, saving or protecting lives, shutting down affected systems and preventing further damage.

Initial Impact: the full impact of some disruptions is felt immediately.

Full Impact: whether it is immediate or delayed, once the full impact hits, performance often drops precipitously.

Recovery Preparations: such preparations for recovery typically start in parallel with the first response and sometimes even prior to the disruption (if it has been anticipated).

Recovery: to return to normal operational levels, many companies make up for lost production by running at higher-than-normal utilization, using overtime as well as suppliers' and customers' resources.

Long-Term Impact: it typically takes time to recover from disruptions, but if customer relationships are damaged, the impact can be especially long-lasting and difficult to recover from.

2.3.4 Supply Chain Vulnerability

As it was pointed out in section 2.3, different authors use a range of different words to describe risk. However, vulnerability is one of the most common words within the literature on SC risk and this section, therefore, assesses the literature that deals with vulnerability.

Today's business environment is harsher for several variable reasons. Firstly, natural and man-made disasters occur more frequently (Figure **13**). Secondly, SCs

are becoming more complex and multi-tiered. Thirdly, to improve their financial performances, SC managers must apply initiatives to boost their revenues (just in time inventories, the reduction of supplier bases and outsourcing). However, it is believed that driving a business strategy focused primarily on cost reduction without sufficient regard for risks, could make the food supply chain even more brittle (Manning & Soon, 2016; Viswanadham & Samvedi, 2013). Finally, competitive pressures force managers to take *"calculated risks"* to improve the company's standing in the market. All in all, these risks have adverse consequences and make SCs more vulnerable and brittle (Dani, 2009; Hollnagel, Woods, & Leveson, 2007; Svensson, 2000; Takahashi, 2011; Tang & Tomlin, 2008; Wagner & Bode, 2006; Zsidisin et al., 2005).
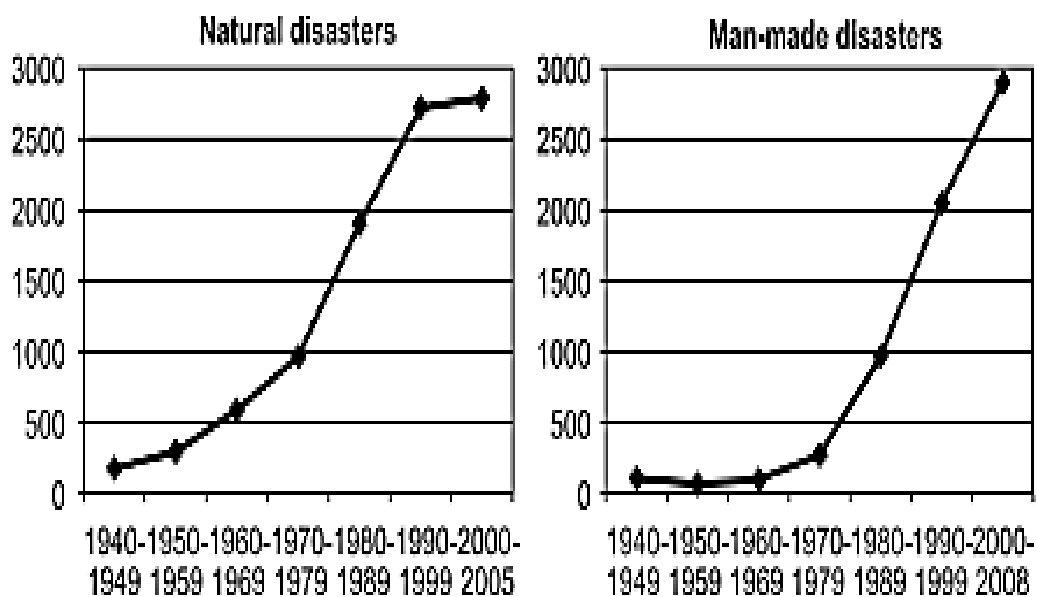
Figure 13 Disruption of natural and man-made disasters over time
Source: Centre for research on Epidemology of disasters, retrieved from (Wagner & Neshat, 2010)

Throughout the progress of the disaster, from the start, during and after supply chain disruptions, companies can lose; up to seven percent of their market share, revenue and incur high recovery costs (Bhatia et al., 2013). It has been claimed that *"if supply chain managers were more capable of measuring and managing supply chain vulnerability, they could reduce the number of disruptions and their impact"* (Wagner & Neshat, 2010, p. 121).

As mentioned before, there are confusing proclamations regarding vulnerability and risk. For example, some authors (Sheffi & Rice, 2005) believe that reducing the vulnerability within supply chains, is equivalent to a reduction in the likelihood of a disruptive event, which results in an increase of resilience. However, others such as Pereira et al. (2014) argue with this statement and advise that this is not always the case, as predicting the likelihood of a risk is sometimes impossible and there is no assurance that reducing risks will lead to less vulnerability of supply chain or more resilience. Described below, are some of the approaches that categorize supply chain vulnerability.

The concept of vulnerability had initially been used in military applications, but; Asbjornslett and Rausand (1999) use vulnerability in other contexts such as human and societal systems, biological or eco-systems, databases and computer systems, organisational structures and financial and industrial systems (Gallopín, 2006). Vulnerability is mostly seen as being specific to unrest that interrupts the system; in other words, a system can be vulnerable to certain disturbances and not to others. Vulnerability is also thought of as a susceptibility to harm, a potential for change or transformation of the system when confronted with a perturbation, rather than as the outcome of this confrontation. The factors that can contribute to vulnerability in production systems are listed in Figure **15**.

Asbjornslett and Rausand (1999) categorise threats to systems using two main factors: internal and external. Internal factors are staff factors, maintenance factors, human factors, management and organisational factors, technical failures and system attributes. External factors are financial factors, market factors, legal factors, infrastructure factors, societal factors and environmental factors. They claim that the "*main difference between risk and vulnerability is that risk analysis focuses on the human, environmental and property impacts of an accidental event, while a vulnerability analysis is focused toward the survivability of the system*" (Asbjornslett & Rausand, 1999, p. 225).

A basic vulnerability assessment involves answering three questions: What can go wrong? What is the likelihood of that happening? What are the consequences if it does happen? In ***Figure 19***, vulnerability is highest when both the likelihood and the impact of disruption are high. Rare, low- consequence events represent the lowest

levels of vulnerability and require little planning or action. Disruptions that combine high probability and low consequences are part of the scope of daily operations management in the normal flow of business. In contrast, those disruptions that are characterized by low probability but high impact, call for planning and a response that is outside the realm of daily activity (Sheffi & Rice, 2005). In line with the frequently quoted business principle that *"you can't manage what you don't measure"*, it is recommended that SC managers need support in quantifying and thus mitigating supply chain vulnerability (Wagner & Neshat, 2010).
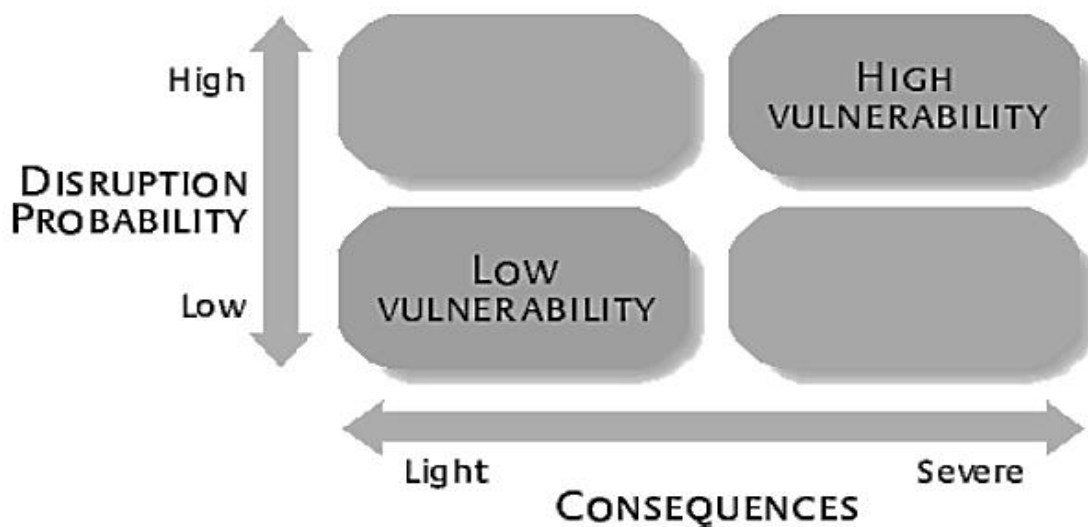
Figure 14: The Vulnerability Framework
Source: Adapted from (Sheffi & Rice, 2005)

The vulnerability framework categorizes the relative likelihood of potential threats to an organisation and the company's relative resilience to these disruptions. Such frameworks will enable and direct management's attention to prioritizing and planning for unforeseeable threats (Coutu, 2002; Sheffi, 2005; Sheffi & Rice, 2005). They recommend that SC managers must not only consider familiar risk factors such as the financial viability of their vendors, the likelihood of natural disasters, the availability of energy supplies and so on, but they must also worry about terrorism and the vulnerabilities of more complex, sensitive global supply chains.

Pioneer authors on risk management (Kleindorfer & Saad, 2005; Wagner & Bode, 2006) have highlighted the importance of quantifying and measuring SC vulnerabilities. Measuring the vulnerabilities of a SC is regarded as a particularly difficult task since today's chains are becoming multi-tiered, and there are no well-developed metrics for evaluating the factors on which vulnerability depends (Pettit et al., 2013; Wagner & Neshat, 2010)
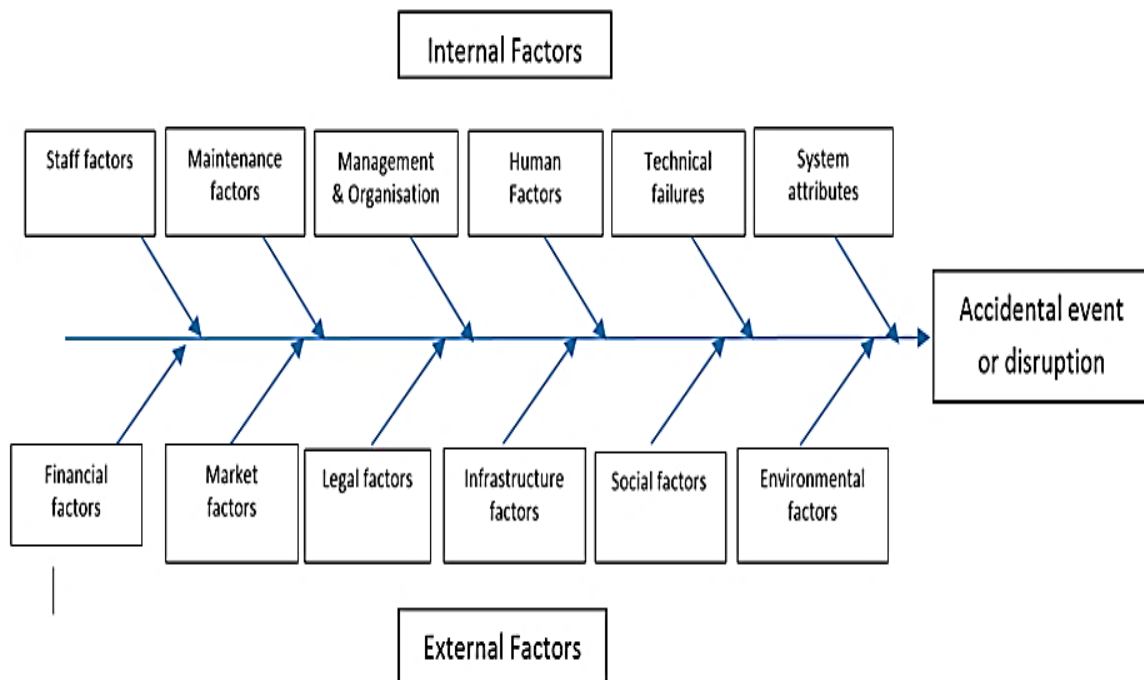
Figure 15 Factors/threats contributing to the vulnerability of a production system
Source: Adapted from (Asbjornslett & Rausand, 1999, p. 222)

Table 3 summarises the main differences between risk analysis and vulnerability analysis:

Risk Analysis	Vulnerability Analysis
What can go wrong?	An extended set of threats and consequences
How likely is it to happen?	Adequate resources to mitigate and bring the system back to new stability
What are the consequences?	The disruption time before new stability is established

Table 3 Differences between risk and vulnerability analysis
Source: (Asbjornslett & Rausand, 1999)

Supply chain vulnerability is defined by Christopher and Peck (2004) as an exposure to serious disturbance. Conversely, Jüttner et al. (2003) define vulnerability as the propensity of risk sources and risk drivers to outweigh risk mitigating strategies, thus causing adverse SC consequences. It is believed that while *"a SC disruption is the trigger that leads to the occurrence of risk; it is not the sole determinant of the final loss. Rather, the susceptibility of the SC to the harm of the situation is of significant relevance, and this leads to the concept of supply chain vulnerability"* (Wagner & Neshat, 2010, p. 221).

There is evidence that SC characteristics are antecedents of SC vulnerability and impact both on the probability of the occurrence of, as well as the severity of, SC disruptions. Accordingly, vulnerability is defined as the *"manifestation of the inherent states of the system that can be subjected to a natural hazard or be exploited to adversely affect that system"* (Aven, 2011, p. 515). Furthermore, it is claimed that the more complex a network is, the more interfaces exist and the higher the vulnerability will be (Gunasekaran, Subramanian, & Rahman, 2015; Peck, 2006).

After seven years of research on the topic of enterprise resilience with major companies in retailing and chemical companies, such as Johnson & Johnson and

Unilever; Fiksel, Polyviou, Croxton, and Pettit (2015) claim to have identified most pertinent factors that can cause perturbations and vulnerability within the supply chains of organisations. Their research has identified six major vulnerability sources. Vulnerabilities that in their eyes are inherent to the business and difficult to avoid.

	Definition	Principal factors in supply chain resilience
Supply Chain Vulnerabilities	Factors that make an enterprise susceptive to disruptions	1. Turbulence 2. Deliberate threats 3. External pressures 4. Resource limits 5. Sensitivity 6. Connectivity
Supply Chain Capabilities	Attributes that enable an enterprise to anticipate and overcome disruptions	1. Flexibility in sourcing 2. Flexibility in manufacturing 3. Flexibility in order fulfilment 4. Capacity 5. Efficiency 6. Visibility 7. Adaptability 8. Anticipation 9. Recovery 10. Dispersion 11. Collaboration 12. Organisation 13. Market position 14. Security 15. Financial strength 16. Product stewardship

Table 4 Supply Chain Vulnerabilities and Capabilities
Source: Adapted from (Fiksel et al., 2015, p. 81)

In their research, Fiksel et al. (2015) report that in the eyes of the companies that they have researched, turbulence in business environments that are external to companies, are the most important cause of vulnerability. In fact, it is agreed that by increasing the supply chain capabilities, the vulnerability of the supply chain decreases. Therefore, resilience in supply chains cannot be obtained without involving the capabilities (Pereira et al., 2014).

2.3.5 Examples of Supply Chain Risk and Vulnerability

A prime example of the vulnerability of SCs in this sector is the West Coast port strikes in late 2014 and early 2015 in the United States. This industrial action, led to delays in loading and unloading of vessel operations. The delays are estimated to have cost the U.S retailers as much as $7 billion, from a combination of lost sales and the need to reroute products. The magnitude of this industrial action went far beyond the retail industry and it is estimated that the U.S. agricultural sector faced a major reduction of exports by $1.75 billion a month, thus, for a while McDonald's customers in Japan were restricted to small portions of fries as the dispute delayed shipments of frozen food from the U.S. (DHL, 2015).

The most recent disaster that has captured global news, is the Tianjin explosions in China. Two massive explosions occurred on the 12th of August 2015 in Ruihai International Logistics warehouse, which stores and transports chemicals, located in the Port of Tianjin. Founded in 2011, Ruihai Logistics specializes in moving hazardous cargo, handling about one million tons of cargo annually. According to a report by Hornby (2015) there were 114 fatalities, 700 others injured and more than 50 still missing. The blasts damaged 17,000 homes affecting 30,000 people. In the two-mile blast zone radius, buildings including warehouses, port buildings and processing facilities were extensively damaged. Tianjin Mayor "Huang Xingguo" confirmed that 176 companies were in areas of the explosions.

What is more, Resilinc (2015) states that, many immediate impacts on the companies in the Tianjin area such as factories, warehouses and other services in the Port of Tianjin, faced extensive damage. The explosion and its resulting wave hit thousands of shipping containers and left them beyond salvage. Specifically, Evergreen's subsidiary, Kingtrans International Logistics- that was located 500 meters from the explosions- reported that they could face tens of millions of Renminbi (the official currency of the People's Republic of China) in financial losses, as the plant and shipping containers it owns have been destroyed. The price of the explosion is believed to have cost insurance companies nearly $1.5 billion, with uninsured losses several times higher. Because of these explosions, Toyota Motor Co., Ltd. and Deere & Co. shut down operations in Tianjin. Companies across China

faced delays and disruption to raw material supplies, from oil to iron ore, and had to look for different export routes to get products to customers overseas (DHL, 2015).

2.3.6   Supply Chain Risk Management

Supply chain risk management is central to mitigating and controlling the vulnerabilities of an organisation's supply network, and is most effective when undertaken through a co-ordinated approach between all the supply network members (Jüttner et al., 2003; Sawik, 2014; Vedel & Ellegaard, 2013). Effective risk management also requires a comprehensive approach: "*a special challenge for supply chain risk management lies in the multitude of risks within a supply chain; a central aspect is the identification of the significance of a particular risk for a supply chain*" (Thun & Hoenig, 2011, p. 243).

As mentioned in sections 2.3 and 2.3.3 above, supply chain disruptions can leave immediate and long term damaging effects on a company's financial performances (Ambulkar, Blackhurst, & Grawe, 2015; Bhatia et al., 2013; Hendricks & Singhal, 2005). It has long been accepted that Supply Chain Risk Management (SCRM) is a necessity in today's business (Christopher & Lee, 2004; Melnyk, Closs, et al., 2014; Tang & Tomlin, 2008; Wagner & Neshat, 2010). Likewise, it is clear to supply chain professionals that a well-functioning supply chain operation is a paramount factor to the success of any organization. Along with a company's capacity to continue its global operations with all the added complications, such as supply and demand volatility, the extreme pace of the introduction of new products and services, and sustainability. To this date, however, the issue of SCRM in the FMCG industry has not yet been analysed in detail (Weise, 2008 cited in Diehl & Spinler, 2013).

Numerous examples of SC vulnerability and disruptions have been reported in FMCG; in the book *"Building a Resilient Supply Chain".* Sheffi (2005) explains that, a major instance of the vulnerability of SCs in this sector, is the West Coast port strikes in 2002. Due to strikes with the logistical companies, major FMCG companies such as P&G were facing delays. In this case, P&G expected its suppliers to search for solutions to the problem. Accordingly, P&G replaced several of its transportation providers with those who were better fitted to the urgent and passionate P&G culture. Twelve years on since the west coast industrial actions, the same strikes happened

in 2014 and 2015, resulting in uncertainty and financial losses for American and global businesses trading with the US (section 2.3.5 above).

One of the key responsibilities within SCM is the collection and generation of risk-related information. Again, managing risk essentially consists of reducing the probabilities and effects of loss-generating events in the up-stream supply chain. As noted earlier, the probability and impact reduction cannot be materialised without knowledge, which makes information gathering, an essential task for the SC manager (Vedel & Ellegaard, 2013; Zsidisin et al., 2005). In recent decades, most large private enterprises adopted systematic approaches to managing their risks, notably through insurance and active mitigation of supply chain risks.

A recent study by Pearson, Crosnier, Kaltenbach, Schatteman and Hanifan (2014) indicates that SCRM is now a key consideration when designing and operating SCs and is valued by organisations alongside other critical areas such as cost, service, inventories and sustainability. However, SCRM is still an emerging and promising new field for researchers, one that has some open-ended boundaries in scope and allows investigation into practical strategies to improve SC robustness and resilience to deal with unexpected events (Colicchia & Strozzi, 2012; Sodhi, 2005). This is particularly the case since it is argued that *"risk-based strategies are most effective when hazard probabilities are known or can be estimated"* (Park et al., 2011, p. 396). Following a comprehensive review on supply risk literature, Manuj and Mentzer (2008) prepared a framework (**Figure 16**) for managing global SC risks:

Figure 16 Global Supply Chain Risk Management and Mitigation Framework
Source: Adapted from (Manuj & Mentzer, 2008, p. 144)

> ➤ Step One: Risk identification: identifying and classifying supply risks.

> ➤ Step Two: Risk assessment and evaluation: analysing and evaluating the identified risks.

> ➤ Step Three: Supply risk reduction: using various risk management strategies.

> ➤ Step Four: Strategy implementation: using various enablers such as organisational learning and performance metrics

> ➤ Step Five: Mitigation of risks within the supply chain and preparation for future risk events.

In addition to the five steps, other researchers believe that supply chain risk management starts with classification of the risks. Accordingly, risk classification allows SCM managers to *"obtain a collective viewpoint on the group of factors, to help to identify the sources of maximum risk"* (Diabat et al., 2012, p. 3041). Supply chain risks were mentioned in section 2.3, however, scholars such as Tang (2006) add that the sources of supply chain risks originate from *Product, Supply, Demand and Information management* (the management of risks that is initiated in any the flows within the SC).
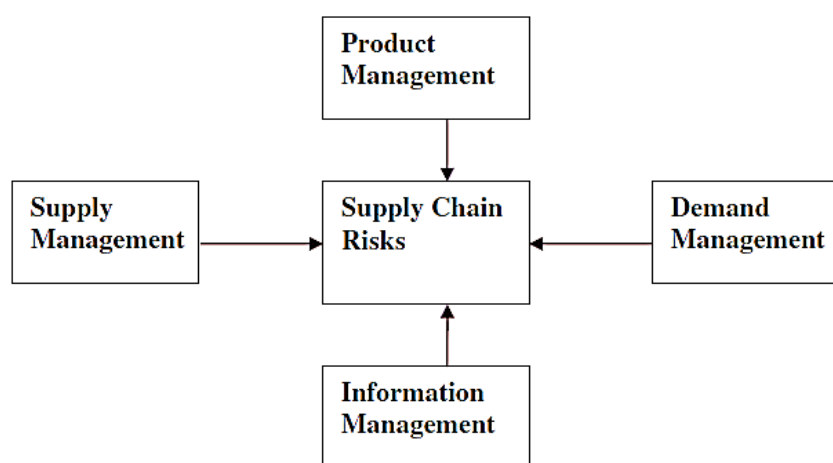
Figure 17 Four basic approaches to manage SC risks
Source: Adapted from (Tang, 2006, p. 453)

It is notable that, risk management strategies usually tend to be company-specific rather than adopted at SC level and that only a few companies are aware of the extent of risk that threatens their SC (Jüttner et al., 2003; Tang & Tomlin, 2008; Thun & Hoenig, 2011). Therefore, Pearson et al. (2014) recommend that regardless of the approach taken, visibility is vital. Indeed, companies should invest in capabilities that enable them to monitor their end-to-end SC in real time effectively. Doing so, allows the companies to identify the potential threats proactively and respond before they become problems.

Lou Ferretti Project executive, product/environmental compliance and SC Social responsibility at IBM, speaking in a webinar hosted by Resilinc in May 2016, indicated that: "*better visibility gives you time and that leads to more options. Therefore, knowing what you need to know at the time of disaster is pivotal*". For example, the floods that inundated Thailand in 2011 and damaged large high-tech manufacturing companies. Where subsequent studies identified that, companies do not have a holistic view on the supply chain risks. In fact, Manners-Bell (2014) state that, when out-sourcing production (and risk), only 10 per cent of manufacturers undertake any sort of risk assessment.

In this context, a recent study by O'Marah, John, Blake and Manent (2014) has identified the most common methods of risk identification currently used by SC managers. Practitioners regard supplier relationship management as the most important factor in the identification of risk (**Figure 18).**
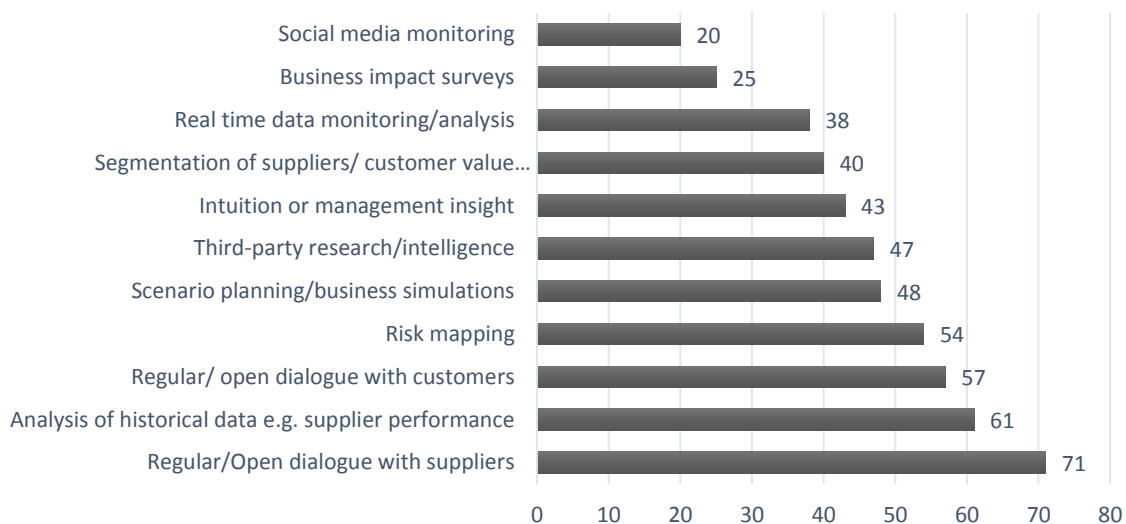
Figure 18 Methods for identifying and assessing supply chain risk
Source: Adapted from (O'Marah et al., 2014)

In continuation, with the previously described research design map in Figure **3**; in order to answer the research questions and develop a conceptual framework for resilient food supply networks, the literature examines the characteristics of food supply chains (Section 2.4). Emphasising the importance of creating a resilient enterprise, whilst at the same time comparing different proposed frameworks for resilience of supply networks.

2.4 Food Supply Chains: Their Importance

Food is, of course, an essential element of daily life, but, in our complex culture, the role of food for basic survival is often overlooked. (Bourlakis & Weightman, 2004; Bruemmer, 2003; Dani, 2015). Nowadays, agricultural products to reach the consumers table, go through different steps of food supply chains (**Figure *19***). It is believed that before the industrial revolution, in the late eighteenth and throughout the nineteenth century, the length of food supply chains was shorter. This meant that human communities all over the world tended to source locally from the farms near their place of habitat. The earliest human settlements were in the regions between Mesopotamia and Lower Egypt known as the Fertile Crescent. These settlements had sufficient water resources and fertile soil to produce sufficient food to cover their demand. However, other settlements such as the nomadic tribes had to make difficult decisions to survive the challenges; for instance, decisions such as whether to produce food and how to transport food to cover their demand; therefore, it is believed that these nomadic settlers were the first supply chain managers on Earth (Mena & Stevens, 2010).

As mentioned earlier, the term Supply chain is a relatively new concept that emerged in the 1980's. Initially, the study of SC's has predominately focused on industries that involve complex assembled products, like automotive and electronics. However, food supply chains are different form these industries. Consequently, "*blindly importing the concepts of other industries to food supply chains would be risky*" (Mena & Stevens, 2010, p. 2).

By 2050, the world's population will reach over 9.7 billion, 34 percent higher than today. The Food and Agriculture Organization of the United Nations (FAO) report that, nearly all this population increase will occur in developing countries. The same

report predicts that urbanization will continue at an accelerated pace, and about 70 percent of the world's population will be urban (compared to 49 percent today). There will be a rise in income levels; it is estimated that they will be many multiples of what they are now. To feed this larger, more urban and richer population, food production (net of food used for biofuels) must increase by 70 percent (FAO, 2016; Farina, 2000).

The World Bank estimates that, by 2030, worldwide demand for food will increase by 50% from 2009 (Evans, 2009). Furthermore, this substantial growth in population (demand) will put the global food supply under great pressure. Most growth will occur in emerging markets. These markets have traditionally been agriculture-based economies, but in recent years, they have witnessed explosive growth of the middle class, driven by greater industrialization and urbanization. An emerging middle class creates changing dietary habits, such as consuming more meat and dairy. These foods are more resource intensive, which puts local supply chains under greater pressure. These factors alone make the production and distribution of food a critical issue for the 21st century (Dani, 2015; Deloitte, 2013; Elliott, 2014; Li, Wang, Chan, & Manzini, 2014; Manning & Soon, 2016).

To satisfy the ever-growing demand for food, today's food supply chain has become global, with numerous participating companies and organisations involved within them. Figure *19* depicts the general structure of a typical food chain. At the farm end of the chain, are producers such as fishing and agriculture, while in the middle there are processors, packaging suppliers, distributors, wholesalers, retailers and caterers, and finally there are the consumers. Estimates show that global food retail sales are worth approximately four trillion US dollars annually, with supermarkets/hypermarkets accounting for the largest share of sales. Most of the leading global retailers are European and U.S firms. As large multinational retailers expand their presence in developing countries, small retail firms increasingly account for a smaller share of total food sales.

The top 15 global supermarket companies comprise of more than 30 percent of world supermarket sales. With improved technologies and economies of size, these retailers enjoy operating cost advantages over smaller local retailers (USDA, 2016).

Rank	Retailer	Country of Origin	Revenue (US $Billion)
1	Walmart	United states	$469.1
2	Tesco PLC	England	$101.2
3	Costco Wholesale	United Sates	$99.1
4	Carrefour S.A.	France	$98.7
5	Kroger Co.	United States	$96.6
6	Lidl Stiftung	Germany	$87.2
7	Metro AG	Germany	$85.5
8	The Home Depot	United States	$74.7
9	ALDI	Germany	$73
10	Target Corporation	United States	$71.9
11	Walgreen	United States	$71.6
12	CVS Caremark	United States	$63.6
13	Aeon Ltd.	Japan	$63.1
14	Groupe Auchan	France	$59.4
15	Woolworths Ltd	Australia	$58.6

Table 5 Top 15 World's Biggest Retail Giants
Source: Adapted from (Rahate, 2015)

A study by Tommi et al. (2009), explains the importance of supply chains when it comes to the food sector. It describes the interrelation of the units involved within a food supply chain. These interrelated units have been identified as food producers, food processors, food distributors and food consumers.

Table **6** below, summarises the overall view of the interrelated units of a food supply chain. Considering food supply chains, it can be seen from **Table 6** that, food moves via interrelated units from the producers to consumers, starting from production, processing, distribution, retailing and consumption (Deloitte, 2013). Food supply chains are social-ecological systems, that are formed via biophysical and social factors linked through feedback mechanisms (Tendall et al., 2015).

Stakeholder	1. Producers	2. Processors	3. Distributors	4. Consumers
Roles	2. Research & Development 3. Farming 4. Ranching 5. Trading	6. Harvesting 7. Butchering 8. Processing 9. Value added processing 10. Manufacturing 11. Marketing and Sales	• Distributing • Retailing	• Shopping • Consuming
Key Issues	• Management capabilities (e.g. Brand and Risk management) • Strategy (e.g. Market strategy) • Financial issues (e.g. Input and sale price volatility)	• Strategy (e.g. Going global, regulatory) • Achieving scale • Supply chain strategy (e.g. Vertical integration, security and safety)	• Strategy (e.g. Consumer) • Supply chain strategy (e.g. Vertical integration, traceability)	• Food process (e.g. High prices, price volatility) • Food security (e.g. Availability) • Food safety (e.g. Traceability) • Health & wellness (e.g. Obesity)
Stakeholder	5. Governments/NGOs/ Regulators			
	• Public Health & Safety • Public Policy • Food and Product Security • Security (e.g., Resources. Land & Food availability and allocation) • Public Support			

Table 6 Stakeholders and Key issues in Food Supply Chains
Source: Adapted from (Deloitte, 2013)

As depicted in the above table, food moves in a "*domino-like fashion"* where it starts from the first unit; farmers, to the last unit; consumers. Correspondingly, once there is a money transaction from the consumer, then it moves into a reserve process, such as consumer to processor. The activities within a farm to fork network incorporate social, economic, political, institutional and environmental processes and dimensions. These activities lead to a number of social and environmental outcomes, as well as a certain level of food security (2.4.3.1) *"when all people at all times have access to sufficient safe, nutritious food to maintain a healthy and active life"* (Tendall et al., 2015, p. 18).Figure *19* shows the relationships amongst various nodes within the farm to fork journey. It also illustrates the simplicity of such movements within the supply chain of food. However, such movements seem to be simple in the illustration, but, when it comes to real life practice, there are massive complexities behind it. Farm to fork networks involve various stages, running through production, processing, distribution, and even the disposal of unwanted food. It is believed that the length of the farm to fork cycle is, on average, almost 1300 miles long (Ahumada & Villalobos, 2009; Boehlje, 1999; Li et al., 2014; Vorst et al., 1998).

The case study companies that have contributed to this research, have supply chains spanned throughout the globe and, more specifically, within the United Kingdom. The reasons behind the selection of each case study company, their history and their foot print within the British food supply chain has been thoroughly explained, separately, in chapter 5 below.
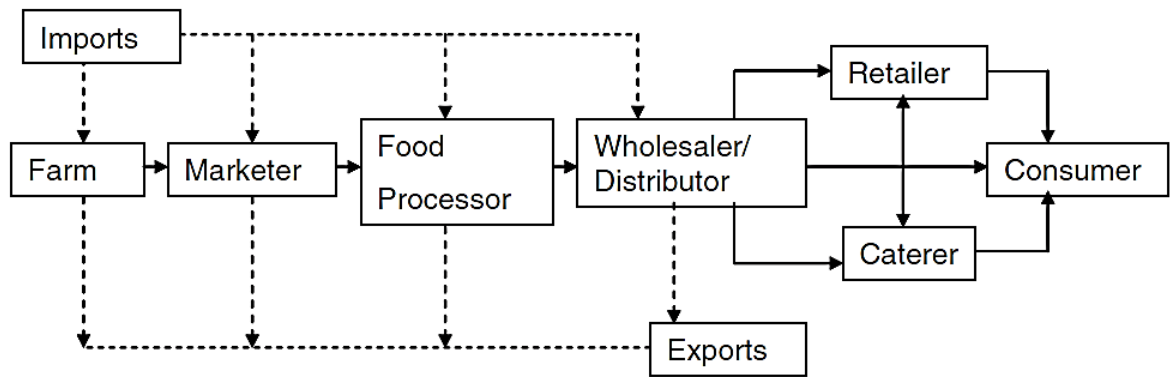
Figure 19 Typical Food Supply Chain "Farm to Fork"
Source: (Dani & Deep, 2010, p. 396)

In the research study entitled *"The World and the US Population Clock"*, it has been reported that the size of the food industry is growing exponentially and the value of global food exports is worth 1375 Billion US Dollars (Census, 2016). This huge industry, which is still the largest manufacturing sector in many developed and developing countries (Li et al., 2014), is witnessing a growing trend of competition amongst food chains (Ahumada & Villalobos, 2009; FAO, 2016), as well as larger physical distances between the source of production and the point of consumption (Tendall et al., 2015).

However, food supply chains are generally becoming more effective and efficient. Hence, the decision makers and players within food SCs are facing new challenges. Some of the challenges (amongst many) include *"modelling, management, analysis, and solutions to overcome these challenges"* (Yu & Nagurney, 2013, p. 273). The highly complex interfaces between the nodes involved within the farm to fork network and their implications, need to be considered in the design and implementation of effective policy and management interventions. Thus, such interventions cannot be treated as isolated changes in one part of a food supply chain. It is reported that most of these efforts have focused on only a specific part of these food supply chains (most often-agricultural production), and have ignored the effects on other parts. Therefore*, "a holistic approach would account for the whole system and its internal interactions between components"* (Tendall et al., 2015, p. 18).

Food supply chains, throughout human history, were used to force the enemy to surrender or slow down their advances. For instance, the scorched Earth policy,

which involved the destruction of food and water supplies of the civilian population in an area of conflict, is banned under Article 54 of Protocol I of the 1977 Geneva Conventions. The relevant passage says:

"Starvation of civilians as a method of warfare is prohibited. It is prohibited to attack, destroy, remove, or render useless objects indispensable to the survival of the civilian population, such as foodstuffs, agricultural areas for the production of foodstuffs, crops, livestock, drinking water installations and supplies, and irrigation works, for the specific purpose of denying them for their sustenance value to the civilian population or to the adverse Party, whatever the motive, whether in order to starve out civilians, to cause them to move away, or for any other motive".

Nevertheless, examples of this strategy have been reported by historians throughout the centuries and, lamentably, this heinous practice is still being used in the 21st century (Prupis & Writer, 2016). The following section, explores the challenges within food supply networks, with a special focus on the challenges that British Farm to Fork networks face.

2.4.1   Food Supply Chain: Characteristics

Food supply chains are distinct from other product supply chains. The fundamental difference between food supply chains and other supply chains is the continuous and significant change in the quality of food products throughout the entire supply chain until the points of final consumption (Aiello, La Scalia, & Micale, 2012; Yu & Nagurney, 2013). In the article *"Unravelling the Food Supply Chain: Strategic Insights from China and the 2007 Recalls"* by Roth, Tsay, Pullman and Gray (2008), it highlights the fact that the modern food industry is comprised of a smaller number of large organisations (Table *5*). Which sell either supplies of homogenous products sold in large quantities or value added products, where the specific nature of the food is of central importance to customers on an increasingly global basis.
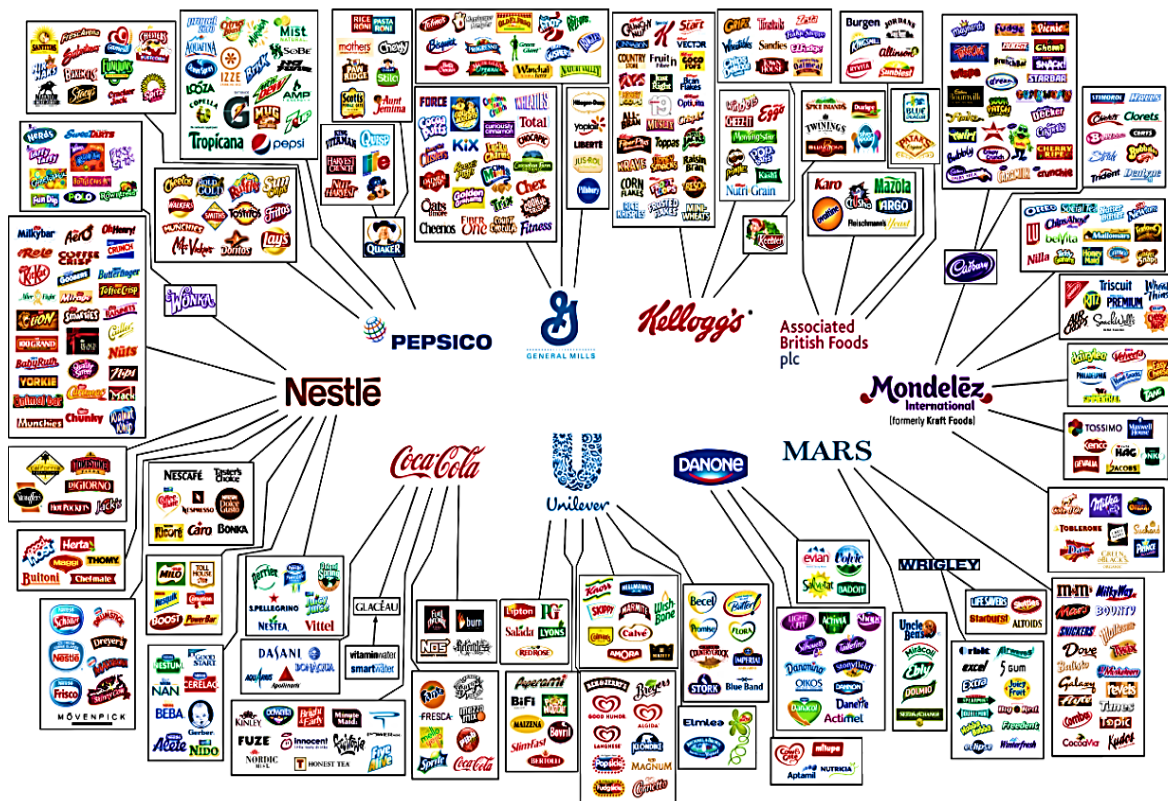
Figure 20 Big corporations that control our food supply chains
Source: Adopted from (Snyder, 2014)

It is evident that the current trend of change in the food market has been extraordinary (Diehl & Spinler, 2013; Sáenz & Revilla, 2014; Thun & Hoenig, 2011). Inevitably, with today's customer (especially in affluent societies) requesting the availability of fresh food and products all-year-around, this has exacerbated the need for the globalisation of food markets (Adenso-Diaz, Mena, García-Carbajal, & Liechty, 2012; Ahumada & Villalobos, 2009; Souza Monteiro, 2007; Jacobus Vorst, 2000). Recent technological advances throughout SCs, particularly in areas such as advances in transporting, conserving and storing products, combined with the efficient and effective flow of information has been the driving force for the provision of customer demands (Cox & Chicksand, 2005; Cox et al., 2007).

Academics researching the topic of food supply chain indicate that the usage of SCM techniques and strategies as a source of competitive advantage (**Figure 5**), has been more widely adopted in the farm to fork industry throughout the last ten years (Purvis, Spall, Naim, & Spiegler, 2016; Tsolakis, Keramydas, Toka, Aidonis, & Iakovou, 2014). All in all, this allows for more productive SCs to cover and control more territories, meaning that fewer transnational corporations control the major part of the food that is consumed by all.

Besides technological advances, other factors such as trade and financial market liberalisation, the encouragement of Foreign Direct Investment (FDI), and improved intellectual property and consumer protection laws, have also supported the ever faster global trade (Farina, 2000; Murdoch, Marsden, & Banks, 2000). According to Cox et al. (2007) these factors have formed a new environment and, as a result, have boosted competition in the world's food market. Though, Ruteri (2009) reports that inappropriate supply chain management practices have resulted in many food organisations within the developing countries performing inefficiently, with the result of them going out of business. In other words, supply chain management plays an extremely essential role within food sectors.

In her doctoral thesis, Romsdal (2014) stated that, every operating entity faces different supply chain challenges. Therefore, for food organisations to achieve requirements and operate effectively and efficiently, it is critical to understand the characteristics of a food supply chain. Furthermore, Schmid et al. (2014) believe that, fresh food products and long life products are two different product categories. Consequently, each category has its own characteristics and it is not possible to use the same supply chain strategy due to trade-offs with other characteristics. Whereas, Romsdal (2014) states that, key characteristics of food supply chains can be divided into three groups: "*Product characteristics*, *Market characteristics* and *Production system characteristics*". Table **7** illustrates the key differences between the previously named characteristics.

Aspect	Description
Product Characteristics	
Perishability and Shelf life	High perishability, with shelf life constraints for raw materials, intermediates and finished products
Complexability	Varied, with mainly divergent product structure and increasing variety in products, packaging sizes and recipes
Variety	High and increasing particularity for promotions, high percentage of slow moving items.
PLC, Innovation and NPD	Decreasing PLC, with high failiure rates for new products.
Volume and Volume Variability	High volume, with higher variablity in downstream processes.
Market Characteristics	
Delivery lead time and lead time variability	Variability by products, but generally retailers demand and receive frequent deliveries and short response time. Demand mainly met from finished goods inventory.
Demand uncertainty	Varying and increasing, largely caused by high inreasing frequency of promotional activities. Strong presence of bullwhip effect. The bullwhip effect is a term to show that small changes in product demand by the end customer of the chain translate into wider swings in demand experienced by the upstream chain members.
Inventory management and stockout rates	Limited availability to keep stock. Periodic ordering, high and stable stock-out rates. Cost of lost sales often higher than inventory carrying costs.
Production System Characterisitics	
Production or make to order lead time	Product dependent, but generally long lead times and low degree of postponement.
Plant, process and technology	Adapted to low variety and large volumes. Mainly integrated and continous production process on capital-intensive equipment with long set-up times and high set-up costs.
Supply uncertainty	Some uncertainty, mainly caused by seasonality, demand amplification and economy of scale thinking, but generally high reliability for raw materials

Table 7 Detailed description of food supply chain characteristics
Source: Romsdal (2014, p. 77)

Characteristics	Efficiency	Responsiveness		
		Replenishment Speed	Supply Chain Speed	Volume Flexibility
Product Characteristics				
Perishability	Low	High	High	High
Complexity	Low			High
Variety	Low			High
Product Life Cycle (PLC)	Low	High	High	High
Volume and volume variability	High/Low			High
Market Characteristics				
Delivery lead time	Low	High		High
Demand uncertainty	Low	High		High
Inventory management	Low/High	High		High
Production System Characteristics				
Production lead time	High	Low	Low	Low
Plant, processes and technology	High	Low	Low	Low
Supply uncertainty	Low			High

Table 8 Summary of characteristics' impact on supply chain requirements
Source: Adapted from Romsdal (2014, p. 80)

Table *8* illustrates the impact of product, market and production system characteristics, that can affect the supply chain and drive it either towards efficiency or responsiveness. It is essential to understand that, each of the characteristics has a different impact on the supply chain requirements, such as responsiveness and efficiency (Romsdal, 2014). As an example, in the table below, perishability has a positive impact on responsiveness while it decreases the need for efficiency.

2.4.2 Context Overview: United Kingdom

The context of this research is the United Kingdom. This section illustrates the key characteristics of the British food supply chain, the organisations that are involved within the farm to table networks, and the challenges that this country faces in food provision. Furthermore, this section and its subsequent sub-sections explain the reasons behind the selection of the UK as the context country for this doctoral research and the proposed framework for resilience in food supply chains.

The United Kingdom of Great Britain and Northern Ireland, commonly known as the United Kingdom (UK) or Britain, is a sovereign state in Europe. Lying off the North-Western coast of the European mainland, it includes the island of Great Britain (the name of which is also loosely applied to the whole country), the North-Eastern part of the island of Ireland and many smaller islands. Northern Ireland is the only part of the UK that shares a land border with another state: The Republic of Ireland. Apart from this land border, the UK is surrounded by the Atlantic Ocean, with the North Sea to its east, the English Channel to its south and the Celtic Sea to its south-southwest. The Irish Sea lies between Great Britain and Ireland. With an area of 93,638 square miles (242,514 km2), the UK is the eightieth-largest sovereign state in the world and the eleventh largest in Europe. It is also the twenty first most populous country, with an estimated 62.8 million inhabitants (BBC, 2016).

Figure 21 Map of the United Kingdom
Retrieved from: www.enchantedlearning.com

Britain was the world's first industrialised country. Its economy remains one of the largest, but it has for many years been based on service industries rather than on manufacturing (BBC, 2016).

The UK, a leading trading power and financial centre, is the third largest economy in Europe after Germany and France. Food supply networks in the United Kingdom are not an exception; playing a significant role in its economy. Agriculture is intensive, highly mechanized, and efficient by European standards, producing about 60% of food need (CIA, 2016). As shown in Figure **22**, a typical farm to fork network consists of agriculture (farm), food manufacturing, food and drink wholesaling and retail, and the food catering and service sector. The UK government's Department for Environment, Food and Rural Affairs (DEFRA), in its' *Annual Food Statistics Pocketbook (2015)* reported that, food supply chains employ around 3.9 million people, which is 14% of national UK employment.

The Agri-Food Chain
Agriculture · Manufacturing · Wholesaling · Retailing · Catering
The Agri-food sector contributed **£109 billion** or 7.3% to the national Gross Value Added in 2014.
3.9m People were employed in the Agri-food sector in 2015. 14% of national employment.
£18.0bn the value of food and drink exports in 2015. Beverages are the largest export category by far.
Food prices fell by 1.7% in real terms in the last 12 months, following a 5-year period when processes were rising faster than general inflation.
£198bn Total consumer expenditure on food, drink and catering in 2014. On average, around 11% of all household spending on food.
Purchases of 5 A DAY **increased to 3.9** portions in 2013. Low income families bought the least fruit and veg: 3 portions per person/day.
£470 The UK average household spend on food that could have been eaten but is thrown away.
1645 Food and environmental incidents investigated by FSA in 2014.
70m Emissions from food chains in tonnes of CO_2. Farming accounted for 56m.

Figure 22 Summary of UK Food Supply Chain 2014
Source: Adapted from (Rumsey et al., 2015)

According to the UK Government (2008) food supply chains play a significant role in the country's economy, accounting for seven percent of Gross Domestic Product (GDP) in the year 2008. In a more recent report by DEFRA (2015) it is highlighted that the contribution of agriculture to the Gross Domestic Product (GDP), fell by £1,374 million to £8,495 million, a 14% decrease. The same report indicates that, food manufacturing is still the largest manufacturing sector in the UK and has contributed £109bn pounds, which is 7.3% to Gross Value Added (GVA), in the year 2014 of this country. "*Gross value added (GVA) is the difference between the value of goods and services produced, and the cost of raw materials and other inputs used up in production*" (Rumsey et al., 2015, p. 8).
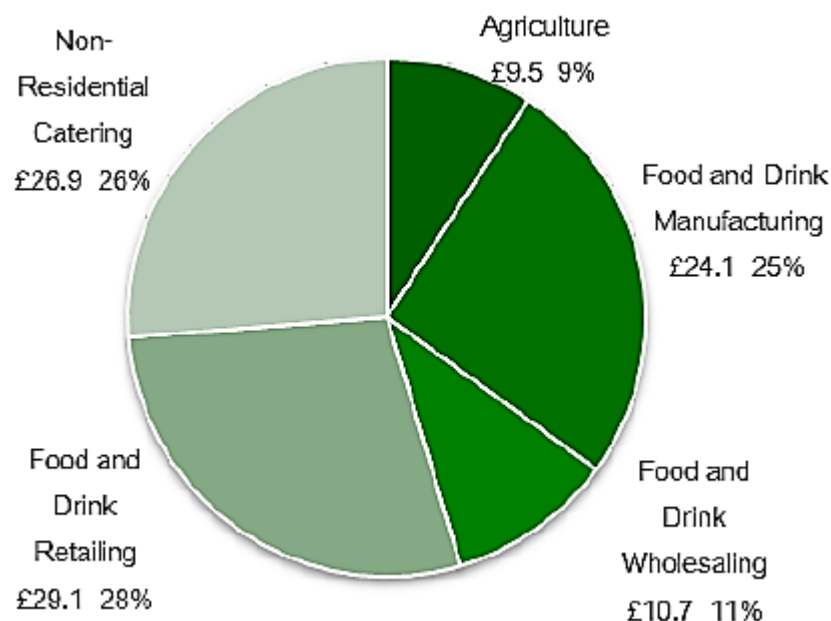
Figure 23 Gross Value Added of the Agri-food sector (£ billion)
Source: Annual Business Survey (ONS) and Aggregate Agricultural Accounts (Defra).

The Agri-food chain is a sector, which is making an important contribution to growth, including through expanding exports. However, to fulfil the demand for food by its growing population, the UK relies significantly on imported food (Benton & Bhunnoo, 2013; DEFRA, 2015).

	UK	EU	Africa	Asia	North America	South America	Rest of Europe	Australia
Series 1	54%	27%	4%	4%	4%	4%	2%	1%
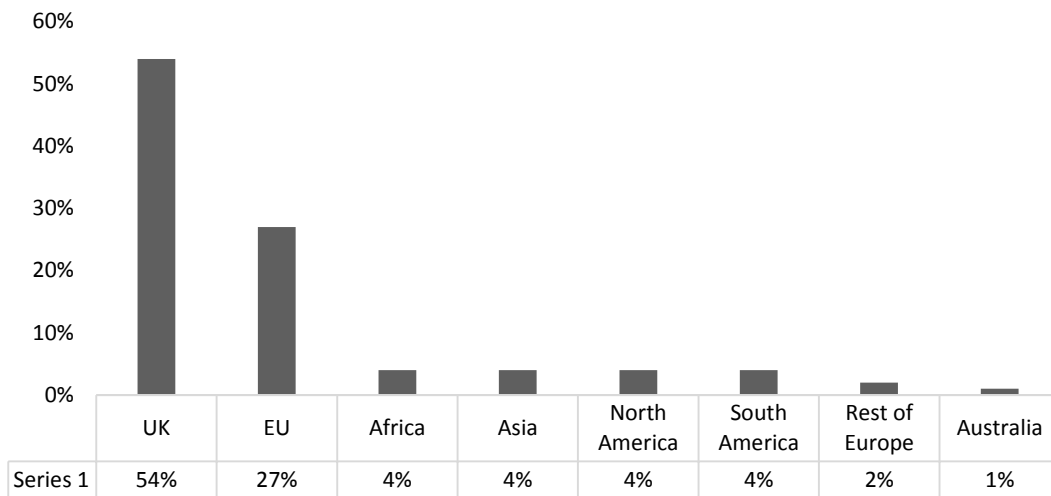
Figure 24 Origins of food consumed in the UK, 2014
Source: Adapted from (Rumsey et al., 2015, p. 23)

Based on a recent government report (DEFRA, 2015), the sum of consumer expenditure and the amount of food exports of the United Kingdom has a total generated £181 billion for UK food supply chains. Although, a recent report by the Food Standard Agency (FSA) is claiming that the size of the food and drink industry in the UK is £200 billion (FSA, 2016). Figure **25** shows the largest elements of the food chain from agriculture as a primary producer, through to food manufacturing and retail trade, to consumers' expenditure. Based on the information provided by the chart below, the difference between the financial amount of imports and exports (circled in red) indicate the trade gap of the UK. Accordingly, the UK has imported £39.5 billion pounds' worth of food products, consisting of highly processed, lightly processed and unprocessed goods from overseas. At the same time, this country has exported £18.0bn of the before mentioned products. Therefore, the size of the UK trade gap in food SC was reported at £21.5 billion pounds in 2015. This fact highlights the ever-important role of logistics and resilient food supply chains to source the needed products safely and securely.

UK Population

65 million people

Total Consumers' Expenditure[b]

on food, drink and catering services - £201bn

Consumers' Expenditure[b]

on catering services - £88bn

Household Expenditure[b]

on food and drink - £114bn

Caterers (restaurants, cafes, canteens)

Gross Value Added[c] - £29.1bn
Employees[d] - 1,658,000
Enterprises - 116,463
Sites - 448,958

Food & Drink Retailers

Gross Value Added[c] - £30.2bn
Employees[d] - 1,157,000
Enterprises - 54,106
Sites - 86,239

Exports[a]

£18.0bn, of which:
Highly processed - £10.7bn
Lightly processed - £5.8bn
Unprocessed - £1.5bn

Food & Drink Wholesalers

Gross Value Added[c] - £11.9bn
Employees[d] - 225,000
Enterprises – 15,722

Food & Drink Manufacturing

Includes everything from primary processing (milling, malting, slaughtering) to complex prepared foods. Many products will go through several stages.

Gross Value Added[c] - £26.9bn
Employees[d] - 422,000
Enterprises - 8,597
Sites – 10,050

Agricultural Wholesalers (including agricultural machinery)

Gross Value Added[c] - £2.6bn
Employees[e] - 39,000
Enterprises - 4,072

Food & Drink Supply Industry (Food & drink processing machinery)

Gross Value Added[c] - £321m
Employees[d] - 6,000
Enterprises - 425

UK Farmers and Primary Producers

Gross Value Added (includes rural England) - £8.5bn
Total labour force - 476,000
Farm holdings – 214,000
Payments to farmers linked to production - £38m
Farm payments not linked to production - £2.8bn
Total agricultural land area - 18.4m hectares

Agricultural Supply Industry (Manufacturing of agricultural machinery, fertilisers & pesticides)

Gross Value Added[c] - £1.1bn
Employees[d] - 13,000
Enterprises - 607

Imports[a]

£38.5bn, of which:
Highly processed - £14.6bn
Lightly processed - £16.0bn
Unprocessed - £7.5bn

Rural England

Agricultural GVA - £5bn

Fishing and Aquaculture

Gross Value Added[c] - £778m
Employees[d] - 10,000
Enterprises - 3,841
Fleet size - 6,383

Greenhouse Gas Emissions[f]

Total Food chain - 147 mt CO$_2$e
(15% of total emissions associated with UK consumption)
Production - 50%
Trade - 40%
Household - 10%

UK Production to Supply Ratio[e]

All Food - 60%
Indigenous - 75%

Energy Consumption[f]

Domestic cooking, agriculture, food & drink manufacturing, transport, food retailing & service sector catering – Together these activities account for an estimated 17% of total UK energy consumption.

Figure 25 Economic summary of food chain in the UK
Source: (DEFRA, 2015)

2.4.3 British Food Supply Chains: The Challenges and Vulnerabilities

In the past two decades, domestic markets and their supply chains in general, and the UK food SC, have witnessed considerable amounts of transformation and turmoil. Tsolakis et al. (2014) report that, some of the real-world challenges have led to the adoption of SCM in the Agri-food sector. For instance; the rapid industrialisation of agricultural production, the oligopoly in the food distribution sector, and the advancement of Information and Communication Technologies (ICT) in logistics. Additionally, further food SC challenges are; customer concerns, governmental food safety regulations, the establishment of specialised food quality requirements, the emergence of modern food retailer forms, and the increasing significance of vertical integration and horizontal alliances, as well as the emergence of a plethora of multinational corporations.

Supply chain risks that were mentioned in section 2.3 above are also relevant in food supply chains. However, food supply chains due to their special characteristics (2.4.1 above) face additional challenges. According to Cox et al. (2007) and Gunasekaran, Rai and Griffin (2011), the following examples are major reasons for the dramatic changes seen in recent years in UK food SC:

- ➤ Common Agriculture Policy (CAP) reforms; consumer concerns over the quality and safety of UK beef products because of outbreaks of livestock diseases including Foot and Mouth Disease (FMD) and Bovine Spongiform Encephalopathy (BSE).

- ➤ Trade liberalisation and globalisation processes have significantly increased customer expectations.

- ➤ Long-term decline in consumer demand for red meat, with a preference for alternative proteins (chicken) and healthier food options.

- ➤ Radical changes in consumer preferences, both in the way we eat (in favour of convenience food choices) and what we eat, (an increasing interest in Genetically Modified free foods and organic products).

➢ The concentration of market power in the hands of a small number of multiple food retailers, (there is a significantly greater concentration of market power in multiple retailers in the UK than in many other counties).

➢ Increased foreign competition and, finally, embargoes on British beef exports owing to restrictions put in place after the outbreak of BSE and FMD (Hingley & Lindgreen, 2002; Taylor, 2005).

Consequently, Cox et al. (2007) believe that the above factors have contributed to pushing primary farmers and producers out of the market, and eventually, in many cases, it has led to a sharp drop in production levels. Moreover, Manning and Soon (2016) consider that the brittleness of food supply chains is due to three factors: *low financial margins*, *low profitability* and *low resource stocks*. The following subsections highlight the most pertinent challenges within UK food supply chains.

2.4.3.1   Food Security and Safety

The danger of an ever-increasing population of humanity, and our ability to produce sufficient food to cover our demand for food was predicted by Malthus (1798) in the book *"An Essay on the Principle of Population"*. Although this book was written over two hundred years ago, the importance of an abundant production of sustainable food has only recently caught our attention (Dani, 2015; Deloitte, 2013). The United Nations estimate that, today about 842 million people – approximately one in eight – are undernourished, while 1.5 billion people are overweight or obese. The majority live in developing countries, where more than 14 percent of people are unable to meet their dietary energy requirements. The highest prevalence of undernourishment is in sub-Saharan Africa; undernourishment also remains a significant challenge in western Asia (Benton & Bhunnoo, 2013; Cargill, 2014; Gunasekaran et al., 2015). In line with this, the annual report *World Economic Forum's Global Risk Report (2015)* has categorised food shortage crises as one of the major risks threatening the world, that has a high impact and a high likelihood (WEF, 2015).

The changes to the food supply outlined in the previous section have led to new concerns for supply chain practitioners, most specifically in supply chain risk and

security, including food supply chain safety. For example, the threat of a bio-terrorist attack on food supplies, is an issue that has created significant concern (Bruemmer, 2003). It is noted that the mind-set of SC professionals and academics towards the safety and security of SCs has changed since the attacks on the World Trade Centre and elsewhere in the USA on September 11th 2001:

"This trend has forced supply chain managers to rethink 'security' within the confines of their four walls as well as across the supply chain. Security is no longer just about theft or product damage, but now must incorporate an assessment of possible disruptions (intended as well as unintended) in an effort to prevent, detect, and potentially recover from such disruptions" (Voss & Whipple, 2009, p. 293).

Moreover, Harl (as cited in Voss & Whiple 2009) stresses that, the importance of food supply chain safety and security increases, since the vulnerabilities of disruption can result from both unintended and intended interventions. Thus, the vulnerabilities of food supply chains could be multifarious. However, it is believed that most of the vulnerabilities are classified in the unintentional disruption category, examples of which are those caused by diseases (Asian bird flu), blight, infestation, improper handling, and perishability. Other categories of vulnerability relate to intentional disruption, primarily for ideological purposes.

Due to the complexities of food supply chains, the £200 billion financial size of the food and drink industry in the UK and the trade gap (Figure **25**), threats to the UK food and drink sector are complex and diverse. One major threat is fraud and criminal activities in this industry. The threats from criminality exist at many levels, from individual opportunistic behaviours to organised criminals (Godfrey, 2016; Perrett, 2016). Unlike other industries, the crimes and fraud occurring in this sector are not widely reported. What is more, because of the downstream of food supply chains, many customers do not even realize that they have been the victim of food fraud. Also, the companies which work throughout the supply chains, are reluctant to report any case of fraud within their supply chain sources, as it can affect their brand reputation and market share (Peck, 2007).

Hence, food, fraud and crime in food supply chains is multifarious. Intricate chains of contracting and subcontracting (**Figure** *28*), both within the UK and abroad, means

that many companies can be unaware of – or deny knowledge of – the conditions under which their goods are produced (Burt, 2015).

Modern slavery in food supply chains is one example of an unfortunate crime, that is being conducted in food supply networks. It can take many forms including the trafficking of people, forced labour, servitude and slavery. Recent statistics show that 27% of potential victims are trafficked into labour exploitation. Traffickers and illegal/unlicensed gang masters target a range of industries including those involved in food manufacturing and processing.

Even though the Slavery Abolition Act was approved in the year 1833, by the parliament of the United Kingdom. The first anti-slavery commissioner was not appointed until November 2014. Markedly, as stated by a UK government factsheet, modern slavery has increased 47% since 2012. The UK's first anti-slavery commissioner, Kevin Hyland OBE (2014) estimated that there were between 10,000 and 13,000 potential victims of modern slavery in the UK (Commissioner, 2015). This trade in human misery is taking place in cities, towns and rural communities across the nation on a shameful scale (Bradley, 2014). With numerous cases of arrests regarding modern slavery having been reported in the British media (Perrett, 2016)

In addition, an example of fraud was reported by Professor Chris Elliot, *founder of the Institute for Global Food security*, in the year 2015, when the institute examined dried oregano and found that 25 per cent of the samples supplied from supermarkets, online retailers and corner shops contained substances other than oregano (Whittle, 2016). Prompting the British government to report that, "*any loss of confidence that UK food is free from the effects of criminality, damages the reputation of our food industry for excellence both at home and overseas, with long-term negative economic consequences*" (FSA, 2016, p. 6). This is in line with a study that showed that 60% of today's consumers are concerned about the safety of the foods they eat. While less than 20% trust food companies to produce, and sell safe foods (Deloitte, 2009).

Following the "horse-gate" fiasco in 2013 (2.4.4.1) the British government asked Professor Chris Elliott to conduct a review into *"the integrity and assurance of food supply networks"*. In response to the report prepared by Elliott (2014) entitled "*Elliott*

Review into the Integrity and Assurance of Food Supply Networks- Final Report "and with the aim of tackling this important issue, the British government created the National Food Crime Unit (NFCU). This unit was established by the Food Standards Agency (FSA) in December 2014. The aim of NFCU is to provide leadership in relation to the food crime response in England, Wales and Northern Ireland. Moreover, the Scottish Government has followed the same route and leading on from a report by Scudamore (2013), the Scottish Food Crime and Incidents Unit (SFCIU) was established in 2015. The SFCIU will provide leadership in the prevention, investigation, disruption and enforcement of food crime and in the management of food safety incidents nationally for Scotland (FSA, 2016).

Andy Morling, the current head of NFCU, speaking in the Westminster Food & Nutrition Forum on the 22nd of March 2016, told the audience that: "*Where there is money, there's crime; where there is big money, there's big crime. The opportunities are certainly there for organised crime to come into food because they have the infrastructures already in place: they own haulage businesses, they own storage facilities, and they have money-laundering capabilities, so it is ready-made, if you like, for organised crime. But I think, for once, we're ahead of the game*".

Despite the creation of these units in the United Kingdom, Professor Elliot argues that, the NFCU does not have muscle power to fight fraud in the food supply chains, and argues that the role of the police in dealing with food crime is incompatible with the complexities of fraud that are currently happening (Whittle, 2016). Recently, the FSA decided to set a wide-ranging review, to assess how the NFCU is working two years after being launched, and recommend changes to its structure and remit, where these are deemed to be necessary. However, Andy Morling (Head of FSA) believes that, there is tension caused by the FSA's role as a consumer advocate and its role as a criminal investigator. Stating that this is a significant barrier to intelligence sharing, and describing the challenges for the NFCU of providing operational leadership in incidents of fraud. As the specialist, national unit, partners understandably look to the NFCU to give strategic and tactical direction in such circumstances or to either support or own such investigation (Pendrous, 2016).

Figure **26** (below) shows the extent of possibilities that can contaminate the food SC and affect food security. In line with the comments of Chris Elliot, academics such as Dani (2014) highlight the fact that the complexity of today's food supply networks is directly affecting food supply chains and it is reducing food security. Throughout the academic literature, there are many definitions to describe and ascribe the meaning of *'food fraud'* and *'food crime'*. Furthermore, individual commentators often employ a range of additional terms to describe specific elements of food related criminality. Such is the range and diversity of potential criminal opportunity that exists within food production and supply; it is likely that wholly satisfactory and delimiting definitions will remain elusive (Firn, 2016; Julien, 2010).

The Food Security Agency, define food crime as *"...dishonesty relating to the production or supply of food which is either complex or likely to result in serious detriment to consumers, businesses or the overall public interest"* (FSA, 2016, p. 9).
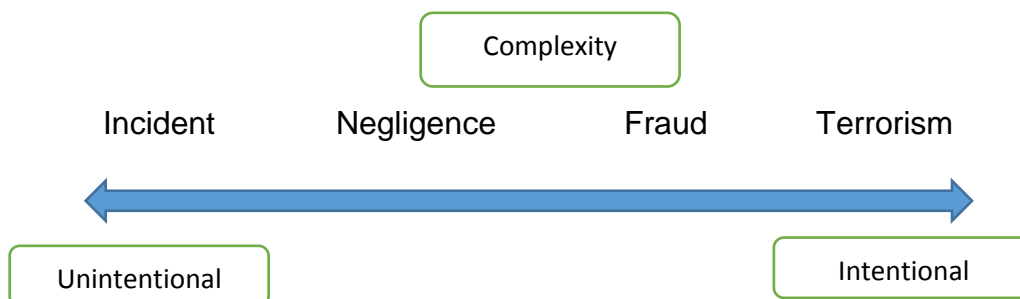
Figure 26 Reasons of contamination in Food Supply Chains
Source: Adapted from (Dani, 2014)

Harl (as cited in Voss & Whipple, 2009) identifies seven general areas of security susceptibility, and five of those relate to the agricultural and food SCs. Additionally, it has been claimed that food SCs may be a desirable platform for any ideologically-motivated disruption, and such disruption could easily reverberate throughout the farm to fork cycle (Bruemmer, 2003; Dani & Deep, 2010).

Furthermore, Bruemmer (2003) suggests that, major food supply chain disruption in the form of bio-terrorism could have extremely severe impacts on societies and the negative consequences can be multiple: *physical, psychological, political,* and *economic*:

➤ *The physical consequences* may include inedible food and/or insufficient food. Distribution centres and retail outlets, such as grocery stores could encounter disruptions in supplies and limitations in the ability to assess the safety of food. The service and hospitality industries, including sites of institutional food service, may be unable to obtain and deliver a viable product. If food is compromised with chemical or biologic agents, the direct results could include significant morbidity and mortality or the indirect results of hunger and inadequate nutrition*.*

➤ *The psychological consequences* could include the perception of an unsafe food supply and vulnerability to hunger and want. Food represents security, comfort, and the ability to provide basic needs to those who rely on others for protection and support. The long-term consequence could include aversion to a food or to an entire class of foods.

➤ *The political consequences* of any act of bioterrorism, including a compromised food supply, could include civil discord and diminished confidence in the government.

➤ Finally, there is the profound potential *consequence to the economy.* Agricultural industries could be severely disrupted in the event of an attack on the food supply. Retail and commercial food vendors could face liability issues and loss of revenue. "*The economic impact could be of significant duration, with lost consumer confidence and diminution of market image"* (Bruemmer, 2003, p. 687).

In the article "*Building a Secure and Resilient Supply Network*", Rice and Caniato (2003) have examined the emerging expectations of supply chain practitioners in relation to security, and emphasize the need to create SCs that are both secure (for example, maintenance of advanced security processes/procedures) and resilient

(that can react quickly and restore operations when unexpected disruptions occur). Accordingly, and in the light of the *"widespread nature of the food supply chain, creating both a secure supply chain as well as a resilient supply chain is of utmost importanc*e" (Voss & Whipple, 2009, p. 295).

2.4.3.2   Sustainability and Competition for Key Resources

As mentioned earlier, the population is growing at a faster rate than previous centuries. To satisfy the demand for food, more natural resources are needed; and then, these are limited (Sahan, 2016). This makes the achievement of sustainable production and distribution, which is defined as the capacity to achieve today's goals without compromising the future capacity, a highly pertinent and timely topic in fulfilling consumer demand (Maleksaeidi, Karami, & Zamani, 2015; Tendall et al., 2015). Sustainable production and distribution are getting more and more pivotal for the food industry, which is still the largest manufacturing sector in many developed and developing countries.

Although food production and distribution systems have become more efficient in many aspects, the industry consumes large amounts of natural resources and faces ever increasing demands (Li et al., 2014). Moreover, Sustainable food supply has constantly been a global challenge in the industry. This is important given the trends taking place in the global marketplace. In the coming decade, it is likely that a disproportionate share of global economic growth will take place in emerging markets. Currently, it is estimated that 175 million people in India and 130 million in China are being "fed with grain by over-pumping" of water.

Meanwhile, it is estimated that 24% of families now have foodless days in India. In these markets, the number of middle-class consumers will rise rapidly. In part, this will be driven by the continued migration of rural inhabitants into the cities. Already today, about half of the world's population is urban. Notably, middle-class consumers tend to consume far more meat, fish, and dairy products than poorer consumers. In addition, these products require more grain inputs to achieve a given level of calories. Thus, not only will food demand rise due to a rising population, but also due to rising incomes (Brown, 2012).

Further complicating the global food supply chain is the resource intensity of food production. The food system makes a considerable contribution to Greenhouse Gas (GHG) emissions. Estimates find that the food supply chains contribute to between 15 and 28% of overall GHG emissions in developed countries, with all stages in the supply chain, from agricultural production through to processing, distribution, retailing, home food preparation and waste (Garnett, 2014; McMichael, 2014). At the same time, water and energy, are two scarce resources in heavy demand in the production and distribution of food. Water is a scarce commodity in many parts of the world, where the population is growing the fastest. Climate change is also influencing water supply in some areas of the world. It can affect the stability of food production systems. Notably, climate change can have a wide array of effects, ranging from direct effects on food production, to changes in the markets, food prices, food utilisation and supply chain infrastructure (Wheeler & von Braun, 2013).

Additionally, pumping, treating, and moving large volumes of water requires a great deal of energy. Most significantly, modern farms use large amounts of energy to plant, fertilize, irrigate, and harvest crops. In many cases, traditional fossil fuels are used to provide this energy, and a change to more sustainable energy resources will be required (Deloitte, 2013). According to Li et al. (2014) companies need to do business continuously in order to survive in this competitive area. Yet, adding sustainable business without considering the strategic impacts would be disastrous for their competitive advantage. Therefore, they recommend that proper objectives or Key Performance Indicators (KPI) should be defined, that will then make decision making easier.

As depicted in Figure **20**, power over the global food system is concentrated in the hands of a small elite of governments and corporate interests, and is too often denied to both the hundreds of millions of small-scale foods producers, who grow most of the food, and to the billions who consume it. Sahan (2016) reports that, if a new sustainable production system is to be implemented, to eradicate hunger by 2030, then the current unequal food systems and the business models that underpin it, must be radically transformed. In a recent report by Oxfam, it is reported that the change is happening, and some of the world's largest food and beverage companies have the means to accelerate it. Just ten of those companies, the 'Big 10' – Associated British Foods (ABF), Coca-Cola, Danone, General Mills, Kellogg, Mars,

Mondelēz International, Nestlé, PepsiCo and Unilever – collectively generate revenues of more than $1.1bn per day and employ millions of people directly and indirectly. Their supply chains are linked to every part of the food system, from the small-scale producer to the everyday consumer (Sahan, 2016).
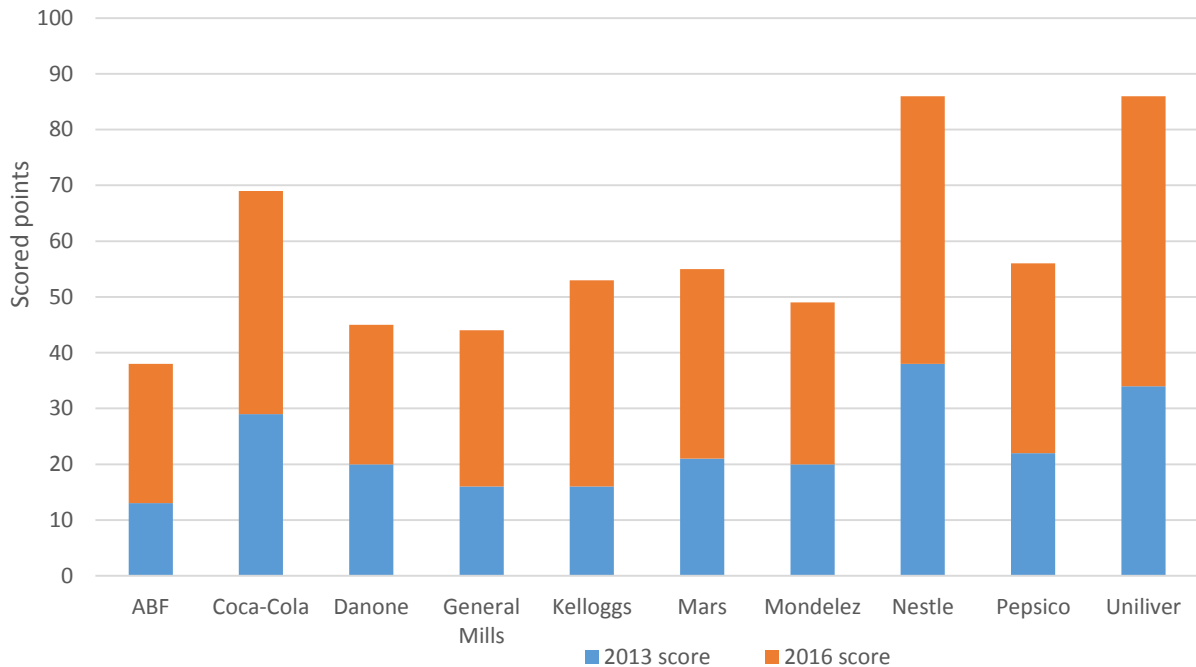
Figure 27 Overall score changes per company from 2013 to 2016
Source: Adapted from (Sahan, 2016)

Sustainability and resilience in food supply chains are considered as complementary concepts. Resilience is defined as the ability of a system to bounce back from unexpected disruptions and therefore forms a part of sustainability (Maleksaeidi et al., 2015; Tendall et al., 2015).

The efforts of the big 10 companies in order to achieve the before mentioned goals are assessed and scored against seven themes: Land, Women, Farmers, Farm Workers, Climate Change, Transparency and Water. A detailed description of the methodology and every indicator assessed in the scorecard is available at: www.behindthebrands.org/about.

2.4.3.3   Consumer Perceptions

The future of food will take shape in a world where biodiversity is declining, the climate is changing, infectious diseases are spreading more widely and rapidly, and global food sourcing is raising safety and sustainability concerns. Current worldwide migration trends will create new burdens as the rural-to-urban movement continues and population growth soars. The use of arable land for food production will compete with demand for fuel crops, while our oceans face degradation and a decline in consumable marine life. Despite these constraints on food production, consumer demands for cheap, tasty, convenient, and increasingly functional food show little sign of abating. Indeed, the ability to obtain just about any food, regardless of local growing conditions, is practically a given for many consumers in developed countries (Lueck Avery, Kreit, & Falcon, 2011).

While change in emerging markets is dramatic, the developed economies are also experiencing a shift in consumption patterns. Modern North American and European consumers are more health conscious than ever before. They are worried about the content of their food, its origin, freshness, and safety. These consumers are increasingly concerned about the sustainability of food production and its impact on the environment. Modern farming techniques such as genetic modification is debated, and often perceived as negative. Whereas, buying local and the organic food movement, are growing trends that have taken hold of the modern consumer (Deloitte, 2013).

2.4.3.4   British Exit from the European Union (BREXIT)

On Thursday the 23rd of June 2016, the British citizens of the United Kingdom participated in a referendum on the future of their country's membership within the European Union. In the following days, it became apparent that the UK voted narrowly but clearly (52% / 48%), to leave the EU of which it has been part of since 1973. Because of the vote, the country has entered into *unchartered waters* status as claimed by David Cameron, the former UK Prime minister. The vote has triggered a wave of change in British politics and forced the then British prime minister to resign. Moreover, it has created a division between Scotland and the rest of the UK. This section does not intend to discuss the reasons behind the outcome of the referendum nor the advantages or disadvantages of BREXIT. However, it will,

highlight some of the challenges that UK food supply chains will be facing after the initiation of Article 50 (also known as the divorce article) of the EU Lisbon treaty.

By activating article 50, the UK will enter the type of issue which Donald Rumsfeld, the former US Secretary of State, addressed in 2002, when referring cryptically to the existence of *"known unknowns"* and *"unknown unknowns"* when asked about the military invasion of Iraq by the US and its allies. In the case of the UK's exit from the EU, this philosophising could be applied. As indicated before, the UK imports almost 40 percent of its required food from overseas, and of this, the EU supplies 27 percent (see **Figure** *24*). Therefore, the challenges that the BREXIT vote is going to impose on the UK food supply chain are multi folded. For example, BREXIT will affect over 12 thousand EU laws, regulations and statutory instruments which now need to be replaced or renegotiated. The food laws and regulations that have been legislated with European partners will now need to be adapted, along with the labyrinthine Common Agricultural Policy (CAP), generations of supply chains, food tastes and consumers who are used to a food system based on EU security, this makes it a very risky project. More optimistically, this is going to be exciting (Lang, 2016).

In the 2015 City Food Symposium held at the City University of London, the possibility of a BREXIT effect on the UK food supply chain was discussed. At the time of writing this thesis, the UK is in a state of uncertainty. Many discussions are going to be held with the EU and the rest of the World to ensure the continuity of high quality food in British food chains. At this stage, it is impossible to say what consequences of BREXIT there will be for British agriculture. The following, are some of the comments by the speakers at this symposium. We *"know the advantages and the problems of EU membership but we don't know what non-membership would mean",* argues Martin Haworth, acting director general, of the National Farmers Union. Alan Swinbank, an Emeritus Professor of Agricultural Economics at the University of Reading claims that, most scenarios of post BREXIT show that, there will be some disruptions in UK food supply chains. However, individual businesses will be gainers and losers, nonetheless the UK's food security is not an issue, as overseas suppliers will still want to sell to a wealthy market. Kate Trollope, editor of EU food Policy believes that the UK will still have to meet all the requirements of the Brussels legislators, if companies want to continue to export to the EU (a market of 450 million consumers).

2.4.4 Case Examples

Now that the most pertinent challenges of the UK food supply chain have been described, the following subsections illustrate a few of the infamous cases that have affected food supply chains. The first case luckily did not have fatal outcomes; however, it has affected the consumers trust. In the second case, unfortunately, the opportunistic behaviours have led to fatalities and severe health conditions. The final case shows the opportunistic behaviour of actors within the supply chain, the importance of animal welfare and the initiative taken by governments to address the issues, and to increase consumer trust, that extends the exporters responsibility beyond the point of sale.

2.4.4.1   Horse Meat Scandal

The contamination of beef with horsemeat in the British retail industry, also known as "horsegate", is known to be the biggest food fraud of the 21st century to date. It led to the withdrawal of tens of millions of burgers and beef products across Europe and a promise from David Cameron that everything possible would be done to get a grip on a "very shocking" crime (Lawrence, 2013). In early 2013, retailers such as ASDA, TESCO and others admitted to the unknowing sale of horsemeat-contaminated products. It is believed that the horsemeat scandal took supermarkets by surprise, because they took a complex supply chain too much "on trust" and were over-reliant on paperwork, rather than sampling and close trade relationships (Addy, 2014).

The interrelated and cross European supply of the meat is depicted in **Figure *28***, Comigel, a French company based in the northeast of France, supplied contaminated meat to the retailers mentioned above. Once the investigation on the sources of the contamination started, it soon became apparent that the supply chain of the meat was far too complex. The French company, Comigel, subcontracted Taviola a company in Luxembourg. Taviola in turn placed its orders through another French company based in the south of France named Spanghero. Again, Spanghero subcontracted the purchase order to a dealer in Cyprus that subsequently placed an order to a Dutch company. Finally, the Dutch trader purchased the meat from Romanian slaughterhouses, that delivered the meat directly to the French company, Spanghero. During the investigations, the Romanian abattoirs claimed that they had

labelled the products correctly and had indicated that the meat contained horse meat. It was argued that, the fraud that occurred in the supply chain was not their responsibility and happened somewhere else along the line.
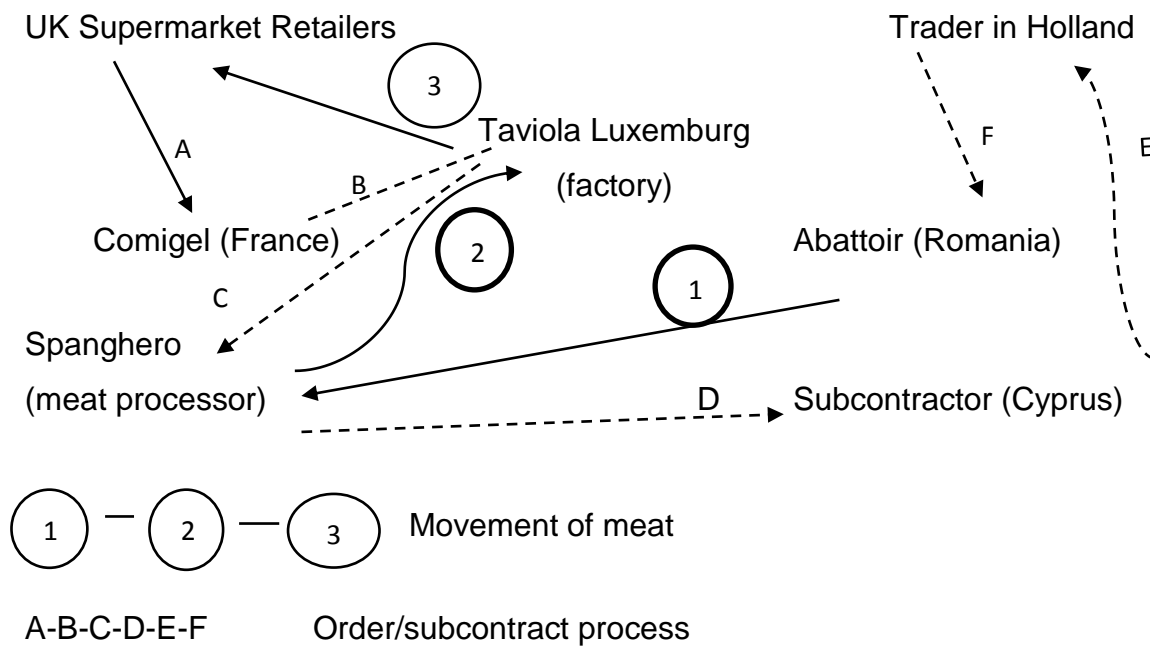
Figure 28 Map of horsemeat scandal
Source: Adapted from (Dani, 2015, p. 147)

After two years of investigation to find the culprits, the first prosecutions were brought in England following Europe's 2013 horse meat scandal. Which ended with one defendant getting a fine, and another, a short and suspended prison sentence, but only for what they admitted to doing (Flynn, 2015).

2.4.4.2 Salmonella Typhimurium in Peanut Butter

One of the largest food product recalls in the United States occurred because of Salmonella Typhimurium found in peanut butter. According to the U.S. Food and Drug Administration (FDA) and the Centres for Disease Control and Prevention (CDC), state and local public health officials investigated a multi-state outbreak of Salmonella. The FDA located the source of the contamination at a processing plant in Blakely, Georgia. The processing plant, Peanut Corporation of America (PCA) was directly linked with the 2008-2009 salmonella outbreak that killed nine people, and sickened at least 714 others nationwide. This resulted in a huge food recall that cast a pall over one of America's favourite foods: peanut butter (Basu, 2014; Dani, 2015; FDA, 2014). The contamination of PCA products had a negative impact on its business and forced the company to file for Chapter 7 bankruptcy in February 2009.

The FDA started an investigation, to identify the source and reason for the contamination, with the results indicating a lack of preparedness. Proven by the fact that, what began as a voluntary recall of specific lots, gradually expanded into a recall of all products, including dry-and oil-roasted peanuts, ceasing the production. The contamination spread through various products, and product categories across several supply networks that used PCA's product as an ingredient in their manufacturing process. The investigation uncovered that the source of contamination was in a PCA manufacturing facility at Plainview, Texas, on the 21st of January 2009. Remarkably, the company executive knew as far as 2006 that the peanut butter was contaminated, but they still delivered it to the supply chain. Furthermore, the manufacturing plant was poorly maintained and unclean. Eventually, there was a criminal investigation against the executives and they were convicted in September 2014 for conspiracy, fraud and other federal charges (Basu, 2014; Dani, 2015).

2.4.4.3 Aussie Sheep killed in Pakistan

Australia exports approximately 2 million sheep via the live export market each year, to about 19 destinations. The Middle East is by far the biggest market for live sheep (Indonesia is the biggest market for live cattle) and earns the nation approximately $185 million per annum for the purposes of ritual slaughter and a guarantee of the freshness of the meat, in the absence of sophisticated cold chains. A shipload of

21,000 Australian sheep was sent to the Pakistani port city of Karachi after being refused permission to lay in Bahrain because of disease concerns. The sheep were unfit for human consumption due to outbreaks of scabby mouth disease, salmonella and anthrax (Grewal, 2012). The sheep were never supposed to go to Pakistan. They only ended up there after authorities in Bahrain rejected the shipment, claiming that the animals were infected with scabby mouth.

Despite a legal challenge, and high level government, diplomatic, scientific and industry representation, a cull still took place. Australia's Department of Agriculture says it was powerless to stop the slaughter (Ockenden, 2012). Hence, animal welfare cruelty is highly important and there is no doubt that, the sheep were killed in a savage manner. Yet, the question to be raised is why the sheep ended up in Pakistan? Furthermore, what happened to the meat? And were the corpses safely discarded or entered into the food supply chain?

Thus, the Australian government developed Australia's Exporter Supply Chain Assurance System (ESCAS). The ESCAS was implemented between July, 2011 and March, 2014. This had some implications for current supply chain practices (Australian Government Department of Agriculture, 2016). According to Jackson (2015) the most interesting point to consider in this list, is that exporters maintain responsibility for the goods (the welfare of the livestock) far beyond the point of sale (Commonwealth of Australia, 2015). Essentially this means that exporters are financially and morally responsible for the humane handling and slaughter of livestock right up to the end of the animal's life. It is believed that this is a unique element of the live export market and a characteristic that sets it apart from any other supply chain. With the exception of product guarantees and insurance, nowhere else is any manufacturer or distributor responsible for the quality and handling of a product beyond the point of sale.

2.5   Resilient Supply Chains

Section 2.1.1 above, explained the approach of this empirical doctoral research towards portraying a theoretical framework for resilient food supply networks in the UK. Moreover, a review on the most pertinent operational challenges, the importance, charateristics and vulnerabilities of food supply chains in the UK and around the globe, were reviewed in section 2.4 above. The subsequent sections explore the phenomenon of resilience in supply chain management contexts. The process of a systematic literature review was explained in 2.1 above and its results are expanded and explained.

The literature review identifies the building blocks of the concept; more specifically the most pertinent to farm to fork networks. "*It is noticed that both capabilities collaborate to facilitate or hamper the creation of supply chain resilience*" (Pereira et al., 2014, p. 631). Therefore, by identifying the enablers of resilience in UK food supply chains, it is construed that a lack of these facilitators can inhibit the extent of the resilience of a company's supply chain. Hence, the literature review focuses on the enabling capabilities of resilience.

2.5.1   Resilience: The Concept

The word *"resilience"* has its origins in Latin, where *"resiliō"* had the meaning of springing back, recoiling or rebounding (Koronis & Ponis, 2012). The modern English definition of the verb *"resile"*, means recoiling to resume a former size (Oxford, 2002). In the world of science, resilience as a concept, can initially be traced back to engineering, where it represents the quality of a material, that can store strain energy. And then, upon unloading, have this energy recovered, without the material breaking or being deformed (Avallone, Baumeister, & Sadegh, 1996; Aven, 2011; Bhamra et al., 2011; Bhatia et al., 2013).

In the context of the study of systems, the word resilience first appeared in literature in a seminal article entitled *"The Resilience and Stability of Ecological Systems"* by Holling (1973). Since then, resilience has been a concept that has been applied to research and practice in almost every discipline (Table **9**), from science to sociology, psychology, nursing, medicine, business and ecology (Garcia-Dia, DiNapoli, Garcia-Ona, Jakubowski, & O'Flaherty, 2013).

In the business environment, tragic events such as the UK fuel protest in September 2000, foot and mouth disease in February 2001 in the UK, and the US terrorist attack in September 2001, has actively encouraged academics and practitioners to investigate the concept of resilience (Masoud Kamalahmadi & Mellat-Parast, 2015; Pereira et al., 2014). This relationship can be observed by comparing the number of declared disasters (Figure **7**) to the number of studies on the topic of resilience (Figure **29**).

Figure 29 Number of studies related to supply chain resilience between 2001 and 2015
Source: (Kamalahmadi & Parast, 2016, p. 118)

Academics and practitioners, alike, are now aware that, through globalisation, organisations are becoming interconnected with suppliers spread around the globe, who may themselves have been supplied by lower-tier suppliers (Chopra & Meindl, 2013; Gunasekaran et al., 2015; Min & Zhou, 2002; Reyes Levalle & Nof, 2015). The increased risks, that are the result of complex and geographically disperse global SCs, dictate that companies need to gain a better conceptual understanding of resilience, an emerging critical topic, to effectively manage risk in business environments (Bhamra et al., 2011; Briano, Caballini, & Revetria, 2009; Carvalho, Barroso, et al., 2012b; Christopher & Peck, 2004; Jüttner & Maklan, 2011; WEF, 2015).

Therefore, today's organizations should be able to respond to the changes in the market, such as shorter product life cycles, rapid design changes and on-going demand for new products from customers (Carvalho et al., 2011). In addition, "*the*

immediate and lingering effects of natural disasters, and the subsequent supply chain disruptions, have spurred renewed concerns about supply chain resilience" (Pettit et al., 2013, p. 46). However, it is argued that the components, that facilitate the creation of resilience, are not well identified and the state of our understanding is still at an incipient stage (Park et al., 2011).

Being part of a *"resilient supply chain"* can arguably protect organisations against the challenges mentioned in section 2.2.2. The literature shows that creating a resilient SC is one of the major concerns of all business executives around the globe: unfortunately, building a resilient SC is easier said than done (Carvalho et al., 2011; Chopra & Meindl, 2013; Christopher & Holweg, 2011; Egli, 2013; Fiksel, Polyviou, Croxton, & Pettit, 2014; Sáenz & Revilla, 2014).

Furthermore, it has been observed that expensive negative experiences, have not made SC practitioners and organisations sufficiently aware of the importance of resilience in their supply networks. A recent study by Deloitte shows that tactical approaches to strengthening SC resilience are anything but clear in the eyes of many executives. "*Despite a broad acceptance of SC resilience as a critical part of managing risk exposure and the demonstrated value of data-driven techniques to build resilience, companies frequently fail to use the latter to achieve the former"* (Marchese & O'dwyer, 2014, p. 129).

Another source of difficulty in the context of supply chain management is that, there are often some terms that are quite different, but are used interchangeably. Robust and resilient supply chains are one of them. Robust supply chains can deal with reasonable variability in input, whilst maintaining good control over output variability. *"A resilient supply chain is certainly robust, but it offers much more; as well as being responsive to predictable input variability it is also able to respond to a sudden and unexpected shift in the level and variability of input"* (Christopher & Rutherford, 2004, p. 25).

Author	Context	Definition
(Holling, 1973)	Ecological systems	The measure of the persistence of systems and of the ability to absorb change and disturbance and still maintain the same relationships between state variables.
BS 65000:2014	Organisational	Organizational resilience is the ability of an organization to anticipate, prepare for, and respond and adapt to everything from minor everyday events to acute shocks and chronic or incremental changes.
(Fiksel et al., 2014; Pettit et al., 2013)	Supply chain	SC Resilience is the capacity for complex industrial systems to survive, adapt, and grow in the face of turbulent change.
(Gaonkar & Viswanadham, 2007)	Supply chain	SC Resilience is the ability to maintain, resume, and restore operations after a disruption.
(Falasca, Zobel, & Cook, 2008)	Supply chain	SC Resilience is not just the ability to recover from mishaps, but is a proactive, structured and integrated exploration of capabilities within the supply chain to cope with unforeseen events.
(Ponomarov & Holcomb, 2009)	Supply chain	SC Resilience is the adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function.
(Carvalho et al., 2011)	Supply chain	SC Resilience is concerned with the system's ability to return to its original state or to a new more desirable one after experiencing a disturbance and avoiding occurrence of failure modes.
(Xiao, Yu, & Gong, 2012)	Supply chain	SC Resilience is the supply chain's ability to return to the original or ideal status after external disruption and includes both the abilities of adaptability to the environment and recovery from the disruption.
(Yao & Meurier, 2012)	Supply chain	Supply resilience is defined as the ability to bounce back from disruptions and to permanently deal with and respond to the changing environment.
(Barroso, Machado, & Machado, 2011)	Supply chain	SC Resilience is the ability to react to the negative effects caused by disturbances that occur at a given moment in order to maintain the supply chain's objectives.
(Coutu, 2002)	Individual	Resilient individuality possesses three common characteristics. These include an acceptance of reality, a strong belief that life is meaningful and the ability to improvise.
(Bruneau et al., 2003)	Disaster management	The ability of social units to mitigate hazards, contain the effects of disasters when they occur and carry out recovery activities that minimise social disruption and mitigate the effects of future earthquakes.
(Hamel & Valikangas, 2003)	Organisational	Resilience refers to the capacity of continuous reconstruction.
(Lengnick-Hall, Beck, & Lengnick-Hall, 2011)	Organisational	The firm's ability to effectively absorb, develop situation-specific responses to, and ultimately engage in transformative activities to capitalize on disruptive surprises that potentially threaten organization survival.
(Resilinc, 2016)	Supply Chain	The capability of a supply chain network and individual suppliers to recover quickly and cost-effectively from an event and with minimal or no impact to the normal flow of supplies.
(Folke, 2006)	Socio-ecological systems	The opposite to Vulnerability. The amount of disturbance a system can take before its control shifts to another set of variables and relationships that dominate another stability region.

Table 9 Definitions of resilience found through scoping literature review

Each activity conducted in a SC carries an inherent risk, which can trigger an unexpected disruption (Mikkelsen & Khan, 2015; Ponomarov & Holcomb, 2009; WEF, 2015). This implies that SCs never actually reach a stable and steady state, due to the unpredictability of the environments in which businesses function. An instability caused partly by the variability of customer demand, and the actions taken by competitors to gain more market share (Braithwaite & Wilding, 2003; Colicchia & Strozzi, 2012; Vorst et al., 1998). Colicchia and Strozzi (2012) argue that, both the academic literature on supply chains and practitioners concur on the possession of the capacity to manage SC risk. Hence, it is a vital requirement to survive and compete in today's increasingly turbulent and unpredictable business climate. Unfortunately, there is no specific method or safe pathway to overcome or avoid these risks. However, Briano et al. (2009) argue that some organisations cope better than others in handling un-quantifiable risks and their symptoms, and these organisations share a critical common characteristic: *resilience.*

To prosper in the face of turbulent change, organisations need to improve how they deal with unexpected disruptions to complex supply chains and resilience lies at the heart of this ability. "*Companies can cultivate such resilience by understanding their vulnerabilities and by developing specific capabilities to compensate for those vulnerabilities*" (Fiksel et al., 2014, p. 79). It was not until recently that large companies such as Toyota, after suffering large financial blows and market share losses, realised the importance of a resilient SC and began building this capacity into their supply networks (Chang-Ran, 2011; Fiksel et al., 2014; Sheffi, 2015a).

The definition of resilience in a company context could be "*the ability to return the company to its original state or to a new more desirable state after experiencing a disturbance while avoiding the occurrence of failure modes*" (Carvalho, Barroso, et al., 2012b, p. 331). It is believed that resilience may be achieved by two means: firstly, by the ability to recover the desired value that has been disturbed within an acceptable period and cost; secondly, by reducing the effectiveness of disturbance by changing the level of effectiveness of a potential threat (Haimes, 2006).

Christopher and Peck (2004) are the pioneering authors on resilient supply chains (Kamalahmadi & Parast, 2016). They consider resilience to be part of an "*agility*"

strategy (**Figure 30**). With the belief that, the decision to design a SC structure should include the goal of adding flexibility to the organisation (**Figure 30**).
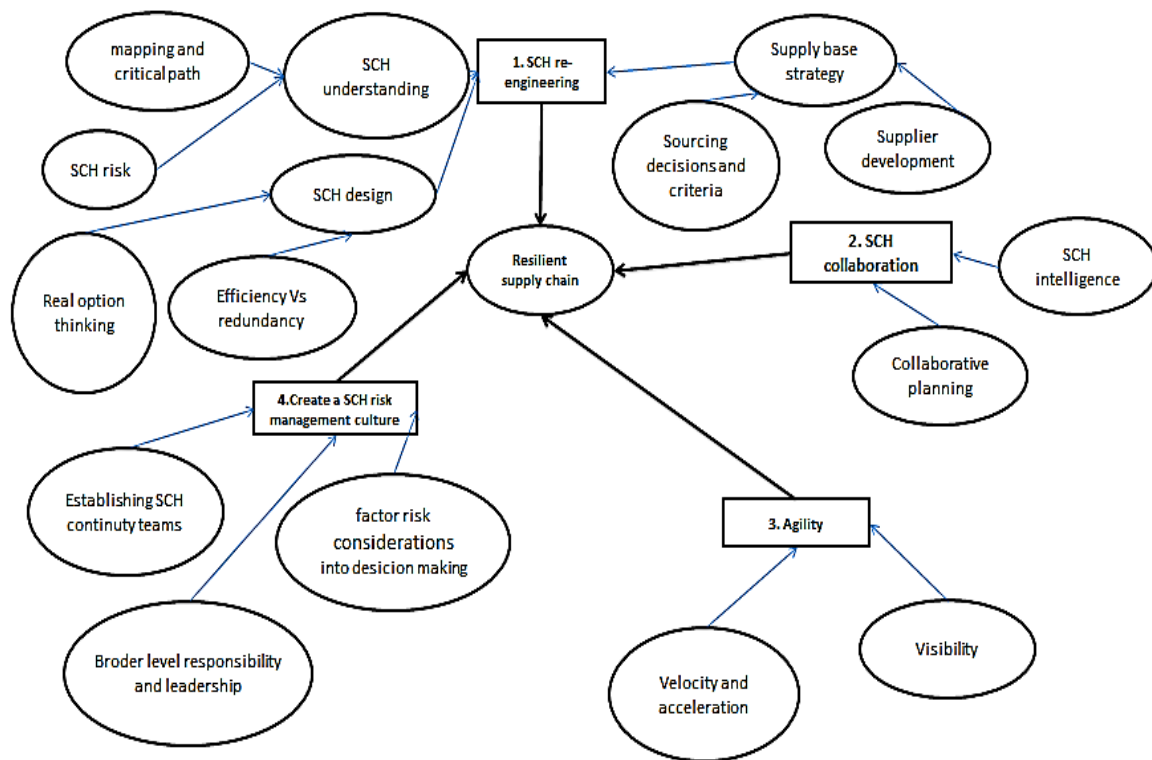
Figure 30 Necessary ingredients to create a resilient supply chain
Source: Adapted from (Christopher & Peck, 2004)

Based on their empirical study on supply chain vulnerability, sponsored by the centre of logistics and supply chain management, Christopher and Peck (2004) consider that certain features, should be included into the supply chain design, to obtain a resilient supply chain. Moreover, collaboration amongst various entities of supply chains is contemplated, in case of an unexpected risk. They conclude that the creation of risk management culture in an organisation, enhances the resilience of the whole supply chain.

From a slightly different perspective, other academic authors argue that supply chain resilience is not merely controlling and managing the risks. It is believed that building redundancy, flexibility and changing the organisational culture are further effective methods of increasing the resilience of a SC.

Redundancy is achieved by the capability of an organisation when holding excess of inventory, low capital utilization and larger supplier bases. Yet, this strategy is seen in contrast to lean production processes and quality control practices such as the Six Sigma (Pettit et al., 2013; Sheffi, 2005).
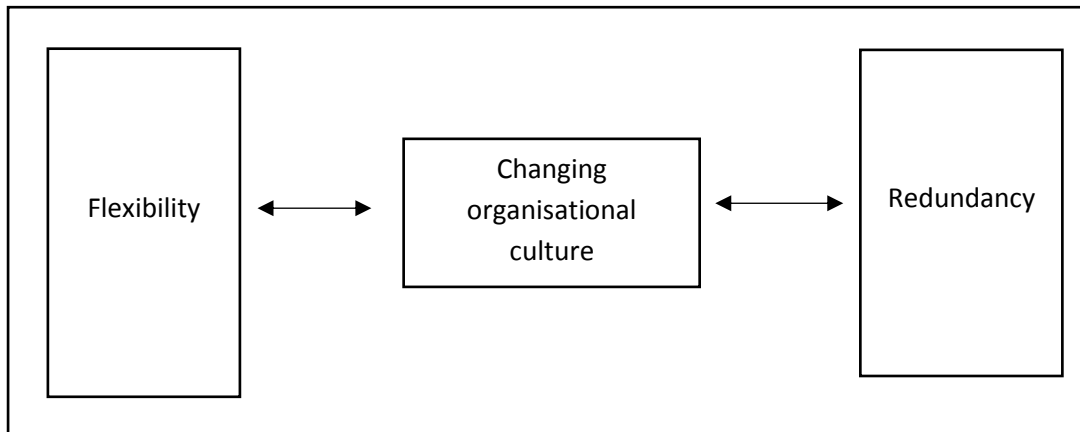
Figure 31 Resilient Enterprise
Source: Adapted from (Sheffi & Rice, 2005)

Accordingly, *flexibility* in supply chains is achieved when companies adopt standardized processes, using concurrent instead of sequential processes in key areas. Such as product development and product distribution, which implement postponement practices, where they can bring the decoupling points closer to the consumer and finally, align the procurement strategy with supplier relationships (Sheffi, 2005, 2015a, 2015b).

In a Deloitte review, four pillars of a resilience framework were introduced by Marchese and O'dwyer (2014). The belief is that through these pillars, companies will be able to identify, prioritise and deploy data analytics and visualisations to improve a company's resilience (**Figure 32**).
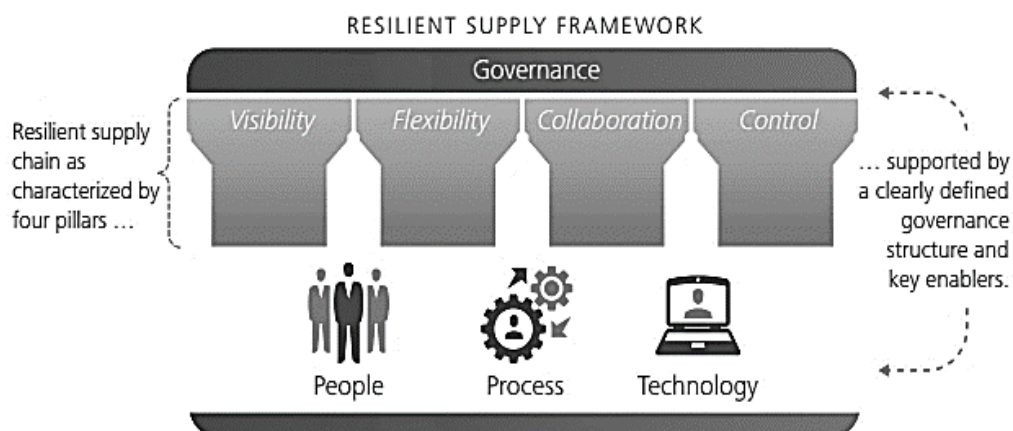
Figure 32 Key attributes of a resilient supply chain
Source: Adapted from (Marchese & O'dwyer, 2014, p. 131)

Moreover, the importance of *collaboration* amongst supply chain partners is a well investigated theme. It is believed that collaboration is one of the most effective gears of risk management (Amber Road, 2015). Specifically, in the moment of materialisation of any disaster, it is claimed that the parties involved within a SC, that use collaborative approaches, are more able to reduce the impact of the disruption and increase the response time to overcome the disruptions. Accordingly, these collaborative actions lead to an increase of visibility and information sharing on the SC vulnerabilities and the probability of their materialisation up and down the SC. This method allows for risks to be spread out across the trading partner network, as a practical way of distributing the ability to control risks, in the respective areas of each link in the supply chain (Carvalho, Azevedo, & Cruz-Machado, 2012).

Although, prominent authors on resilient supply chains consider *agility* as part of the resilient strategy (Christopher & Peck, 2004), there are still misinterpretations amongst academics and SC practitioners, between the differences of '*agile'* and '*leagile',* carefully combining both lean and agile (Naylor, Naim, & Berry, 1999) and resilience. To clarify this confusion, an agile approach enables the organisations to respond promptly to any spike in demand fluctuations, ensuring that the ever-important competitive advantage edge over the competitors is maintained. A resilient approach on the other hand, withstands the current level of supply chain performance even when disruptions occur (Carvalho, Barroso, et al., 2012b) or even allows rise to the performance level above the pre-disruption level (Carvalho, Azevedo, et al., 2012; Pettit et al., 2013).

Significantly, *trust* is considered as one of the most important qualities in the creation of a resilient supply chain. It is the expectation that entities, which are involved throughout the supply chain, make a good-faith effort to behave in accordance with any commitments. Agreeing to be honest in negotiations and not take advantage of others, even when an opportunity to do so is available (Hosmer, 1995; Roth et al., 2008).

	Flexibility	Redundancy	Visibility	Collaboration	Financial strength	Risk management	Trust	Agility	Recovery	Security	Anticipation	Product stewardship	Efficiency	Control
(Dani, 2014, 2015)	*	*	*	*		*	*	*		*			*	*
(Fiksel et al., 2015)	*	*	*	*	*			*	*	*	*	*	*	
(Sheffi, 2005, 2015a, 2015b)	*	*	*											
(M. Kamalahmadi & Parast, 2016)	*	*	*	*		*	*	*				*		
(Khan & Sepulveda Estay, 2015)				*		*				*			*	*
(Jüttner & Maklan, 2011)	*		*	*		*							*	
(Pettit et al., 2013)	*		*	*	*			*	*	*	*		*	
(Ponomarov & Holcomb, 2009)	*	*	*	*				*	*					*
(Peck, 2007)	*	*	*			*					*		*	
(Christopher & Holweg, 2011)	*	*						*						*
(Blackhurst et al., 2011)	*	*		*		*		*						
(Spiegler, Naim, & Wikner, 2012)	*	*		*				*			*			
(Pereira et al., 2014)	*	*	*	*	*	*	*	*	*			*		*
(Tendall et al., 2015)	*	*	*					*	*					
Manning and Soon (2016)	*							*	*			*	*	
Annarelli and Nonino (2016)	*	*	*	*				*						
(Gunasekaran et al., 2015)	*		*	*		*			*			*	*	
(Brandon-Jones, Squire, Autry, & Petersen, 2014)			*	*									*	

	Flexibility	Redundancy	Visibility	Collaboration	Financial strength	Risk management	Trust	Agility	Recovery	Security	Anticipation	Product stewardship	Efficiency	Control
(Harrington, 2014, 2015)			*	*				*			*			
(Leat & Revoredo-Giha, 2013)				*		*								*
(Marchese & O'dwyer, 2014)	*	*	*	*										
(Golgeci & Ponomarov, 2013)				*		*						*		
(Macfadyen et al., 2015)		*				*								
(Mandal, 2014)			*	*		*		*						
(Ponis, 2012)	*	*	*	*				*		*				
(Purvis et al., 2016)	*	*						*						
(Resilinc, 2016)		*	*		*	*						*		
(Wilding, 2013)			*	*		*		*				*		
(Tukamuhabwa, Stevenson, Busby, & Zorzini, 2015)	*	*	*	*				*						
(DHL, 2015)	*		*	*	*	*		*			*			
(Melnyk, Closs, et al., 2014; Melnyk, Narasimhan, et al., 2014)	*	*	*			*				*	*	*		*
Number of Citations	**23**	**19**	**22**	**23**	**5**	**16**	**3**	**19**	**7**	**6**	**7**	**9**	**9**	**7**

Table 10 Enablers of resilience in supply chains

Factors	Definitions
Visibility	Encompasses a company's ability to track and monitor supply chain events and patterns and proactively turn these insights into actions.
Flexibility	Refers to a company's ability to adapt to disruptions without significantly increasing its operational costs. Flexibility in sourcing, manufacturing and order fulfilment are considered to enable a company to become resilient.
Collaboration	Refers to a company's ability to develop symbiotic, trust-based relationships with supply chain partners and other key strategic networks.
Agility	The ability to respond quickly to unpredictable changes in demand and/or supply.
Risk Management Culture	Ensuring that all organisational members embrace supply chain risk management. It involves top management support and firm integration/team work.
Product Stewardship	Sustainable business practices throughout the product life cycle.
Efficiency	Capability to produce outputs with minimum resource requirements.
Control	Refers to a company's ability to implement policies and execute processes that prevent disruptions.
Anticipation	Ability to discern potential future events or situations.
Recovery	Ability to return to normal operational state rapidly.
Security	Defence against deliberate intrusion or attack.
Financial strength	Capacity to absorb fluctuations in cash flow.
Trust	Building up trust with shareholders and stakeholders.

Table 11 Resilience enabling factors identified in the literature review

Table **11** above, outlines the resilience enabling factors that were elicited from the systematic literature review, and their respective definitions.
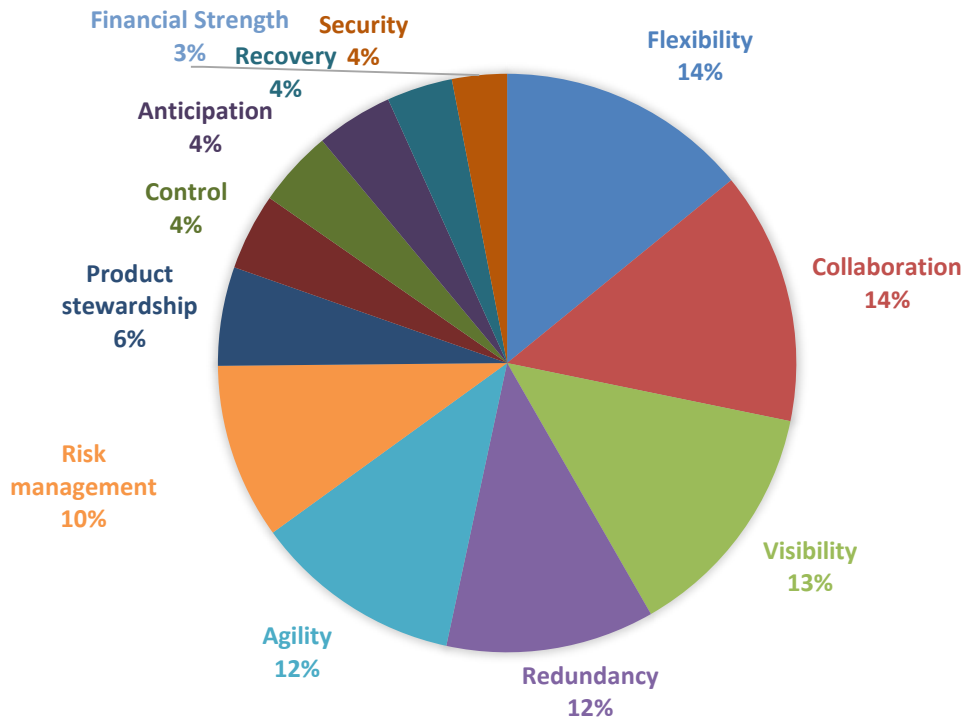
Figure 33 Importance of each enabler of resilience

The above pie chart demonstrates the most cited enabling factors of resilience in supply chains. It is through incorporating flexibility, diversity, decentralization, collaboration, transparency, foresight and redundancy, that stakeholders in the food web can cultivate adaptation and a competitive advantage. Even as they embark on a journey to ensure that the world's food supply in 2020 will be more resilient than it is today (Lueck Avery et al., 2011).

2.5.2   Resilience and Risk Management

The risks, vulnerabilities and the challenges of today's supply chains (more specifically in food SC) were explored in section (2.3 above) and its subsequent subsections. This section, however, highlights the differences between resilient supply chain and Supply Chain Risk Management.

Several scholars argue that risk management and resilience strategies are not equivalent (Briano et al., 2009; Fiksel et al., 2014; Kamalahmadi & Parast, 2016; Park et al., 2011; Ponomarov & Holcomb, 2009). As has been noted, risk management based strategies are most successful when hazard probabilities can be estimated (impact and effect) and the organisations are aware of them. However, Park et al. (2011, p. 396) argue that *"ignorance of emergent hazards does not justify a lack of preparedness; and various disasters such as the Fukushima earthquake, Deep Water Horizon and Hurricane Sandy reinforce the view that some degree of ignorance in a complex system is irreducible"*. Therefore, an exclusive risk management approach is never acceptable, and a lack of attention to resilience will intensify the consequences of inevitable failures (Park et al., 2011; Pettit, 2008; Ponomarov & Holcomb, 2009; Rice, 2013; Rice & Caniato, 2003; Sáenz & Revilla, 2014).

The literature shows that risk analysis and risk management alone, are insufficient to help companies handle current turbulent conditions under which organisations are working. It is recommended that *"a better understanding of design for resilient, coupled, complex systems must be emphasized"* (Park et al., 2011, p. 396). Moreover, academics see resilient strategies as a source of competitive advantage and conclude that *"organisations that can overcome the risk can strengthen their position in the market and increase their public loyalty"* (Dani & Deep, 2010, p. 395).

As demonstrated in **Figure** *16*, risk management begins with hazard identification (Manuj & Mentzer, 2008) but it should be noted that, "*this approach is problematic where the hazards are unknown, inestimable, or very low-probability and high-consequence events*" (Park et al., 2011, p. 396). In complex coupled systems, all probabilities of risk are conditional on some background knowledge, including suppositions that camouflage unknown hazards (Aven, 2011; Tendall et al., 2015).

As the full knowledge of unexpected hazards, and how the cascading effects emerge in complex coupled systems, cannot be acquired, risk management can fail when confronted with unexpected shocks (Barroso et al., 2011; Bhamra et al., 2011; Fiksel et al., 2015; Kamalahmadi & Parast, 2016; Ponomarov & Holcomb, 2009).

The Aberdeen Group has conducted research where most companies that participated did have a clear understanding of the importance of resilience. However, as shown below (Figure *34*) when the elements such as speed of recovery and risk management are incorporated, there is a greater fall-off in capabilities adaptation. In today's SCs, uncertainty still plays a major role in impeding managers to make effective remedial decisions. Current research demonstrates that catastrophic events such as environmental disasters can affect, directly or indirectly, the other significant business pressures shown in **Figure 9**.
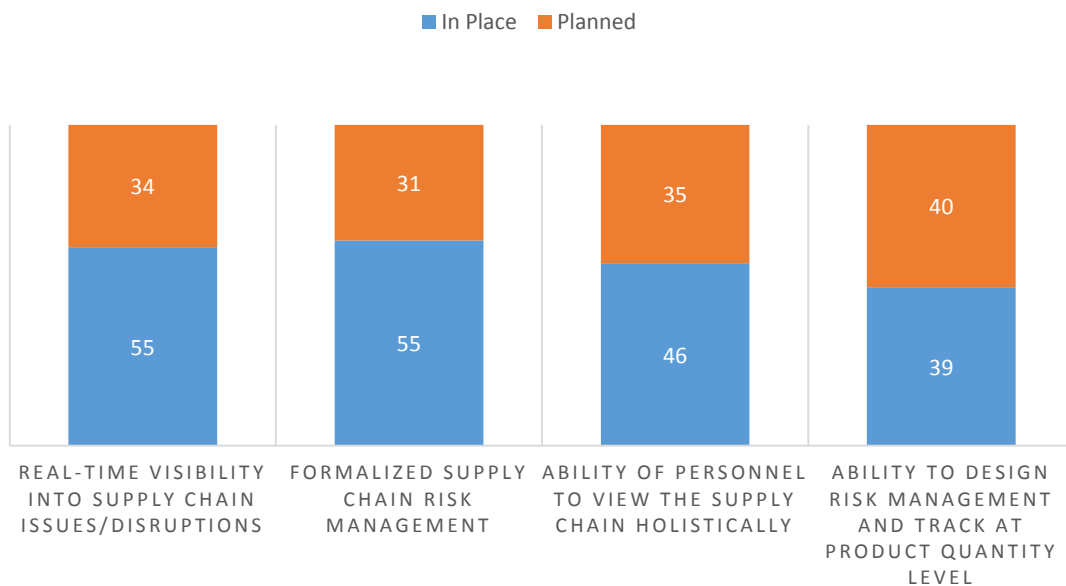
Figure 34 Risk management and time driven capabilities
Source: Adapted from (Ball, 2012)

Resilience, therefore, represents an alternative design management strategy to risk management (Barroso et al., 2011; Bhamra et al., 2011; Fiksel et al., 2015; Jyri, Paavo, & Jan, 2014; Ponomarov & Holcomb, 2009).

2.5.3 Resilience in Food Supply Chains

Farm to fork networks and their importance to our lives were explored in the previous sections 2.4.1). It was noted that food systems are challenged by a plethora of interrelated factors, such as the changing socio-economic and political context. Along with the scarcity of natural resources, environmental degradation, natural diseases, terrorism (Leat & Revoredo-Giha, 2013), climate change and the effects of BREXIT on food supply chains (2.4.3 above). Furthermore, food fraud and wider food crime are concerns affecting food supply chains (Manning & Soon, 2016).

Perturbations and the vulnerabilities that affect the supply chains were discussed earlier (section 2.3). It has been distinguished that the risks can be in different forms: external to the company or internal within the company (section 2.3.1). Supply chain strategies such as, just in time and lean supply chain management, are considered as strategies, that can enhance the brittleness of the supply chains (section 2.2.2). Additionally, low financial margins; as low profitability increases the brittleness of food supply chains. The degree of "*financial brittleness in a food supply chain will depend on the level of profitability, liquidity, the ability to meet loan repayments and continue to implement capital investments*" (Manning & Soon, 2016, p. 1477). Contrariwise, the agility of a food supply chain is determined by the level of financial return, efficiency, innovation, resource management and the ability to have alternative sourcing mechanisms in place for key ingredients.

Each node within the value chain cannot meet these challenges individually, without multi-stakeholder action and coordinated initiatives along the food chain. To overcome these challenges, a resilient system that has a holistic, systemic approach to the design of processes within Agri-food chains is needed. To unlock their full potential and deliver economic, social and environmental benefits (Pereira et al., 2014).

The conceptual frameworks proposed by prominent academics and professionals for resilient supply chains were examined in section 2.5.1 above. Resilient food systems are defined as food systems with the capability of "*delivering sufficient, appropriate and accessible food to all in the face of various and even unforeseen disturbances*" (Tendall et al., 2015, p. 19). By comparing the disruption profile, Figure **12**, against the food system's resilience profile, it is seen that the impact of

disruptions on the system performance follows a similar pattern. Furthermore, Simonovic and Peck (2013) believe that resilient food supply chains can be divided into different components.

There are blatant similarities amongst the capabilities identified by the frameworks as the enabling capacities of resilience in supply chains. Therefore, the enabling capabilities can be generalised to all types of supply chains. However, the trade-offs must be taken into consideration as it will affect the company's competitive advantage.
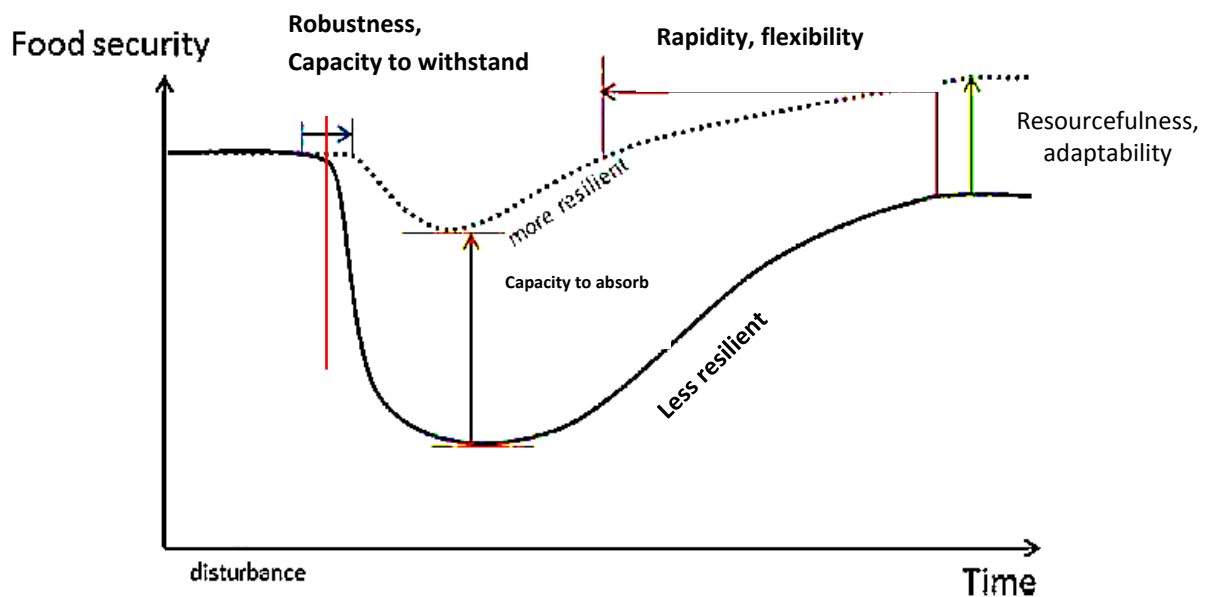
Figure 35 Food System Resilience
Source: (Tendall et al., 2015, p. 19)

2.6　Chapter Summary

This chapter commenced with an introduction to the processes and procedures of collecting and condensing the relevant sources of literature. To answer the research questions and achieve the objectives of this empirical research, the development of conceptual frameworks was described and the researcher justified the choice by citing prominent authors on the development of conceptual frameworks. Furthermore, this chapter drew a line between supply chain management and logistics, and explicitly highlighted their differences and the importance of supply chain management, in achieving a competitive advantage. Additionally, this chapter identified the challenges that are pertinent to the daily functions of supply chains and investigated supply chain risk management processes such as advantages and shortfalls.

This empirical research concentrates on resilient food supply chains in the context of British food supply chains. Therefore, the literature review focused on the importance of food supply chains, along with their characteristics and provided an in-depth insight into the current state of British food supply chains. Moreover, the concept of resilience was critically investigated and the differences between resilience and risk management strategies were critically examined. Finally, the literature review identified the enablers of resilience in supply chains and developed a primary theoretical framework. The relevance and importance of these factors were later tested during the face to face interviews and observational studies, when the researcher visited the case study companies.

Based on the literature review and in line with the research aims and objectives, the following interview questions were developed, to find answers to the research questions **Table 12**. The interview process and format of conducting the interviews is explained in chapter four of this study. However, to keep track of the already identified enablers, the researcher has recorded the elements of resilience. In this way, any possible element that was not mentioned, could be immediately captured during the interviews. Furthermore, to aid preparation of the discussion chapter, as well as tracking the academic references to each research question, the names of the authors, who have identified the enablers of resilience, is displayed in the right-hand column of this table.

Interview questions	Elements of Resilience sought in the interviews	Author
1. What is your understanding of supply chain risk? Do you see it as a Threat or Opportunity? 2. Can you provide some examples of risks (external and internal) in your supply chain operations? 3. Out of those risks which one do you consider more important? How do you see them being relevant to material, money or information? 4. Would you say that those risks are interrelated? If so in what way?	1. Visibility 2. Collaboration 3. Financial Strength 4. Dispersion 5. Control	(Geraint, 2014) (Sawik, 2014) (Carvalho, Barroso, et al., 2012b) (G. A. Zsidisin et al., 2005) (O'Marah, 2015b)
5. Do you have contingency plans in case those risks occur? Which risk mitigation strategies do you use? 6. How much risk is your company willing to bear and what are the tolerance levels?	• Risk management • Anticipation • Efficiency • Culture • Security • Product Stewardship • Financial Strength	(Deloitte, 2012) (Leat & Revoredo-Giha, 2013) (Fiksel et al., 2014)
7. How much information do you have about the financial and operational performances of your tier 1 and tier 2 suppliers and customers? If so how do you use that information? 8. How do you identify, understand, and deal with risks occurring within tier 2 and tier 3 suppliers? 9. How quickly can you and your suppliers implement mitigation plans and ensure the resumption of normal daily operations?	• Visibility • Security • Collaborative Planning • Trust • Recovery	(Williams, Lueg, & LeMay, 2008) (Chopra & Meindl, 2013) (Briano et al., 2009) (Dani (2009); Dani, 2015)
10. Would you consider your approach to supply chain risk management as being reactive or proactive?	• Collaboration • Agility • Recovery • Anticipation	(Yu & Nagurney, 2013) (Fiksel et al., 2014) (Marchese & O'dwyer, 2014) (Pereira et al., 2014)

Interview Questions	Elements of Resilience sought in the interviews	Authors
11. How do you ensure that customer service levels are maintained when disturbance occurs within your supply chain?	• Visibility • Control • Redundancy • Product Stewardship • Security	(Waters, 2011) (Harrison & van Hoek, 2005) (Fiksel et al., 2014) (Apgar, 2006)
12. In your view what are the important characteristics (capabilities) that your organisation must possess in order to be able to mitigate supply chain risk? 13. Out of these capabilities which ones do you consider more important? How do you prioritise in developing these characteristics?	• Flexibility • Collaboration • Agility • Control • Product Stewardship • Risk management • Flexibility • (all the remaining enablers)	(Christopher & Peck, 2004) (Pettit et al., 2013) (Sheffi, 2005) (Egli, 2013)
14. What does supply chain resilience mean to you, and your organization? Would you say it is different to supply chain risk? 15. In your view, in what way does supply chain risk management affect resilience in supply chains? 16. How do you compare your current relationships (more/less dependent, transparent, etc.) with customers, suppliers and 3PL compared to say a few years ago?	• Definitions/Essential/Extra cost • Similar/Different/Interchangeable • Arm's length/ Collaborative • Extent of Collaboration • Control/ Visibility	(Bhatia et al., 2013) (Koronis & Ponis, 2012; Ponomarov & Holcomb, 2009) (J. Rice & Caniato, 2003) (Bhamra et al., 2011) (Diehl & Spinler, 2013)

Table 12 Interview Questions

Chapter Three:
Methodological Approach

3.1   Introduction

This chapter describes the fundamental premises of this research. Furthermore, with the goal of satisfying the research aims and objectives and answering the research questions; the research philosophy is explained and justified. To do this, the chapter begins with an insight into the literature on different methodologies and approaches. The researcher uses a relevant theory to justify the selection of the methodology to meet the project's aims and objectives. This is in accordance with Saunders, Lewis, and Thornhill (2012) who explain that to achieve valid answers to research questions, it is important to ask the right questions and make use of appropriate methods.

Regarding the differences between the terms *"methodology"* and *"methodological"*, Polychronakis (2011) explains that, methodology originates from the two Greek words "*methodos*" and "*logos*". This term is very different from "*methodological*" and "*research methods*", the logical techniques used to reach conclusions about a phenomenon or observation. Accordingly, the latter is closer to the actual research process, and the term "*methodological approaches*" is currently widely adopted by scholars in their studies. Polychronakis describes the research method as a subset of both methodology and methodological approaches, one that refers to the various methods available for collecting information/data (in its many forms). A research method is only applicable, when consensus has been reached on the most appropriate research methodology, and a methodological approach has been decided.

Based on the above, it is safe to say that the decision for choosing the most suitable research method, must be focused on the underlying philosophical considerations evolving from the meaning of the word *"methodology"* (Polychronakis, 2011). Accordingly, the way in which a researcher chooses the most appropriate research methods, depends heavily on the way that he/she tries to solve a research problem, to add to the body of knowledge. Based on this, the most favoured research paradigms among researchers are *"positivism"* and *"phenomenology"* (Collis & Hussey, 2009; Neville, 2005; Saunders et al., 2012). Both terms are going to be

explored further in section 3.3, but, before this, section 3.2 presents definitions of different types of research.

3.2   Research Types

According to Collis and Hussey (2009) there is no unified definition for "*research*" within literature: they believe that research is viewed differently by each individual. However, seminal authors on business research methods define research *as "something that people undertake in order to find out things in a systematic way, thereby increasing their knowledge"* (Saunders et al., 2012, p. 5).

The purposes of research are itemised by Collis and Hussey (2009) as follows:

- ➢ To review or synthesize existing knowledge
- ➢ Investigate existing situations or problems
- ➢ Provide solutions to problems
- ➢ Explore and analyse more general issues
- ➢ Construct or create new procedures or systems
- ➢ Explain new phenomenon
- ➢ Generate new knowledge
- ➢ Or a combination of any of the above!

Research can employ two different approaches. Firstly, it can be used to solve an actual problem, and, secondly, it can develop and add to the existing body of knowledge on a subject. The first option is considered to be applied research, whereas the second option is regarded as basic, fundamental or pure research (Cavana, 2001; Sekaran, 2010). Authors such as Collis and Hussey (2009) categorize research into four premises. Firstly, based on the purpose of its execution, for example, why the research is being conducted. Secondly, based on the process of the research, such as how the data is collected and analysed. Thirdly, the logic of the research, for instance, does it move from general to the specific or vice versa; and, finally, based on the outcome of the research – is it generating new knowledge or does it try to solve an existing problem?

In addition, Sekaran (2010) believes that research can be undertaken for two main reasons. One is practical. To find, for example, a timely solution for the problems that managers face in their workplace. This type of research is known as "applied research". The other is, where a researcher intends to add to the body of knowledge, by trying to understand certain problems that happen in a range of organisations. This type of research is called "basic" or "fundamental" research.

In another classification, Easterby-Smith, Thorpe, and Jackson (2012) divide research into three main categories: *pure*, *applied*, and *action*. Pure research intends to lead to conceptual developments, where there may or may not be, any practical implications. Easterby-Smith et al. (2012) report that conceptual developments take three forms of pure research. Firstly, "*discovery*" occurs when a completely new idea arises from the pure research and it can revolutionise thinking on a topic. Secondly, "*reflection*" is where an existing theory, technique or group of ideas, is re-examined in a different organisational or social context. This type of research is more widely used in doctoral theses. Thirdly, "*invention*" is where a new technique, method or idea, is created to deal with a kind of problem. According to Easterby-Smith et al. (2012), applied research tries to find a solution for a specific problem by using the application of theory, and this type of research is widely used in the dissertations produced by students at MBA or Masters' level.

3.3   Research Philosophies

Researches are usually not "*neutral*", and they tend to reflect some of the researcher's personal interests, values, abilities, assumptions, aims and ambitions (Neville, 2005). Authors such as Easterby-Smith et al. (2012) emphasise the significance of understanding research philosophies for better developing the research design. According to them, the relationship between the data generated and the theory underpinning the research has been debated by philosophers for centuries. Easterby-Smith et al. (2012) believe that having a good grasp of philosophical issues enables the researcher to clarify the research design, deciding what will work and what will not, and that philosophical awareness will also help in identifying designs, that may be part of the researchers past experiences. Neville (2005) refers to the two fundamental research philosophies as "*positivistic*" and "*phenomenological*", which are now explored in more detail.

3.3.1 Positivistic Research

Creswell (2007) describes positivistic research as the "*traditional*", "*experimental*" or "*empiricist*" paradigm. The objective of this type of approach is to identify, measure and evaluate any phenomena, while trying to provide a rational explanation for it. Positivistic research is *"founded on a belief that the study of human behaviour should be conducted in the same way as studies conducted in the natural sciences"* (Collis & Hussey, 2009; Saunders et al., 2012). Therefore, the positivistic philosophy is mostly related to quantitative data collection methods, where the investigator tries to elucidate causal relationships between the variables by moving from theory to data (Saunders et al., 2012). Because of this, to produce generalizable conclusions, large samples of a sufficient size need to be used. In this type of study, the researcher is independent of the topic of the research and his/her interest is irrelevant.

3.3.2 Phenomenological Research

Phenomenological research or as Easterby-Smith et al. (2012) call it, "*social constructivism*", is research firmly rooted in human behaviour. The results of such research are not as easily measured and explained, as those found in the natural sciences (Neville, 2005). Easterby-Smith et al. (2012) report that phenomenologists argue that, unlike the positivist stance, social reality is dependent on the human mind and, indeed, there is no reality independent of the mind.

In many research projects, there can be an overlap between the two philosophical positions. In all cases, however, as Neville (2005) claims, philosophical positions influence the chosen methodology. That is, the overall approaches to and perspectives on the research process. In addition, research methods are the various specific tools that are used for the collection and analysis of the data and include, for example, interview checklists, observations and data analysis software.

Saunders et al. (2012) describe phenomenological research as an approach, which inclines towards producing "*qualitative data*", that is usually very rich but can also be subjective. According to Saunders et al. (2012) such data is predominantly produced by using small samples, usually in the form of a small number of carefully chosen case study organisations and/or individuals. Naturally, phenomenology is concerned

with generating new theories and/or refining existing ones. Therefore, a predetermined hypothesis is not always necessary or even desirable, since it may be advantageous to permit changes of research emphasis, as the enquiry progresses and new findings become known. Easterby-Smith et al. (2012, p. 30) draw the distinction between positivist and phenomenological philosophies in *Table 13* below.

Elements	Positivism	Social Constructionism (Phenomenology)
The observer	Must be independent	Is part of what is being observed
Human interest	Should be irrelevant	Are the main drivers of science
Explanations	Must demonstrate causality	Aim to increase general understanding of the situation
Research progress through	Hypotheses and deduction	Gathering rich data from which ideas are induced
Concepts	Need to be operationalized so that they can be measured	Should incorporate stakeholder perspective
Units of analysis	Should be reduced to simple terms	May include the complexity of 'Whole' situations
Generalisation through	Statistical probability	Conceptual abstraction
Sampling requires	Large numbers selected randomly	Small numbers of cases chosen for specific reason

Table 13 Contrasting Implications of Positivism and Phenomenology
Source: (Easterby-Smith et al., 2012)

Collis and Hussey (2009) draw a similar distinction between the two philosophies in *Table 14*.

Positivistic Paradigm	Phenomenological Paradigm
Tends to produce quantitative data	Tends to produce qualitative data
Uses large samples	Uses small samples
Concerned with hypothesis testing	Concerned with generating theories
Data is highly specific and precise	Data is rich and subjective
The location is artificial	The location is natural
Reliability is high	Reliability is low
Validity is low	Validity is high
Generalises from sample to population	Generalises from one setting to another

Table 14: The main differences between the two paradigms
Source: (Collis & Hussey, 2009)

3.4   Research Approach

At the initial stages of the research, the extent to which the researcher is aware of the investigation project, raises the issue of selecting the most appropriate research approach. There are several approaches that could be used while conducting the research:

1. Qualitative and Quantitative
2. Applied/Basic
3. Deductive/Inductive

Tashakkori and Teddlie (2003) state that, isolated use of quantitative or qualitative approaches rarely exists and, to answer the research questions, these approaches may be combined – an approach known as *"multiple methods"*. The use of combined data collection techniques (multiple methods) and procedures is recommended for business and management research (Curran & Blackburn, 2000).

It has been argued by several scholars, that multiple research methods are more useful for answering research questions, than a purely quantitative or qualitative approach. Saunders et al. (2012) identify two advantages in using multiple research methods. Firstly, it allows the researcher to use different data collection methods for different purposes. Secondly, as different data collection techniques have their strengths and weaknesses, the research results are affected by the data collection techniques and procedures used. Therefore, they suggest that since different techniques and forms of analysis have different effects, it is advisable to use different methods, to cancel out the "*method effect*" which may skew the findings.

3.4.1 Quantitative and Qualitative Approaches

Quantitative research approaches lay emphasis on collecting and analysing numerical data; concentrating on measuring scale, range and frequency. This type of research is harder to design and develop in the initial stages. However, the results attained through quantitative research are usually highly detailed and structured, and the results are often demonstrated using statistical diagrams.

Qualitative research approaches, on the other hand, are more subjective in nature than quantitative research, and qualitative methods are synonymous with any data collection technique, that generates or uses non-numerical data. Qualitative research usually includes examining and reflecting on the less tangible aspects of a research subject, for example values, attitudes and perceptions.

The advantage of qualitative research is that it may be easier to initiate the data collection than in quantitative studies. However, interpreting the results and the presentation of the findings can often be more difficult than in quantitative research. Another downside to this type of research is that the findings, which have an element of subjectivity, can easily be challenged.

For the purposes of this empirical study, the researcher decided to use multiple research methods to minimize the errors caused by single data collection methods. Mixed method approaches have been used for data collection and analysis in a sequential process. Having said that, the researcher used predominately qualitative types of data collection techniques. A combination of the data collection methods

enabled the researcher to generate further research questions as the study progressed.

According to Saunders et al. (2012), there are two other approaches towards research: "*deductive*" and "*inductive*". The former relates to the development of a theory and/or hypothesis, and requires the design of a suitable research strategy to test that theory/hypothesis. An inductive approach is taken, when a theory is unknown at the outset, but is developed because of the analyses of the data collected. Collis and Hussey (2009) also describe deductive research as a study, where a conceptual structure is developed and then tested by empirical observation. On the other hand, inductive research is a process where a phenomenon is first observed and certain conclusions are subsequently drawn (Cavana, 2001). Or, as Collis and Hussey (2009) put it, the inductive approach relates to research, where the theory is developed from the observation of empirical reality. Both approaches are described in *Figure 36*. Additionally, *Table 15* lists the major differences between the two approaches.
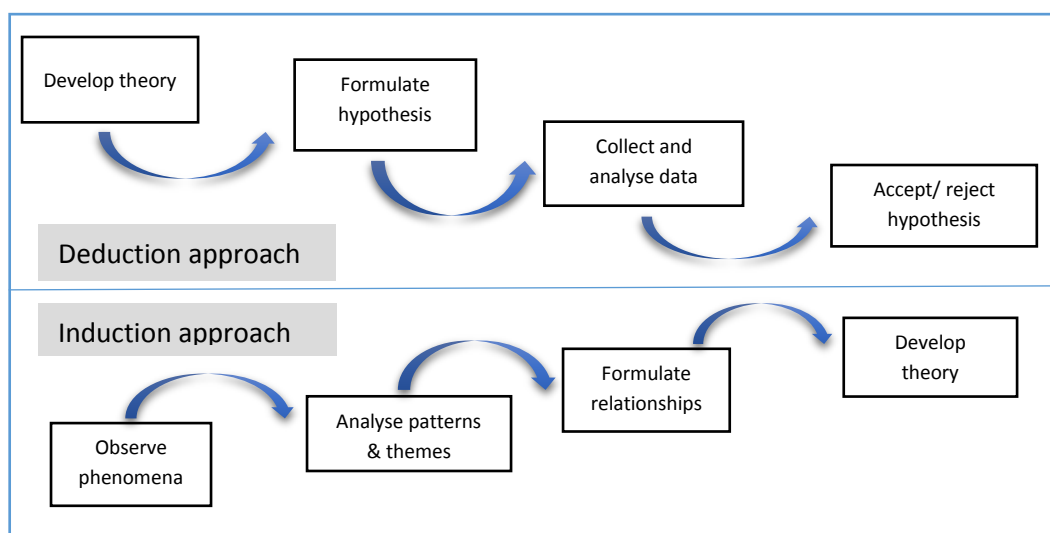
Figure 36 Deductive and Inductive approach
Source: Adapted from (Cavana, 2001, p. 36)

As stated earlier, an overlap can exist between research philosophies within a single project. However, taking into consideration the differences between the approaches, it is safe to conclude that the inductive approach tries to obtain a close understanding of the research context. And the collection of qualitative data provides the researcher with more flexibility in the case of unforeseen changes, as the research progresses.

Deduction (Quantitative) Emphasises	Induction (Qualitative) Emphasises
Scientific principles	Gaining an understanding of the meanings humans attach to events
Moving from theory to data	A close understanding of the research context
The need to explain causal relationships between variables	The collection of qualitative data
The collection of quantitative data	A more flexible structure to permit changes of research emphasis as the research progresses
The application of controls to ensure validity of data	A realisation that the researcher is part of the research process
The operationalization of concepts to ensure validity of data	Less concern with the need to generalise
A highly-structured approach	Gaining an understanding of the meanings humans attach to events
Researcher independence of what is being researched	
The necessity to select samples of sufficient size to generalize conclusions	

Table 15 Major Differences between both approaches to research
Source: (Saunders et al., 2012)

In this study, the researcher followed a phenomenological research philosophy with an inductive approach, to provide reliable answers to the research questions, as well as fulfilling the aims and objectives of the research. To achieve this goal, the researcher was required to have a clear understanding of the case study companies and different actors within their supply chains. To achieve this, the researcher relied heavily on predominantly qualitative data obtained via semi-structured interviews, documentations and observational methods (explained in section 4.1).

3.5   Research Design and Strategy

A range of strategies can be applied in business and management studies, some taking a positivistic stance and some a phenomenological one. Yin (2009) identifies three conditions which can affect the choice of the research strategy. Firstly, the type of research question. Secondly, the extent of control an investigator has over the actual behavioural events. And thirdly, the degree of focus on contemporary as opposed to historical events. Table *16* displays these three conditions and shows how each is related to the five major research methods: experiment, survey, archival analysis, history and case study.

In this study, as Saunders et al. (2012) advise, the choice of strategy has been influenced by the research questions, objectives and the amount of prior knowledge, time and other resources available to the researcher. Therefore, the researcher opted to follow a case study strategy, to find answers to the research questions and achieve the research aims and objectives (1.2 and 1.3).

Method	Form of Research	Requires Control of Behavioural Events?	Focuses on Contemporary Events?
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival Analysis	Who, what, where, how many, how much?	No	Yes/No
History	How, why?	No	No
Case Study	How, why?	No	Yes

Table 16 Relevant Situations for Different Research Methods
Source: Adapted from (Yin, 2009, p. 8)

3.5.1 Research Questions and the Choice of Strategy

As mentioned in the previous section, the research questions guided the researcher to adopt a research strategy. If the research question focuses on "*what*" questions, two possibilities arise. Firstly, some "*what*" questions are considered exploratory, for example, what can be learned from the study of a start-up business? The second type of "what" question is a form of a "*how many*" or "*how much*" line of inquiry, for example, *"what have been the ways that communities have assimilated new immigrants?"* "*Who*" and "*where*" questions suggest the use of fixed strategies such as surveys (Yin, 2009, p. 9). Yin continues to explain that "*how*" and "*why*" questions have a more explanatory approach and are more likely to lead the researcher, to use case studies, histories and experiments, as their preferred research methods.

3.5.2 Research Questions

The questions that this study sought to answer were as follows:

- ➢ What is the explicit definition of Supply Chain Resilience and how does it differ from Supply Chain Risk Management?

- ➢ What are the main enabling factors for a food supply chain to become resilient? How do these factors interact and how are they mitigated?

- ➢ To what extent (and why) do these enablers exist within British food supply chains in empirical scenarios?

- ➢ What strategies are more advantageous in creating a resilient food supply chain?

Considering the comments in section 3.5.1, as well as the aims and objectives of the research, a case study approach was used to carry out this research.

3.6   Case Study Research

A case study is defined as *"the research strategy that involves the empirical investigation of particular contemporary phenomenon within its real-life context, using multiple sources of evidence"* (Saunders et al., 2012, p. 588). Similarly, one of the most prominent authors on case study research, Yin (2009, pp. 17-19) defines a case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when boundaries between phenomenon and context are not clear. Typically, a case study has the following features:

➢ Selection of a single case of a situation, individual or group.
➢ Study of the case in its context.
➢ Collection of information via a range of data collection techniques such as observation, interviews or documentary analyses.
➢ Systematic but flexible research strategy, that provides detailed prescriptions for data analysis and theory generation.

A case study strategy can be used, if the researcher is interested in understanding and gaining a rich knowledge of the context of the research, and the processes being enacted (Morris & Wood, 1991). Merriam (1998, p. 12) believes that *"a case study often builds upon tacit knowledge and provides a thick description of the case under the investigation"*.

3.6.1   Case Study as a Vehicle to Knowledge Generation

Case study research can be found in areas as disparate as administration, anatomy, anthropology, artificial intelligence, biochemistry, business studies, clinical medicine, counselling, criminology, education, gerontology, history, industrial relations, jurisprudence, management, military studies, personality, politics, psychoanalysis, social work and sociology (Bromley,1986, cited in Polychronakis, 2011).

A case study is recognised to be a suitable design for an analysis of "*process*". Process as a focus for case study research is viewed in two ways. The first meaning of process is monitoring, and this involves describing the context and population of the study. The second meaning of process is causal explanation and this involves the discovery or confirmation of the process, through which an action had the effect

that it did (Merriam, 1998, p. 33). The case study, accordingly, can be virtually anything. Amongst others, it often includes studies of organizations and institutions in the light of issues like best practice, policy implementation and evaluation, industrial relations, management and organizational issues, organizational cultures, processes of change and adaptation.

3.6.2   Types of Case Study

There are different types of case studies described in the literature on business and management research. As mentioned above, the "*case*" could be anything. Robson (2002), for example, explains that when an individual person or group is the case, this is a simple, single study which would just focus on that person, organisation or group in its context.

On the other hand, multiple case studies tend to be more complex in nature and would involve the study of several individual "*cases*" (people, organisations or groups) again within their context. Table *17* below shows the range of different types of case studies:

Type	Attributes
Individual Case Study	Detailed account of one person tends to focus on antecedents, contextual factors, perceptions and attitudes preceding a known outcome. Used to explore possible causes, determinants, processes and experiences contributing to outcome.
Set of Individual Case Studies	As above, but a small number of individuals with some features in common are studied.
Community Study	Study of one or more local communities. Describes and analyses the pattern of relations between main aspects of community life. Commonly descriptive, but may explore specific issues or be used in theory testing.
Social Group Study	Covers studies of both small direct contact groups, for example families and larger more diverse ones such as original groups. Describes and analyses relationships and activities.
Studies of Organisations and Institutions	Studies firms, workplaces, schools, trade unions and departments. Many possible foci, such as best practice, policy and organisational issues, cultures, processes of change and adaptation.
Studies of Events and Relationships	Focus on a specific event. Very varied; includes studies of police-citizen encounters, doctor-patient interactions, specific crimes or incidents, studies or role conflicts, stereotypes, adaptations.

Table 17 Case Study Types
Source: Adapted from (Robson, 2002)

Based on Table *17*, the most appropriate type of case study for this research would be the study of *"organisations and institutions".* This study focuses on the food supply chains of the case study companies, that are located in the United Kingdom. Senior management of the companies, whom are responsible for the management of food supply chains, their operations and service delivery, are the embedded cases.

It is important to note that case study strategy may feel unscientific and that the findings of these types of research are subjective. Therefore, it can be difficult to assert wider, more generalised points from the research (Neville, 2005). Nevertheless, Saunders et al. (2012) argue that a case study strategy can be a very useful way to explore existing theories. There is no clear guide for the number of cases to be included (Perry, 1998). However, Voss, Tsikriktsis, and Frohlich (2002) claim that the fewer the cases, the greater the opportunity for in-depth observation. In line with this, Yin (2009) recommends that each case should be selected carefully in order to be able to predict similar results (literal replication) or, alternatively, to predict contrasting results but for predictable reasons (conceptual replication).

3.6.3 Single Versus Multiple Case Designs

Traditionally, in certain fields such as anthropology and political science, the multiple case study approach has been a distinctive methodology. One set of rationales has been developed to do single case studies, and a second for doing so-called "*comparative*" (or multiple) case studies. Yin (2009), however, suggests that the two should be seen within the same methodological framework and stresses that the main differences rely on their specific attributes. Therefore, their use is dependent on the aims, objectives, and the general design of the specific study. As the evidence from multiple case studies tends to be more compelling and the whole study is consequently regarded as being more robust, this research will be using a multiple case study strategy.

3.6.4   Case Study and Alternative Research Method Approaches

The previous section and Table **17** highlight a very important issue. they demonstrate that the case study can be most effectively utilised in the study of an organization and its foci. However, the case study approach is not the only research method available to the researcher. Other alternative research methods include: surveys, experiments, histories, and computer based analyses of archival records.

Robson (2002) reports that a survey is mainly used to facilitate the collection of a small amount of data in standardized form, from many individuals, organizations and departments. So, surveys are not well suited to carry out exploratory work (3.7). However, case studies are very effective when they are used to study organizations and institutions. They are well-suited to exploratory work and, as such, do not need tight pre-structuring. In a sense, they are more "*forgiving*" in their design, as they allow space for modifications and a change of focus at every stage (Yin, 2003).

3.7   Exploratory Research

When a researcher is carrying out exploratory work, s/he is trying to get some feeling as to what is going on in a novel situation, where there is little to guide on what one should be looking for. This approach could ultimately be embedded in a wider study, which may throw further light on relationships, or even suggest alternative views of the phenomena. Exploratory research is almost always undertaken, when there is very little information about the situation, or when no information is available on how similar problems or research issues, have been solved in the past. Sekaran (2010) argues that, this type of research can be undertaken when some facts are known, but information is still needed for developing a viable conceptual framework.

For this empirical study, the researcher conducted exploratory research to find the answers to the research questions and to develop a conceptual framework, that captures and summarises the elements that make-up "*resilience*". Such as its enablers and their interactions, with a view to allowing organisations to focus and prioritise.

3.8   Case Study Companies and Selection Rationale

This section justifies the reasoning behind the selection of case study companies that contributed with this research. The case study companies are introduced in sections 3.8.1, 3.8.2 and 3.8.3. The researcher used the selection criteria are demonstrated in Table *18* to select the case study companies. The first selection condition is the extent of case study company involvement in food industry and more specifically in British food supply chains. The company size i.e. in terms of operations and financial turnover are major factors in selecting these companies. The access to senior directors and right managers who have a comprehensive understanding on the company's business and have a voice in company's decision making chain are paramount selection criteria. Also, the interview participants should have a holistic overview on the company's supply network and expertise in the realm of supply chain management.

Furthermore, the case study companies should have an active presence in all the stages of supply chain i.e. Plan/Design, Source, Make, Deliver/Return. Chapter four of this thesis introduces the data collection methods that are going to be used in this empirical research.

	Direct involvement in Food Industry	Involvement in British Farm to Fork SCH	Access to Senior Directors	Financial Turnover	Plan/Design	Source	Make	Deliver/ Return
Case Study One	✔	✔	✔	✔	✔	✔	✔	✔
Case Study Two	✔	✔	✔	✔	✔	✔	✔	✔
Case Study Three	✔	✔	✔	✔	✔	✔	✔	✔

Table 18 Case Study Company Selection Criteria

3.8.1 First Case Study Company: Introduction and Reason for Selection

Case study number one is a fast food restaurant chain, that specializes in fried chicken and is headquartered in Louisville, Kentucky, in the United States. It is the world's second largest restaurant chain (as measured by sales) after McDonald's, with 18,875 outlets in 118 countries and territories as of December 2013. The company is a subsidiary of Yum! Brands, a restaurant company that also owns the Pizza Hut and Taco Bell chains.

Case study number one has eight hundred and fifty stores spread throughout the UK and Ireland. England had the first overseas branch of this company, which opened in the city of Preston, Lancashire in May 1965. This was the first American fast food restaurant chain to become established in the UK, pre-dating the arrival of its major competitor by almost a decade. According to Wong (2014) the company's British turnover was around £684.5 million in the year 2013. In the article *"Martin Shuker Has an Appetite for 'Finger Lickin' Food and Growth",* Cave (2015) highlights that about 70 percent of outlets are run as franchises, with the remainder company-owned. Case study number one has been awarded best employer for the last three years and employs 24,000 people.

The average outlet turnover is between £1 and £1.5 million pounds per annum (Cave, 2015). Annual sales amount to 60,000 metric tonnes of chicken, 60 percent of which is purchased from the four largest suppliers in the UK, including the Faccenda Group and the 2 Sisters Food Group, and it is delivered fresh to outlets at least three times a week (Mendick & Leach, 2010). The remaining 40 percent is sourced from companies in Europe, Thailand (including Charoen Pokphand Foods) and Brazil. However, all the Original Recipe chicken is sourced within the UK. The above-mentioned data has been double-checked and confirmed by the company's Product Excellence Director.

During a visit to the company's headquarters, six (06) interviews were held in the new head office of case study number one in the town of Woking, Surrey. The interviewees were two senior directors and four senior managers. The job titles of the interview respondents were as follows: Director of Product Excellence, Director of Procurement and Supply Chain, Head of Procurement (Food and Packaging),

Head of New Product Development, Head of Indirect Procurement, and Distribution Manager (Table **19**).

For observational studies, the researcher visited the head office of the company and one of its busiest stores (company owned), which is in the Arndale centre food court in Greater Manchester's city centre. The data collected from these activities were analysed in the context of the experiences and observations of the researcher in a non-participant manner (4.1.2.)

Participant	Code	Gender	Years with the company	Level of Education
Product Excellence Director	D1	Male	15+	University Degree
Director of Procurement and Supply Chain	D2	Male	10+	University Degree
Head of Procurement for Food and Packaging	SM1	Male	8+	University Degree
Head of New Product Development	SM2	Female	10+	University Degree
Head of Indirect Procurement	M1	Male	7+	University Degree
Distribution Manager	M2	Male	5+	University Degree

Table 19 Interview Participants Profile

Case study one is chosen due to its involvement with all the stages of farm to fork networks, as can be seen in Figure **37**. This company's unique characteristics and involvement with almost all the actors of food supply chains, makes them suitable to be considered as one of the case study companies in this doctoral research.
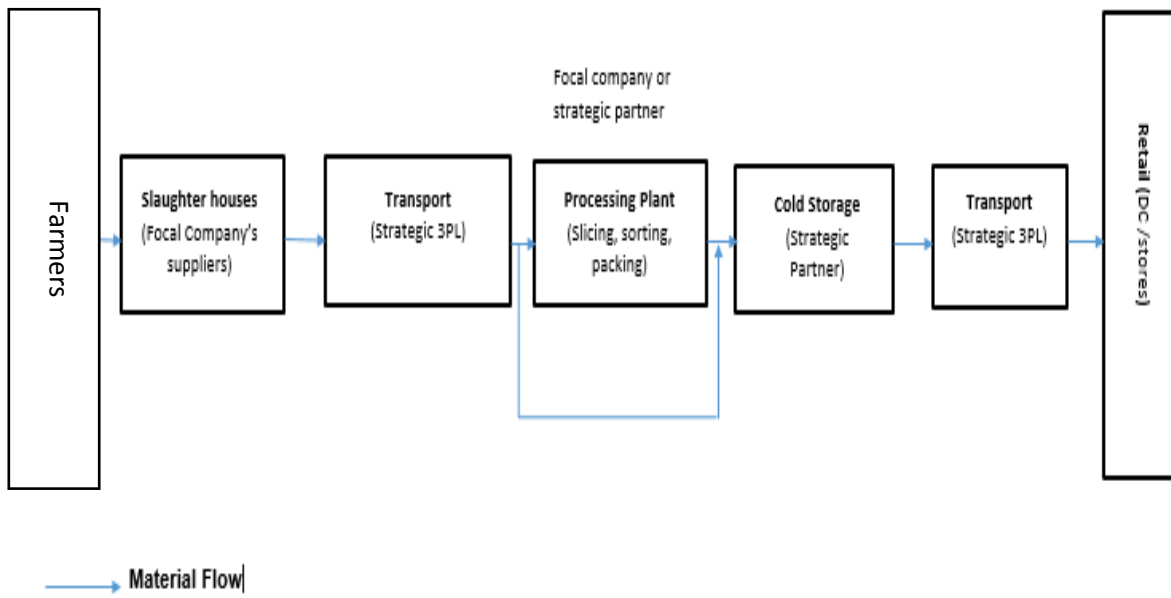
Figure 37 Schematic of Case Study Number One's Supply Chain

3.8.2   Second Case Study Company: Introduction and Reason for Selection

Case study number two is a British baking firm, founded by Thomas Warburton and his wife Ellen in 1876 and is based in Bolton, a town in Greater Manchester, England. 140 years on and case study number two is still a private family-owned business, actively managed by the fifth generation of family members. It is the largest family-owned bakery business in the country, and employs around 4,500 people at 11 bakeries and 13 depots across the UK. Now recognised as Britain's favourite bakery brand, case study number two has doubled in size in the last decade alone to become a £500 million-a-year business. The company embarked on a large expansion program in the late 1990s, which continued in the 2000s and it has grown across the United Kingdom, after being relatively unheard of outside of Greater Manchester (Reuben, 2007).

During the last decade, case study number two has invested over £400m into the business, to build new and upgrade bakeries. This includes £20 million of investment to Burnley bakery, equipping it with the capability to produce 34,000 individual items per hour. This company delivers to 18,500 retail customers each week, a number that has grown by more than 1,000 in the last year alone. Case study number two produces more than two million products a day, including famous wax wrapped loaves, wraps, crumpets, pancakes and bread rolls. Their products account for a quarter of the total wrapped bakery market, which is worth more than £2.8 billion a year.

Case study number two's brand is the most popular bread in the United Kingdom, ahead of rivals Kingsmill and Hovis, a position it has held since 2008. This company has been named as the number one bakery in the UK. Additionally, following Coca-Cola® at number one, case study number two has earned the silver medal for its £715.1m sales figure for the year ending the 3rd of January 2015 (Smolen, 2015). The wheat which case study number two uses to produce flour, is produced under contract with farmers in the UK and Canada. The company has been working with the same farmers for over 15 years, meaning they are able to achieve outstanding quality (Warburton's, 2016). During a visit to the company's head office, the director of procurement verified the above information, whilst adding that the company sources wheat from other suppliers in Europe as well.

As mentioned above, case study number two's long heritage along with its presence within the British household and its profound involvement in food supply chains, makes them a suitable case study company to investigate the research questions of this doctoral research.

Two senior directors (director of procurement and director of operations) of case study number two have contributed to this research and have shared both insights and experiences. During a one-day visit to the company's headquarters located in Bolton-Greater Manchester, access was granted to observe the procurement and operation team's functions. Additionally, a guided tour was given within the company's premises and bakery plant. For the analysis purposes of this research, the two senior directors are coded as D3 and D4 respectively. The process and procedure of data analysis follows the same process as the previous case study company.

Participant	Code	Gender	Years with the company	Level of Education
Director of Procurement	D3	Female	8+	University Degree
Director of Operations	D4	Male	8+	University Degree

Table 20 Interview Participants Profile

3.8.3   Third Case Study Company: Introduction and Reason for Selection

Case study number three is the UK's largest logistics service provider in the frozen food sector, as well as offering ambient, chilled and freight forwarding solutions. With its head office located in Heywood, Greater Manchester, it provides services such as cold storage, ambient storage, distribution and global logistics through its logistics and food sales to its customers. The food division wholesales a full range of innovative frozen products to customers in all sectors of the marketplace through its food sales; Belfield, IcePak and Export division. With more than 40 years' experience, it's food sales division has a dedicated team of 30 sales advisors and

telesales operatives to suit specific customer requirements with a comprehensive range of competitively priced products.

Helping customers in retail, catering, public sector institutions and the export market with access to its comprehensive range of over 1,500 competitively priced products. Belfield offers exclusive imported products, supplying private label and branded goods to major retail and foodservice multiples, and manufacturers. IcePak is case study number three's food specialist seafood importer. Working with suppliers overseas, IcePak sources a range of seafood products from whole and filleted fish, to fresh, battered and breaded prawn and squid products.

Case study number three's export division delivers predominantly British brands to over 30 countries worldwide (Figure 38). Being a part of its group allows access to a vast storage capacity of 13 depots throughout the UK and a fleet of over 300 varied use vehicles, which means nationwide delivery to most places at least twice per week. It also enables the purchase of products in bulk ensuring supply and value for money in changing climates. In addition to this, there are quality products purchased and offered at discounted prices on a monthly basis. It has 12 sites nationally, a total capacity of 365,000 pallets and a fleet of over 300 temperature controlled vehicles delivering nationwide. The food markets supply a full range of innovative frozen products to customers in all sectors of the marketplace including export. It also offers exclusive imported frozen foods under its Belfield brand and IcePak, the Group's specialist frozen seafood supplier serves the wholesale and restaurant market.

The volume of operations of this company in British food supply chains makes it a perfect fit to investgate the enablig factors of resilience in British food supply chains. Figure 38 below demonstrates the size of logistical operation of this company in 2016.
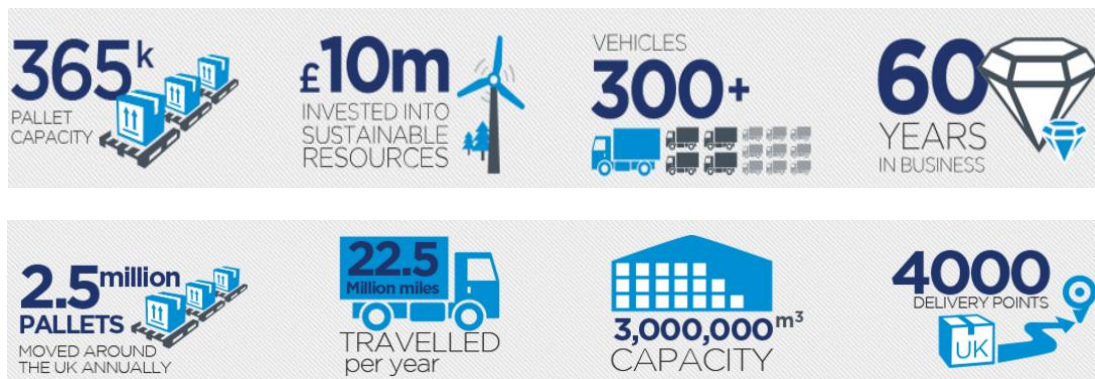
Figure 38 Case Study Number Three's Latest Facts & Figures
Source: (Yearsley Group, 2016)

An interview with the senior director and senior manager of case study number three's group was held at its headquarters in Heywood, Greater Manchester. Again, like the two previous case study companies, a visit to the company's headquarters was granted and the daily operations of the company and some of their archival records were observed.

Participant	Code	Gender	Years with the company	Level of Education
Director of Sales, Marketing and Procurement	D5	Male	30+	University Degree
Head of Global Logistics	SM3	Male	18+	University Degree

Table 21 Interview Participant Profile

3.9   Chapter Summary

In summary, this chapter investigated and analysed different types of research philosophies and justified the reason for selecting the most appropriate research philosophy for the study – phenomenological philosophy. The impact of the research philosophy on the research methodology was explained, together with the different types of case study strategy, and the differences between a case study and survey research were explained. The advantages and disadvantages of the single and multiple case study strategy were examined. Furthermore, the researcher introduced the case study companies, which were involved in this empirical study and presented a profile of the interview participants. Finally, the researcher utilised the literature to justify the choices made on the appropriateness of research philosophy, strategy and approach. In the upcoming chapter, the researcher justifies the choices of data collection with the support of best practices mentioned in the academic literature on each method. Moreover, the next chapter, addresses the limitations of each data collection method and the action taken to alleviate these restrictions.

Chapter Four:
Research Design

Introduction

"Data refers to known facts or things used as a basis for inference or reckoning"
(Collis & Hussey, 2009, p. 160)

This chapter explains the data collection methods used to address the research questions. In brief, as an empirical qualitative research study, the researcher relied on a combination of both interviews and observation studies as primary sources of data. Furthermore, this research benefited from documentation and archival records as secondary sources, to address the research objectives and answer the research questions within a multiple case study research strategy.

4.1   Methods of Data Collection

There are two types of data – primary and secondary – depending on the sources from which the data has been derived. Primary data is that collected at source and includes survey data, experimental data, interviews and focus group observations. Secondary data is that which already exists in reports, archives, laws and annual reports. Both primary and secondary data may be either quantitative or qualitative in nature, or a combination of the two (Collis & Hussey, 2009; Neville, 2005; Saunders et al., 2012).

There is an interesting rule of thumb, with four constituent processes. As suggested by Robson (2002) to select a primary data collection method. Firstly, one should be finding out what people do in public, which can be achieved through direct observation. Secondly, the researcher should find out what they do in private, which can be achieved by conducting interviews. Thirdly, is the discovery of how people feel or behave, and the appropriate methods to achieve this are interviews or attitude scales. Finally, determining people's abilities or measuring their intelligence or personality using a standard test. Yin (2009) describes the six data collecting methods, that are most commonly used when carrying out case studies as: interviews, documents, archival records, direct observations, participant observation and physical artefacts. As mentioned earlier, Yin (2009) argues that, no single data

collection method has an overall advantage over the others, and combining the usage of multiple sources of evidence, can help to clarify the real meaning of the phenomenon under scrutiny. Table **22** illustrates the strengths and weaknesses of each of the six research methods. In this study, the following data collection methods will be utilised to extract the evidence needed to answer the research questions mentioned in section 3.5.2.

Source of Evidence	Strengths	Weaknesses
Documentation	Stable- can be reviewed repeatedly. Unobtrusive- not created as a result of the exact case study - contains names, references, and details of a broad coverage event- long span of time, many events and many settings.	Retrievability- can be low. Biased selectivity, if collection is incomplete reporting bias- reflects (unknown) bias. Author access-may be deliberately blocked.
Archival Records	(Same as above for documentation) Precise and quantitative.	(Same as above for documentation) Accessibility due to privacy reasons.
Interviews	Targeted- focuses directly on case study topic. Insightful- provides perceived casual inferences. Can establish rapport and motivate respondents. Can clarify the questions, clear doubts, add new questions. Can read nonverbal cues. Rich data can be obtained, CAPI can be used, and responses entered in a portable computer.	Bias due to poorly constructed questions. Response bias. Inaccuracies due to poor recall. Reflexivity- interviewee gives what interviewer wants to hear. Costs more when a wide geographic region is covered. Can introduce interviewer bias. Respondents can terminate the interview at any time. Respondents may be concerned about confidentiality of information given.
Direct Observations	Reality- covers events in real time. Contextual- covers context of events.	Time consuming. Selectivity- unless broad coverage. Reflexivity- event may proceed differently because it is being observed. Cost- hours needed by human observers.
Participant Observations	(Same as direct observations. Insightful into interpersonal behaviour and motives.	(Same as above for direct observations) Bias due to investigators' manipulation of events.

Table 22 Source of evidence: strengths and weaknesses
Source: (Sekaran, 2010; Yin, 2009, p. 102)

4.1.1 Interviews

In this study, the researcher used face-to-face interviews with directors and senior management of the case study companies to identify the most influential Food SC vulnerabilities. As well as the pertinent organisational capabilities, that would enable companies to bounce back in unexpected disruption scenarios. The answers obtained from the interviews, along with relevant questions identified within the literature, were used as the basis to design and prepare the formats. To record the observations in a structured manner (explained in 4.1.2 below) to suit the goal of this research.

4.1.2 Observational Studies

There are other forms to elicit responses from subjects, other than the usual data collection methods such as: interviews or questionnaires. Sekaran (2010) explains that, information of interest to research on people, can be attained by observing them in their working or living habitat. Sekaran, believes that the researcher *"can play one of two roles while gathering field observational data: that of a none-participant-observer or participant- observer"* (Sekaran, 2010, p. 211). According to Sekaran, the observations can be both in the forms of structured and un-structured observations.

Structured observation is where the researcher has a predetermined set of categories of activities or phenomena to be studied. Whereas unstructured observations are conducted when, at the beginning of the research, the observer does not have a definite idea regarding the aspects that need focus. In this case, the observer records practically everything that is observed (Sekaran, 2010, pp. 213-214). As mentioned in Table **22**, Yin (2009, p. 98) explains that direct-observation and participant-observations can be used to gather evidence, along with other sources such as documents, archival records, interviews and physical artefacts.

In this empirical study, the researcher acted predominately as a none-participant observer. Or as Yin (2009) calls it, a direct observer using a structured manner. By doing this, the researcher moved away from the idea of participation. This usually involved one-visit interviews and called for relatively more formal observation. Here, there is a possibility of misunderstanding, as it is more of an encounter between

strangers. In this empirical research, however, this is not the case, as the researcher was acquainted with the case study companies and most of the people within the case study organisations. Hence, this limitation was taken into consideration. During the observational visits, the researcher observed the existence of the building blocks mentioned by the interviewees. By doing this, it allowed the researcher to obtain a deeper understanding of each element of resilience, and their importance in the company food supply chain cycle. For instance, Plan/Develop, Source, Make, Deliver and Return.

4.1.3   Documentation and Archival Records

It has been recommended by Yin (2009) that documentary information can be considered to be relevant to all case study research except for preliterate societies. Yin, introduces many forms of documents that can be used as the sources of data:

> ➢ Letters, email correspondence and other personal documents.

> ➢ Agendas, announcements and minutes of meetings, and other written reports of events.

> ➢ Administrative documents such as: proposals, progress reports and other internal records.

> ➢ Formal studies or evaluations of the same case that "you" are studying.

> ➢ News clippings and other articles appearing in mass media or community newspapers (Yin, 2009, p. 103).

In this empirical study, the researcher screened, summarized and analysed relevant documents for this research. This included the participating organisation's documents. For instance, documents pertinent to supply chain strategies, process mapping documents, supplier selection and evaluation methodologies, supplier questionnaires and business continuity plans. In addition, other sources such as academic and professional webinars and news articles relevant to the case study were collected. The researcher concentrated on the qualitative content, but was also

aware of any quantitative trends that could arise during the analysis. Throughout this process, the researcher has constantly looked for the existence of resilience enabling elements stated by the interviewees and observational studies. To cross check the presence of resilience building block in a food supply chain cycle.

4.1.4 Collection of Observational and Archival Record data

Section 4.1 of this document explained the data collection methods used in this empirical doctoral research. Table 23 below was used by the researcher to capture the enabling factors of resilience during visits to case study companies. The left-hand side column is used as an indicative resource for researcher to easily cross-check the enabling factors that were identified during the observational and document review. The white coloured columns permit the researcher to capture the enabling factors identified during the literature review in each case study company. The researcher recorded any other enabling factors that was identified during the documentation review in Yellow coloured columns and observational studies in the Grey row. The results of observational studies and archival records method are presented in Appendix One: Observation and Documentation

Case Study Company		Date: Location:	
Resilience Enabling Factors Identified in the Literature Review	*Existence of Identified Factors in Case study company*	*Enabling Factors Identified in Documentation Review*	*Stage of Food Supply Chain*
Visibility			
Flexibility			
Collaboration			
Agility			
Risk Management Culture			
Product Stewardship			
Efficiency			
Control			
Anticipation			
Recovery			
Security			
Financial strength			
Trust			
Observations:			

Table 23 Observation & Documentation Checklist

4.1.5 Triangulation

This empirical research used a multiple case study strategy (3.6.3) in which several data collection methods were utilised. It is intended that this will lead to a reduction in errors and misinterpretation of the data. Triangulation was used in order to be more confident in a result, where the use of different methods/sources led to the same results (Sekaran, 2010). Triangulation is defined as *"the use of two or more independent sources of data or data-collection methods within one study in order to help ensure that the data are telling you what you think they are telling you"* (Saunders et al., 2012, p. 146). The term "*triangulation*" has been borrowed from navigation, surveying a minimum of three reference points to check an object's location (Smith,1975, cited inEasterby-Smith et al., 2012).

Sekaran (2010) reports that several kinds of triangulation are possible:

➢ Method triangulation: using multiple methods of data collection and analysis.

➢ Data triangulation: collecting data from several sources and/or at different times.

➢ Researcher triangulation: multiple researchers collect and/or analyse the data.

➢ Theory triangulation: multiple theories and / or perspective are used to interpret and explain the data.

Referring to the research questions set (section 3.5.2 above), semi-structured interviews and observational methods were used, as the main method of collecting primary source data. Along with documentary research and archival record screening, as a means for collecting further data for triangulation purposes. The researcher recorded the findings of other data collection methods for each case study company i.e. methods two and four demonstrated in Figure 39. In the first stage of triangulation, the findings of observational studies and archival records for each case study company were separately compared against the findings of the interview analysis for each case study company. In the second stage of triangulation process,

the researcher cross checked and examined the findings of first stage of triangulation of each case study company againt other two case study companies. The findings of this process allowed the researcher to locate the enabling factors to the most pertinent stage in food supply chain cyle as portrayed in the theorthical framework developed in this study Figure 41.
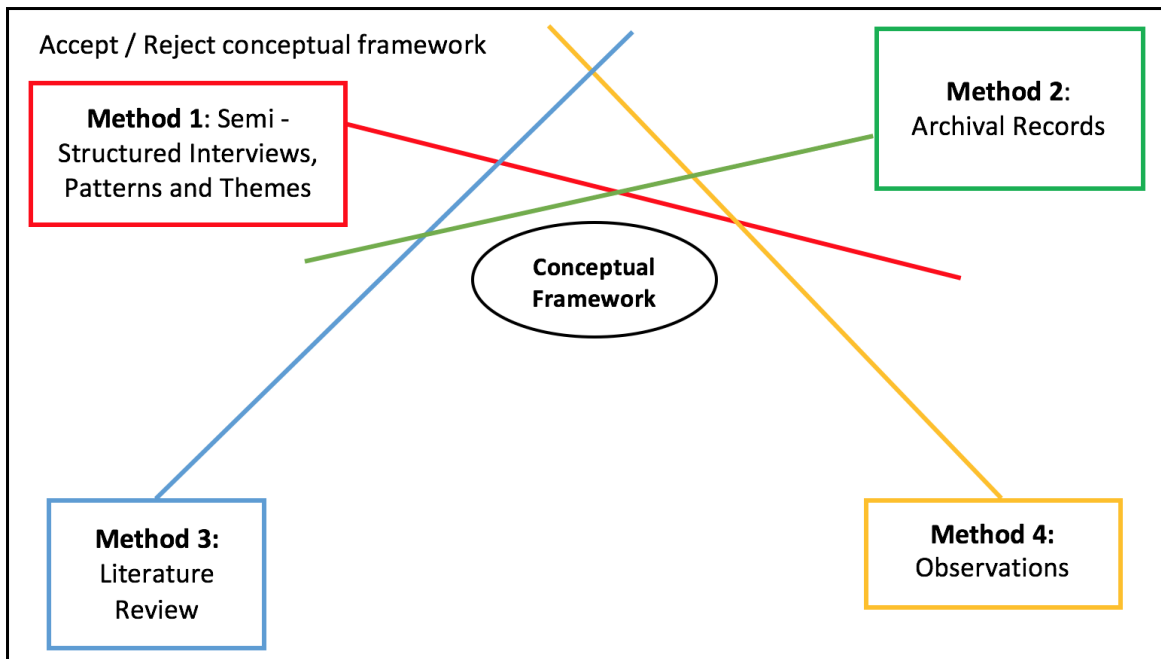
Figure 39 Methodological and data triangulation in this thesis.
Source: Adapted from (Denscombe, 2003, p. 133)

4.1.6   Methodological Approach

Chapter three of this thesis explained the methodological approaches taken in this research. The data collection methods that were described in previous sections will allow the researcher to identify the enabling factors of resilience in the British food supply chains. Table 24 below demonstrates how these methods can contribute in finding answers to the research questions and consequently justify the objectives and aim of this empirical research.

Research Aim: To investigate "*resilience*" as a form of capability for risk mitigation within food supply chains and identify the most influential food supply chain vulnerabilities. As well as the pertinent organisational capabilities, which can enable companies to bounce back and grow with minimal recovery time, in the case of unexpected disruption scenarios.			
Research Objectives	**Research Questions**	**Methodological Approach**	**Expected Outcomes**
R. Objective 1: To undertake a comprehensive and critical review of the most relevant literature, including academic publications, white papers, and professional body periodicals on the current understanding of an emerging strategy in supply chain management, *"resilience".*	**R. Question 1:** What is the explicit definition of Supply Chain Resilience and how does it differ from Supply Chain Risk Management?	➢ This will be achieved through **Scoping** and **Structured Literature Review** processes (2.1.1)	Through this process, the enabling factors of resilience that are already identified in the literature will be captured and evaluated. Furthermore, the researcher will identifiy the definition of resilience in other fieds of study and will narrow its definition to food supply chain. This literature review process will draw an explicit line between the common misunderstood concepts i.e. resilience and risk management.
R. Objective 2: To define and draw the conceptual framework, that encompasses all elements of resilience for resilient food supply chains.	**R. Question 2:** What are the main enabling factors for a food supply chain to become resilient?	➢ Scoping and Systematic Literature Review will allow the investigator to develop **Semi-structured interview** questions (Table 29).	➢ Interview questions will identify the enabling factors of resilience in highly resilient companies that are involved in British food supply chains.
	How do these factors interact and how are they mitigated?	➢ Comparing the interview responses of findings of case study companies.	➢ The interview responses of each case study company will be compared against each other to identify possible synergies or contrasts in the responses.
		➢ Triangulation of interview responses, Observational studies and archival reviews.	➢ This will allow to identify the interactions of the resilience enabling factors and their interactions and reduces the errors in judgment and research bias.

Research Aim: To investigate "*resilience*" as a form of capability for risk mitigation within food supply chains and identify the most influential food supply chain vulnerabilities. As well as the pertinent organisational capabilities, which can enable companies to bounce back and grow with minimal recovery time, in the case of unexpected disruption scenarios.			
Research Objectives	**Research Questions**	**Methodological Approach**	**Expected Outcomes**
R. Objective 3: To explore the components of "*resilience*": • In specific industrial contexts. • Conceptualising the linkage between the enablers and inhibitors of resilience.	**R. Question 3:** To what extent (and why) do these enablers exist within British food supply chains in empirical scenarios?	➢ **Semi-structured interviews** with senior directors and managers of leading Food organisations. ➢ Qualitative data analysis and identification of theorethical frameworks in interview responses. ➢ Trainagulation of findings data collection methods	➢ This method will Identify new enablers of resilience that were not identified in the body of knowledge during the Scoping and Systematic Literature Review. This method will identify the building blocks of resilience that are directly related to British food supply chains. ➢ The theorethical frameworks developed through the interview responses analysis will illustrate any possible synergy or dissimilarity between companies that are involved with food supply chains. ➢ Through this the researcher will be able to identify the enablers of resilience and eliminate any rearch bias or other weaknesses in data collection (**Table 22**)
R. Objective 4: To conceptualise the understanding of, and linkage between, supply chain resilience, organisational capabilities and sourcing strategies within the major UK food supply networks.	**R. Question 4:** What strategies are more advantageous in creating a resilient food supply chain?	➢ Literature review (Scoping and Structured Literature Review) ➢ In-depth Semi-structured interviews with influential professionals in leading companies involved in British food industry. ➢ Observation and Documentation review ➢ Triangulation	➢ This will pin-point the enabling factors that are already identied in the body of literature. ➢ Enabling factors that are most pertinent to British food supply chains will be identified. ➢ This will allow the research to identify the building blocks resilience and their existence in Plan/Design/Source/Make/Deliver and Reurn cycle.

Table 24 Methodological Framework

4.2   Development of Interviews

Kahn & Cannell (1957) cited in Saunders et al. (2012, p. 318), define interview as: a purposeful discussion between at least two or more people in order to gather valid and reliable data. Neville (2005) categorizes the interviews based on the level of formality into three categories:

➢ Structured interview;
➢ Semi-structured interview;
➢ Unstructured or in-depth interviews.

As explained earlier (Section 3.7), the purpose of this research was exploratory based. Therefore, to answer the research questions (Section 3.5.2 above) in this empirical study, the researcher conducted semi-structured interviews with the senior management of the case study companies. Bryman (2006) states that, semi-structured interviews can be used to validate the findings of other methods used in the research. In this case observational methods, documentary research and archival record screening. The researcher conducted semi-structured interviews, where questions were used to gather information, with regards to influencing factors that can affect supply chain resilience, such as its enablers and inhibitors and their interactions.

4.2.1   Interview Problems

Table **25** identifies the steps that were necessary to ensure the interviews were as effective as possible, and to pre-empt any potential problems. Neville (2005) identified the following examples as possible issues, that could affect the interviewee and their responses.

➢ Bias
➢ Behaviour of interviewer
➢ Suspicion of the interviewee
➢ Conduct of interview
➢ Confidentiality of the interview

Action suggested for semi-structured interview	Action taken by the interviewer
How might the level of preparation and knowledge of the interviewer affect the willingness of participants to share the data?	Prior to the interviews, the researcher conducted an in-depth literature review on the research questions (Chapter 2 of this thesis).
What sort of information is useful to send to an interviewee prior to the interview?	The researcher issued a pre-prepared participant information letter: where the list of interview themes, research goals and objectives were explained to the interviewees before the interview event (Appendix).
How will your appearance during the interview affect the willingness of the interviewee to share data?	Following the suggestion of Robson (2002), the researcher conducted face-to-face interviews with the senior managers of the case study companies. Therefore, a similar style of dress to those managers i.e. formal dress is used.
Have you considered the impact that your interview location may have on the participants' responses and or your own personal safety?	In order to reduce the possible impact of the location of the interview on the responses of the interviewees, the researcher asked the interviewees' to arrange for a quiet place where they could easily and comfortably share their ideas.
How will you prepare yourself to be able to commence the interview with confidence and purpose?	The researcher conducted a practice of the questions and voice recorded himself to eliminate any shakiness in his voice. Moreover, four pilot semi-structured interviews were conducted (see 4.4 below). At the beginning of each interview the research purposes were explained to the participants.
What concerns or needs for clarification may the interviewee have?	The confidentiality of information regarding the information revealed in the interview will be restated. The intention to ask for the number of incidents, actions and outcomes will be clarified to the participants. Questions regarding product pricing will be omitted.
How will you seek to overcome these concerns or provide this clarification?	The researcher explained the nature of the outputs to the participants and what would happen to the collected data during and after the research. The researcher promised the company full access to the pertinent analysis of the study. The researcher will NOT publish anything before case study companies have seen and agreed the final results.
What will you tell your interviewee about their right to not answer particular questions and to end the interview should they wish?	Before starting the interview, the right to not answer any question or stop the interview, if wished by the participant, is restated to each interviewee.
How would you record the data revealed in the interviews? How did you raise the request of using a voice recorder to record the interview?	The researcher explained the importance of the audio recording of the interviews to each interviewee. The permission of recording was granted before the start of the interviews.
How do you avoid projection of your own views or feelings through your actions or comments?	After preparing the questions for the interview, in order to have the questions phrased clearly, they were checked and corrected by the PhD supervisor. The researcher rehearsed the questions to ask them in a neutral tone of voice (Easterby-Smith et al., 2012) Four pilot studies were carried out (4.4 below).
What will you tell your interviewee about yourself, the purpose of research, its funding and your progress?	The researcher will briefly outline the research and its progress. A pre-prepared participant information letter was prepared and e-mailed to each interviewee prior to the interview.

Table 25 Problems and actions taken for conducting interviews

Bias is the most important issue that can significantly affect the conduct of interviews. Neville (2005) therefore, recommends that in order to reduce the bias effect, the interviewer should be aware of demeanour, suspicion, confidentiality and the form in which the interview is conducted. In order to minimise the effect of these issues, the researcher used the previous checklist (left column – action suggested for semi-structured interview) when conducting the semi-structured interviews (Saunders et al., 2012, p. 336).

4.2.2 Interviews

Following the above preparatory steps, selected senior managers of the focal company were interviewed. The duration of each interview varied as it was on discretion of each interviewee. However, the average interview duration was around one hour. In order to answer the research questions, pre-determined questions were used to structure the interviews. The results and analyses of this activity are explained in chapter 5 of the thesis.

Prior to the interviews, senior directors of the case study companies were approached and presented with a complete description of the research including the purpose, aims and objectives (see page 240). Easterby-Smith et al. (2012) emphasize the importance of establishing trust between the researcher and the targeted interviewees. The researcher was acquainted with the six interviewees from the first case study company due to past employment. The remaining interview participants from the second and third case study companies were selected based on their level of involvement in the decision-making hierarchy of the respective companies, besides their knowledge/expertise on the vulnerabilities and capabilities of creating resilient food supply chains.

The time allocated for each interview varied as this was at the discretion of the interviewees. However, on average, the interviews lasted approximately one hour and, whilst the interviews were tape recorded, notes on the responses were written down by the researcher and his research supervisor; Dr Yiannis Polychronakis. During the interview process the interviewer had the opportunity to collect other sources of evidence relevant to the study from the interviewees, including company documentation. For example, documents pertinent to supply chain strategies,

process mapping documents, supplier selection and evaluation methodologies, supplier questionnaires and business continuity plans.

All the interviews were conducted in the English language. Before commencing the interviews, as part of the protocol of the University of Salford research ethics, the interviewees were given the participant information sheet and a consent form (see page 240 to 244). Notes from the interviews were later converted into a computerised text document to be analysed with the help of QSR NVivo 10.

4.2.3 Sample Size

A sample is *"a sub-group or part of a larger population"* (Saunders et al., 2012, p. 600). To ensure that the most appropriate members of senior management in the case study companies were interviewed, the researcher carried out a preliminary research study within the hierarchy of command in each of the case study companies. This investigation revealed that the interviewees have an active role in developing, presenting and evaluating the supply chain strategy within the focal company throughout the United Kingdom and Ireland. Furthermore, the interviewees concur with the researcher that the outcome of these interviews will provide important information to investigate and answer the research questions. The information received in the interviews and the information extracted from the literature review, were used as the basis for the preparation of a predetermined set of categories of activities or phenomena to be studied in the observations.

4.3   Limitations of Research Methodology

Despite the advantages of each research method employed, as discussed earlier in this chapter, it is acknowledged that there are always limitations to any research methodology. In particular, an element of bias within all qualitative research methods is possible. However, to mitigate against possible bias, the researcher used the best practice instructions recommended by researchers such as Collis & Hussey (2009). In addition to previous limitations, it is claimed that 70% of supply chain executives lack the information needed to effectively manage their organisation, as employees withhold vital input, out of fear that doing otherwise will reflect poorly on them (Feldman, 2004). Therefore, to alleviate this limitation, the researcher approached

senior directors and manager who were highly aware of the topic and willing to share their insights (Table **25**).

4.4   The Pilot Study

A pilot study is defined by Saunders et al. (2012) as follows:

"A small-scale study to test a questionnaire, interview checklist or direct observation schedule, to minimise the likelihood of respondents having problems in answering the questions and of data recording problems as well as to allow some assessment of the questions' validity and the reliability of the data that will be collected" (Saunders et al., 2012, p. 103).

In this empirical study, the researcher conducted four pilot interviews to determine the suitability of the questions used in the interviews for the target audience. All four pilot interviews were conducted at Salford Business School, and the two scholars who collaborated on the pilot had the necessary experience and expertise in the fields of risk and food supply chains. The other two participants in the pilot study were fast food supply chain professionals, who provided valuable input to the development of the interview questions. Because of the pilot study, the researcher modified the interview questions based on some minor feedback received. The pilot interviewees suggested, for example, that the researcher would encounter situations of "*hesitation in replying*" or "*biased*" answers without some amendments to the way the questions were initially worded.

4.5   Validity and Reliability

Validity is the extent to which the research findings accurately represent what is really happening in the given situation. Validity in positivist research is very low, while in phenomenological research, it is considered to be higher. The purpose of the latter is predominately to capture the essence of the phenomena and extract data that is rich in content (Collis & Hussey, 2009).

Reliability, on the other hand, is concerned with actual research findings and the overall credibility of the findings. Essentially, if the research was to be repeated

again, the same results should arise. The reliability in positivist studies is high while, in phenomenological studies, it is low.

Cavana (2001) states that validity is concerned with whether the researcher is addressing the right question, whereas reliability is concerned with the stability and consistency of measurements. That is, if the same phenomenon is measured more than once with the same instrument, then the same results should be obtained (Mason, 2002).

All in all, validity receives more attention than reliability in qualitative research. The question of validity can be shortened to a question of whether the researchers see what they think they see. It has been reported that validity is concerned with whether the researcher measures the right concept, and reliability is concerned with stability and consistency in measurements (Cavana, 2001).

Yin (2009) mentions four tests used to establish the quality of empirical research:

1) Construct validity: establishing the correct operational measures for the concepts being studied. To increase construct validity, three tactics are available:

   i. Use multiple sources of evidence: this tactic is relevant during data collection. To increase the construct validity in this empirical research, the researcher used many sources of evidence, such as semi-structured interviews as the main source of data, plus three other sources which are; documentation, archival reports and direct observations as in the case of this research.
   ii. Establish a chain of evidence: this tactic again is relevant during data collection.

   iii. To have the draft case study report reviewed by key informants.

2) Internal validity (for explanatory or casual studies only, and not for descriptive or exploratory studies): establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished by spurious relationships.

To increase the validity of this research, the interview questions were carefully prepared, piloted and refined. Table **26** outlines the steps taken during the case study.

Tests	Case study tactics	Phase of research in which tactic occurs
Construct validity	• Use of multiple sources of evidence • Establish chain of evidence • Have key informants review draft case study report	Data collection Data collection Composition
Internal validity	• Do pattern matching • Do explanation-building • Do time-series analysis	Data analysis Data analysis Data analysis
External validity	• Use replication logic in multiple-case studies	Research design
Reliability	• Use case study protocol • Develop case study data	Data collection Data collection

Table 26 Case Study Tactics for Four Design Tests
Source: Adapted from (Yin, 2009, p. 41)

4.6   Conducting the Case Study

As explained in section 3.4.1 above, this is an empirical research project which uses inductive research methods, in which no hypotheses are needed. In this type of research approach, the incidents as they appear can form patterns, which the researcher can develop into concepts and theories (Gummesson, 2000).

It is regarded that two to ten participants or research subjects are sufficient to reach saturation (Dani, Burns, & Backhouse, 2006; Munhall, 2012). Along these lines, Creswell (2009) recommends long interviews with up to ten people for a phenomenological study, as an appropriate number of interview participants. Therefore, in this empirical research on the *Building Blocks of Resilience in British Food Supply Chains,* the researcher has conducted a total number of ten (10) interviews (excluding the four pilot interviews: 4.4 above) with senior directors and

managers of three major companies with strong footholds in the British food industry. The case study companies have been chosen as they have an active role in all the stages of farm to fork networks. A detailed presentation on each case study is given in section 3.8. The interviews were conducted from December 2014 to October 2015.

4.7   Chapter Summary

This chapter explained the primary data collection methods used in this empirical research with a case study research strategy. To increase the validity and reliability of the results, this empirical doctoral study triangulated the primary data via document reviews, direct observations and archival records, to reduce or eliminate any possible bias and the sterility of each single method approach. This chapter also discussed the general limitations of the data collection methods applied in the thesis. The researcher believes that the main constraints were the limited time and resources available in carrying out the study. However, the methods applied in this study were the most appropriate to answer the research questions.

The upcoming chapter begins with an introduction to data analysis procedures used in this study and justifies the chosen data analysis style. Furthermore, the researcher provides an introductory overview on each of the case study companies involved within this empirical research. Along with the interviewees who contributed, their roles, and the number of years of experience their involvement within their respective case study companies amount to. Various qualitative data analyses mentioned in the body of the literature are explored, and the researcher justifies the choice of data analysis used; *pattern matching*.

Chapter Five:
Data Analysis and Research Findings

5.1   Introduction

This chapter aims to analyse the participants' interview responses and present the major findings of the empirical study, which was carried out on major companies that are heavily involved in the British food industry. As explained in Section 4.1 the main source of evidence for this research was the face-to-face interviews in a semi-structured manner. The secondary data was supplemented through the revision of the documentation; archival review screening and observational studies conducted by the researcher on the case study companies. These sources of data were used for triangulating purposes (4.1.5) of the primary data obtained from interviews.

The data is analysed to answer the following research questions:

> ➤ What is the explicit definition of Supply Chain Resilience and how does it differ from Supply Chain Risk Management?
> ➤ What are the main enabling factors for a food supply chain to become resilient? How do these factors interact and how are they mitigated?
> ➤ To what extent (and why) do these enablers exist within British food supply chains in empirical scenarios?
> ➤ What strategies are more advantageous in creating a resilient food supply chain?

Section 1.5 of this thesis described how all the elements of this research are interrelated. Accordingly, the research questions of this thesis act as a glue, which connect all its components. In line with this, Table **27** demonstrates the linkage between the elements of this research i.e. the aim, objectives, questions and the findings of the literature review. Furthermore, this table introduces prominent authors, who have worked extensively in the field of resilience and have publications in peer review subject related journals. Consequently, their works did contribute towards identifying resilience building blocks and answering research questions.

Research Aim: To investigate "*resilience*" as a form of capability for risk mitigation within food supply chains and identify the most influential food supply chain vulnerabilities. As well as the pertinent organisational capabilities, which can enable companies to bounce back and grow with minimal recovery time, in the case of unexpected disruption scenarios.			
Research Objectives	**Research Questions**	**Literature Review**	**Research Findings**
R. O1: To undertake a comprehensive and critical review of the most relevant literature, including academic publications, white papers, and professional body periodicals on the current understanding of an emerging strategy in supply chain management, *"resilience".*	**R. Q1:** What is the explicit definition of Supply Chain Resilience and how does it differ from Supply Chain Risk Management?	(Pearson et al., 2014) (O'Marah et al., 2014) Differences between Resilience and SC Risk Management (Sawik, 2014; Vedel & Ellegaard, 2013) Explicit SCRM Definition (Colicchia & Strozzi, 2012) (Manners-Bell, 2014)	➢ Literature review chapter Two. • Resilient food supply chain is defined as: supply chains that have a series of competences in which all actors are able to; Recognise, Report, React and Recover from any unforeseen event, leading to a Rapid return to a similar or better state of performance. ➢ SCRM & Business Continuity programmes enable resilience. ➢ SCRM identifies eminent & obscure risks
R. O2: To define and draw the conceptual framework, that encompasses all elements of resilience for resilient food supply chains.	**R. Q2:** What are the main enabling factors for a food supply chain to become resilient? How do these factors interact and how are they mitigated?	The absence of capabilities that create resilience can hinder the company to reach a resilient state (Pereira et al., 2014). (Fiksel et al., 2015) (DHL, 2015) (Sheffi, 2015b) (Duarte Alonso & Bressan, 2015; Macfadyen et al., 2015) Table *11*	Different capabilities were named in the stages of the food supply chain as enabling factors for resilient food SC. However, interviewees concurred that a lack of resilient capabilities leads to overall brittleness of SC. A theoretical framework was developed in this doctoral research, see *Figure 41*.

Research Aim: To investigate "*resilience*" as a form of capability for risk mitigation within food supply chains and identify the most influential food supply chain vulnerabilities. As well as the pertinent organisational capabilities, which can enable companies to bounce back and grow with minimal recovery time, in the case of unexpected disruption scenarios.			
Research Objectives	**Research Questions**	**Literature Review**	**Research Findings**
R. O3: To explore the components of "*resilience*": • In specific industrial contexts. • Conceptualising the linkage between the enablers and inhibitors of resilience.	**R. Q3:** To what extent (and why) do these enablers exist within British food supply chains in empirical scenarios?	(Resilinc, 2016) (Purvis et al., 2016) (Manning & Soon, 2016) (Tendall et al., 2015)	➢ Risk awareness, understanding business threats and vulnerabilities can enable companies within the food industry to become resilient. ➢ None availability of material is considered as the make or break factor in the food industry. ➢ Buying behaviour of major food supermarkets can affect other supply chains that are not directly related to them. ➢ The capability and capacity of transport and logistics company i.e. road/rail/sea service providers to meet the service levels are regarded as crucial to business stability. ➢ Information and data exchange capabilities of all actors within the food supply chain were considered pivotal in overcoming unpredictable events. ➢ Financial strength of the organisation and its partnering tiers in food supply chain is highly important. It was mentioned that the ability to cost engineer the SC to sacrifice profit for performance can allow companies to withstand any unpredictable hiccups. ➢ Unambiguous Key Performance Indicators between all the parties is regarded as a salient factor that can increase SC resilience. ➢ Establishing close relationships with suppliers and customers up and down the SC can lead to better identification of risks. ➢ The interview participants indicated that process quality audits, company specific audits and food safety and security certification organisations are effective tools to add control and enhance visibility. ➢ Human resources were regarded as an important enabling factor that can allow resilience to be generated in supply chains. Risk awareness, training and preparation on scenarios were identified as tools that can prepare staff to react timely and adequately in unforeseen events. ➢ Procurement function is named as the organisational function that can boost Inter/Intra-organisational cross functionality and eliminate working silos.

Research Aim: To investigate "*resilience*" as a form of capability for risk mitigation within food supply chains and identify the most influential food supply chain vulnerabilities. As well as the pertinent organisational capabilities, which can enable companies to bounce back and grow with minimal recovery time, in the case of unexpected disruption scenarios.			
Research Objectives	**Research Questions**	**Literature Review**	**Research Findings**
R. O4: To conceptualise the understanding of, and linkage between, supply chain resilience, organisational capabilities and sourcing strategies within the major UK food supply networks.	**R. Q4:** What strategies are more advantageous in creating a resilient food supply chain?	(Annarelli & Nonino, 2016)	➢ Unification of production processes, equipment and machinery were mentioned as strategies that create flexibility in SC. ➢ Risk management processes and business continuity programmes are identified as the strategies that can identify the vulnerabilities in SC and consequently generate resilience capability. ➢ Multiple sourcing for mission critical suppliers were regarded as one of the most common strategies used by the case study companies. However, a few participants indicated that they would not block their supplier capacities due to ethical reasons. ➢ Use of cold chains and cold storage facilities were indicated as solutions for the creation of buffers within the food supply chains. ➢ Creation of a disruption task force that can liaise with supply chain partners and align the processes according to the situation, is another strategy that reduces the time to react for case study companies.

Table 27 Research Chart and Research Findings

5.2   Data Analysis

As stated by Saunders et al. (2012), because of its nature, there is no standardised approach to the analysis of qualitative data. It has been claimed that *"clear-cut rules about how qualitative data analysis should be carried out have not been developed"* (Bryman, 2006, p. 398). The overall goal in data analysis is to treat the evidence fairly, produce compelling, analytic conclusions and rule out alternative interpretations (Yin, 2009). As mentioned in section 4.1 above, this research relies on qualitative data: as qualitative data is vast and differences are great, its analysis also differs.

Although there is a lack of a standardised approach, most qualitative analysis does possess some common features; Miles & Huberman (as cited in Robson, 2002) list them as a fairly classic set of analytic moves:

- ➢ Giving codes to the initial set of materials obtained from observation, interviews and documentary analysis (5.2.2).
- ➢ Adding comments, reflections or keeping memos.
- ➢ Going through the materials to identify similar phrases, patterns, themes, relationships, sequences and differences between sub-groups.
- ➢ Gradually elaborating a small set of generalisations that cover the consistencies one discerns in the data.
- ➢ Linking these generalisations to a formalised body of knowledge in the form of constructs or theories.

Another attempt to identify the main elements of qualitative data analysis was reported by Lindolf (as cited in Collis, 2003), who mentions four interrelated domains:

- ➢ *Process*: where the analysis of the data takes place continuously throughout the study.

- ➢ *Reduction in data*: sorting, categorising and interrelating data by means of coding or placing data in charts or matrices.

➤ *Explaining*: understanding the coherence of meaning and action in the case under investigation.

➤ *Theory*: is the context in which the analysis of qualitative data offers explanations.

Other various typologies (Robson, 2002) linked to the method of qualitative data analysis mentioned in the literature are; the *quasi-statistical method*, *the template approach*, *the editing approach*, and *finally the immersion approach* that are explained in **Table** *28*.

Different Approaches to Qualitative Analysis	
Quasi-statistical Approach	Use of word or phrase frequencies and inter-correlations as key methods of determining the relative importance of terms and concepts. Typified by content analysis.
Template Approach	Key codes are determined either on a priority basis (i.e. derived from theory or research questions) or from an initial read of the data. These codes then serve as a template or bins for data analysis, the template in this case could be changed as analysis continues. Typified by matrix analysis, where descriptive summaries of the text segments are supplemented by matrices, network maps, flow charts and diagrams.
Editing Approach	More interpretive and flexible than above. None or very few priority codes used. Codes are based on the researcher's interpretation of the meaning or patterns in the texts. Typified by grounded theory approaches.
Immersion Approach	Least structured and most interpretive, emphasising researcher insight, intuition and creativity. Methods are fluid and not systemised. Closed to literary/artistic interpretation and connoisseurship (calling for expert knowledge and targeted at a similarly skilled audience). Difficult to reconcile with the scientific approach.

Table 28 Different Approaches to Qualitative Analysis
Source: Adapted from (Robson, 2002)

It is important to mention that, Collis and Hussey (2009) believe the analysis of qualitative data depends on the quality of the researcher's interpretation. Various criteria are mentioned that can be used to evaluate a phenomenological study, which could also be used to assess the quality of an analysis. Lincoln & Guba (as cited in Collis and Hussey 2009) suggest that four criteria can be used:

> *Credibility*: this demonstrates that the research was conducted in such a manner that the subject of the enquiry was correctly identified and described. Credibility can be improved by the research's immersion into the study for a prolonged period, by persistent observation of the subject to obtain deeper understanding.

> *Transferability*: this is concerned with whether the findings can be generalised to another situation.

> *Dependability*: illustrates that the research process is systemic, rigorous and well documented.

> *Conformability*: if the study has described the research process fully, allowing assessment on whether the findings flow from the data.

Yin (2009) suggests that the following five analytic techniques can be used for case study analysis:

> *Pattern Matching*: pattern matching logic is to compare an empirically based pattern with a predicted one. If the case matches the predicted patterns, then the case supports the theory in the same way as successful experiments support a theory. If the pattern coincides, the results can help a case study to strengthen its internal validity.

> *Explanation Building*: the goal of this technique is to analyse the case study data by building explanations about the case. Yin (2009) suggests that, in explanation building processes, the findings are compared to any statement or propositions created.

> *Time Series*: Yin (2009) argues that if the events have been traced in detail and with precision over time, the time-series analysis technique may be possible.

> *Logical Model*: the logic model deliberately stipulates a chain of events over an extended period. The events are phased in with a reported cause- effect-cause-effect pattern, whereby a dependent variable (event) at an earlier phase becomes the independent variable for the next phase. This process can help define the sequence of programmatic actions which will accomplish the goals (Yin, 2009).

> *Cross-Case Synthesis*: cross-case synthesis is a technique especially relevant to research consisting of at least two cases. This technique treats each individual case study as a separate case (Yin, 2009).

5.2.1 Data Analysis Process

Following the literature review introduction on several proposed methods of data analysis, this empirical study used pattern matching logic to analyse the qualitative data and followed the steps below to analyse it:

- ➢ All the voice recorded interview audio materials were transcribed into text in Microsoft Word® document format.

- ➢ All interview transcripts, notes, documents and other sourced data were read thoroughly, to acquire an in-depth understanding of the data.

- ➢ The researcher categorised the collected data, that were obtained from semi-structured interviews, observational studies, notes and memos into meaningful categories developed from the interview questions. This process identified two main categories (risk/vulnerability in SC questions and resilient SC related questions) and four subcategories as demonstrated in Table 29.

- ➢ The data were unitised by attaching relevant "*chunks*" of data (referred to as units of data) to the appropriate category or categories. A unit of data could be several words, a sentence, a paragraph or sometimes a complete answer to a question asked in the interviews that fit the category. During this stage of the analytical process, the researcher followed the guidelines of Saunders et al. (2012) and reduced/rearranged the data into a manageable and comprehensive form.

- ➢ After completing the above-mentioned process, in the first stage of data analysis, the researcher continued to explore the key themes and patterns or relationships among the data units within the responses of each case study company. In addition, the researcher consulted other sources of data collected during the fieldwork, such as reports, notes taken during the observational studies and any other relevant archival resources. As mentioned earlier, this step served the triangulation purpose (4.1.5 above) and enhanced the clarity of the issue and themes under investigation.

- ➢ In the second stage of data analysis, the interview responses of case study companies were compared against each other; and similar/contrasting responses were highlighted.

5.2.2 Coding

A code in qualitative analysis is most often a word or short phrase, that symbolically assigns a summative, silent, essence-capturing, and/or evocative attribute for a portion of language-based or visual data (Saldaña, 2012). In this study, the researcher used codes to refer to the various members (their role and position) within the case study companies participating in this research (4.2.3).

For the purpose of data analysis, the following codes were used:

➢ Directors: D1, D2, D3, etc.
➢ Senior Managers: SM1, SM2, SM3, etc.
➢ Managers: M1, M2, M3, etc.

5.3   Case Study Organisation Data Analysis

The interview questions (5.3.1 below) for this were divided into two categories; *supply chain risk/vulnerability related questions* and *resilient supply chain related questions*. The data organisation involved the identification of thematic categories, that emerged from the thematic analysis conducted for this study. Thematic analysis, as used in the present study, has allowed the researcher to identify the significant elements or thematic categories, manifested themes, and the emergent attributes from the responses obtained from the participants. Noticeably, thematic categories emerged from the literature review, as well as the responses of the participants of each case study company. Overall, this has allowed the researcher to develop the concepts of the case study, for instance the development of a conceptual framework for resilient food supply chains in the UK.

In this study, the researcher used the QSR NVivo 10® software to sort the terms and phrases, that were commonly mentioned (word frequency and text search) in the responses of the participants. These terms and phrases have been summarised in composite descriptions, which were then counted to determine the relevance of the descriptions to the current understanding of the phenomenon.

The composite description of the thematic categories and themes that were relevant to the research are as follows:

Thematic category: Interview Questions on Risk/Vulnerabilities
Sub-category

- ➢ Risk management, vulnerabilities in British Food SC

- ➢ Identification of the most important strategies for effective risk mitigation

Thematic category: Interview Questions on Resilience
Sub-category

- ➢ Enabling factors of resilience in Food SC

- ➢ Comprehensive definition of Resilient Food SC

5.3.1 Interview Questions

The interview questions were developed by the researcher to answer the research questions (see Section 1.1) and consequently addressed the research aim and objectives, as described in Table **27**. The interview questions were established from the literature review and its various sources are mentioned in **Table 12.**

Thematic Category: Interview Questions on Risk/Vulnerabilities		Elements of Vulnerability/Resilience sought in the interviewees responses
Sub category Risk management, vulnerabilities in British food SC	1. What is your understanding of supply chain risk? ➢ Do you see it as a Threat or Opportunity? 2. Can you provide some examples of risks (external and internal) in your supply chain operations? 3. Out of those risks which one do you consider more important? ➢ How do you see them being relevant to material, money or information? 4. Would you say that those risks are interrelated? ➢ If so in what way?	• Lack of visibility • Functional silos • Financial disruption • Environment/Diseases • Loss of control • Corruption/Fraud
Sub category Most important strategies for effective risk mitigation	5. Do you have contingency plans in case those risks occur? ➢ Which risk mitigation strategies do you use? 6. How much risk is your company willing to bear and what are the tolerance levels? 7. How much information do you have about the financial and operational performances of your tier 1 and tier 2 suppliers and customers? ➢ If so how do you use that information? 8. How do you identify, understand, and deal with risks occurring within tier 2 and tier 3 suppliers? 9. How quickly can you and your suppliers implement mitigation plans and ensure the resumption of normal daily operations? 10. Would you consider your approach to supply chain risk management as being reactive or proactive?	• Risk management • Anticipation • Efficiency • Culture • Security • Product stewardship • Visibility • Security • Recovery • Agility • Recovery • Anticipation • Collaboration • Trust • Collaborative planning

Thematic Category: Interview Questions on Resilience		Elements of Resilience sought in the interviewees responses
Sub category Enabling factors of resilience in food SC	11. How do you ensure that customer service levels are maintained when disturbance occurs within your supply chain? 12. In your view what are the important characteristics (capabilities) that your organisation must possess in order to be able to mitigate supply chain risk? 13. Out of these capabilities which ones do you consider more important? How do you prioritise in developing these characteristics?	• Visibility • Control • Redundancy • Product stewardship • Security • Flexibility • Collaboration • Agility • Control • Product stewardship • Risk management • Flexibility • (All the remaining enablers)
Sub category Comprehensive definition of Resilient Food SCH	14. What does supply chain resilience mean to you, and your organization? ➢ Would you say it is different to supply chain risk management? 15. In your view, in what way does supply chain risk management affect resilience in supply chains? 16. How do you compare your current relationships (more/less dependent / transparent) with customers, suppliers and 3PL compared to say a few years ago?	• Essential/Important/Extra cost • Similar/Different/Interchangeable • Extent of collaboration • Control/ Visibility • Arm's length/ Collaborative

Table 29 Interview questions asked during the semi-structured interviews

5.3.1.1   Interview Questions Rationale

As illustrated in the table above, the first set of questions were related to food supply chain vulnerabilities and supply chain risk management. *Question one* was asked by the researcher to examine the level of familiarity of interviewees on risk/vulnerabilities, and to understand their personal and managerial perception on business risk. *Questions two* and *three* were posed to interviewees to identify and assess the most pertinent business risks/vulnerabilities (food supply chains) in their respective businesses. Furthermore, the participants were challenged to think about the extent of criticality of each threat. The interviewees were asked in *question four* to explain whether the occurrence of the before mentioned risks, affects the probability of manifestation of other business risks such as their interrelatedness.

Question five examined the contingency plans and strategies that each case study company had in place to react to any unforeseen event. Also, the level of familiarity of each interviewee to these plans were examined. *Question six* scrutinised the extent to which case study companies are willing to expose themselves to business risks. The purpose of *questions seven* and *eight* were to examine visibility and information exchange between the case study companies and their respective business partners up and down the supply chain. *Question nine* sheds light on the time to react and recovery time of case study companies. The *final question* in the first set of interview questions was a recall question, where the interviewees were reflecting their previous answers, by judging their supply chain risk management activities and clarifying their definition of supply chain risk management.

The purpose of the second set of interview questions was to develop a clear picture on supply chain mitigation and resilience strategies and capabilities. *Questions eleven* and *twelve* explored the capabilities that interviewees considered as the enablers of resilience within their organisation, that can excel them through the occurrence of any unpredicted events in the food supply chain. The responses to the *thirteenth interview question* were linked to the second research question, and prioritized the named capabilities in the creation of resilience in food supply chains. *Question fourteen* was related to the first research question and tested the practitioner's understanding of resilience in food supply chains, whilst eliciting an explicit definition for resilient supply chains. *Question fifteen* was a recall question,

that further examined the relationship between risk management and resilience in food supply chains. The *final question* sought to obtain an overall evaluation of supply chain relationships, in participating case study companies with their business partners.

The following sections describe each case study company profile and their significance in the British food supply chain. Furthermore, the interview responses of the interviewees are analysed in a pattern matching logic.

5.3.2   Thematic category: Supply chain risk related questions

The first set of questions were related to food supply chain vulnerability and risk management. These were put to senior directors and managers of case study number one to evaluate the level of understanding of supply chain risks, the vulnerabilities that can affect the business and the risk mitigation strategies. As mentioned in section 4.2.3, all the participants have extensive experience in food supply chains and in-depth knowledge on the topic of the research.

Based on the responses provided by the participants to the first set of interview questions, the following themes emerged in Table **30**.

Thematic Categories Constituents	Number of participants to offer this experience	% Participants to offer this experience
None availability of products	Six	100%
Transport and Logistics capacity	Six	100%
Reduction of profit permits financial flexibility in SC	Six	100%
Strategic Relationships and Supplier Audits	Six	67%

Table 30 Themes emerging from interview questions on risk

5.3.2.1 None Availability of Products

The first theme, *none availability of products*, is identified as one of the major factors that can generate critical risk for the survival of business. D1 stated that, availability for the case study company, is the availability to deliver the product not just the availability to pick. One of the major vulnerabilities identified by the interviewees, that can cause none-availability of products is the accuracy of purchase orders or forecasts. However, the interviewees to the date of the interview, emphasised that the company has not faced any major forecasting issues. Yet, after reviewing the archival records and asking the case study number one's store manager based at Manchester's shopping centre, examples of glitches within the forecast accuracy of supply chains were noted. By reviewing the process of order placement, it was noticed that the initial forecast is sent to the suppliers 12 months in advance (for contractual purposes), to the main headquarter in Dallas, Texas - USA. However, the forecast is updated weekly to eliminate any forecast anomalies in demand that may generate risk. On the one hand, D1, D2, SM1 and SM2 gave examples, where a sudden rise in the number of customers – due to promotions – have created situations that caused short term non-availability.

M1 and M2 on the other hand, claimed that:

"The biggest challenge is that three parties have an interest in the forecast i.e. our suppliers, our distributors and our company. We are great in the forecast at macro level. The thing that we do not have control of 100 percent is the buying behaviour of our distributor; they might buy a 1000 cases of some products one week and not buy anything the following week".

All the interviewees were fully aware of the importance of availability and on time in full delivery of the products. SM2 explained that:

"In our business, having the product available is the most important issue, no matter what the cost of sale is or what your new product development programme looks like. In our business, when you run out of the products (chicken and chips) then you are dead. We have felt the pain of that several times. Therefore, we try to maintain our restaurants full to keep the offers".

Availability and on time in full delivery of the products, was the most essential function of the supply chain by all the interviewees. SM1 stated that, most of their outlets are located inside shopping centres and this limits their operation time. During the observational studies, the store manager of Arndale mentioned that they need to share the cargo lifts with other fast food stores in the mall. Therefore, the timelines of the deliveries are of utmost importance. In line with this, D1 noted that:

"We aim to take zero risk and keep availability at 99.7%. The cost in our supply chain does matter as well. However, we are lucky that (2/3) two thirds of our business is franchise owned. They own other brands (not necessarily our direct competitors) and they can tell us about the cost that we pass through our supply chain and they keep telling us if we are not performing".

Participants also mentioned that in the case of any risk such as non-availability, they would *contact every restaurant* and every franchisee to make sure that advertising boards changed, so that the relevant offer is removed. All the participants unanimously considered risks and business disruptions that can affect supply chain performances as an opportunity. SM1 explained the reason as being:

"I believe that risks can be an opportunity as you can identify your supply chain risk and try to mitigate those risks. This can drive you to continuous improvement by looking always for the ways that you can make your supply chain more efficient and more robust. If you do not look at those risks, you might not identify the complexities of your supply chain".

The interview participants stated that, external risks are those that occur outside the realm of the company SC. These are more difficult to control and can have a direct effect on product availability. D1 mentioned that throughout working with the company several external cases had been faced, that have interrupted the company's supply chain. The avian flu outbreak in Thailand was given as an example, as one of the company's biggest suppliers was affected. A breakdown of the computer systems of business partners is one of the external risks that has also affected the business in recent years.

B*uying behaviour* and *buying power* of other companies in the market is also seen as one of the external risks that can affect the prices and profit margins of the case study company. D2 hypothesized an example by adding:

"We are in the chicken business and suddenly Tesco's or any other major supermarket chain says to everyone that all of their chicken will come from the UK; then this completely changes the market place and creates a big risk for us".

5.3.2.2   Transport and Logistics Capacity

The second theme that has emerged from the interviews on the risks in the food SC, is the role of the *transport and logistics capacity*. Through observational study, the researcher noted that much attention is being paid to this company's performance and capability. The process documents and risk mitigation procedures of the case study company toward its logistics service provider are clear and thorough. The case study company has outsourced its food handling from its distribution centres to its retail stores, to an enterprise specialised in transporting food products (ambient and cold line).

The reason behind this was, as D1 highlighted, their core business strength is selling chicken and chips. Managing a fleet of trucks for the size of their business is not financially justifiable. The logistics company has the expertise and capacity to pick, transport and deliver the purchase orders from case study distribution centres (three in the UK and one in Ireland) to each store, 48 hours after the order has been placed. The interviewees stated that, handling, integrity and security of the product is of the utmost importance. Therefore, the logistic company drivers are aware of the standards of procedures for handling the products. Moreover, in the trucks that carry the cold and frozen products, their temperatures are monitored, registered and their location is tracked throughout the journey.

D1 and D2 both emphasised the importance of the logistics service provider in the success of their businesses. D2 explains the vital importance of the distributor by stating that:

"Coordinating and controlling the flow of information between supplier and distributors to have the products at the right time is a very important task for us. It is important that the distributor does not destroy the product, to have the product on time and in full, the distributor must pick the order correctly and deliver the order correctly. If the distributor does not control the temperature; the product gets spoiled. To load and unload the product is of the utmost importance. All of the before mentioned processes can break and create a risk".

5.3.2.3   Reduction of Profit Permits Financial Flexibility in SC

The third theme, *reduction of profit towards financial flexibility in SC,* has a direct link with the themes already mentioned. Examples of supply chain risk (external to the company) were presented by D1 and D2. For example, the effect of an outbreak of a major disease was reported, which led to the loss of major international suppliers.

Examples of internal sources of risk were given by four participants as; a breakdown of ERP systems, forecast anomalies, competition with major retailers and food quality issues. However, D2 explained that as such risks are interrelated, to minimise their effects;

"We *have organised our supply chain in such a way that we have turned down profit opportunities to assure continuity of supply. Therefore, in our case, money will come last for us. So, the lack of money has not caused a supply continuity issue. Whereas, the retailers' supply chain has been cost engineered and that creates the risk".*

It was observed that the interview participants were glad to share their experiences and expertise on the overall topic of this research. However, the researcher also noticed that, when questioned on issues such as quality, cost and benefit, M1 and M2 were very hesitant to go into details, whereas D1, D2, SM1 and SM2 were more relaxed in answering these questions.

D1 explained that accidents and business disruption can occur at any time. Adding that, if the current remedies and processes cannot solve the problem, then they need to pay a surcharge to have the problem solved. D1 stated that:

"At the end, money solves everything 80% of the time. I go for a 3*3 matrix where you have money, likelihood and impact. Ideally you want the likelihood of the risk to be minimal, but at the end something happens. If you know the amount of money that you are going to throw at it and it is manageable, then it becomes a low risk item".

SM1 regards the case study company as a risk aversive company and highlights that, the aim is not to take any risk that can affect product availability and safety. Hence, the importance of the cost of running the SC and its effect on the competitive edge of the company is emphasised. However, SM1 also mentioned that to ensure the operation and none availability of the products is reduced, the case study company has different points of stockholding (usually in restaurants or distributor centres), which can help mitigate the none-availability. SM2 mentioned that:

"With the suppliers that are riskier and we think that we might face some problems with, we make sure that they keep stock available. We can even airfreight products in order to solve the problem".

In addition, D2 revealed the importance of cold chains and temperature controlled products in reducing any sudden fluctuation of demand in the supply chain. Adding that:

"Cold chains, although more expensive, allow products to withstand longer transit times without spoiling. We have reduced our profit opportunity in the supply chain and therefore, we can afford to use these expensive capacities, if required".

5.3.2.4   Establishing Strategic Relationships and Supplier Audits

Finally, the last theme that emerged from the responses of the interviewees on the first set of interview questions, is the vitalness of *establishing strategic relationships and supplier audits*. D2, M1 and M2 mentioned the annual reports, which are run on their suppliers, and which can then be analysed to gain a clear understanding of the suppliers' operations and efficacy. SM1 emphasised the importance of supplier audits, and the documentation for the audit process was also observed during the documentation screening activity.

This was further affirmed by D1 stating:

"Every supplier has to be checked and we have an audit program (two types of audit), that checks the suppliers before entering the tender process. We check the products and sample it. We try in our supply chain, not only to have availability but also to have the same weight and uniformity for all our products".

In line with this, D2 highlighted the importance of industry standards such as RED TRACTOR®. This organisation was established in 2000 and is the biggest farm and food standard scheme, covering all animal welfare, food safety, traceability and environmental protection.

D2 emphasised that they use RED TRACTOR® certified farms:

"RED TRACTOR certified farms give a certain level of trust to consumers and case study number one. In the way that the food is farmed and prepared, which is checked by independent experts to make sure it is of a good standard".

SM2 remarked that:

"In this company, we meet up with our strategic suppliers every month and we carry site visits as well. In these meetings, we discuss methods to reduce cost and savings in our supply chain".

Meanwhile, during the observational studies, the use of punitive clauses in the contracts to assure the continuity of supply, was discovered. This matter was explained and justified by D1 as follows:

"We talk a lot on the cost of sales in this business. In our contracts, we always try to be on the safe side and to have a continuous on time, in full supply, and delivery of the products to the stores every day. We do not use tons of elements to cost-engineer our supply chain. We use contracts that have punitive clauses in them".

SM1, SM2, M1 and M2 also explained the processes of supplier classification and their effect on the business and brand. Dual sourcing has been the most favoured risk mitigation strategy. D2 commented that they usually prefer to work with suppliers, who have two sites of production. And this supplier selection method was one of the methods, that was also observed in the document screening process. D1, however, emphasised that:

"Depending on the type of products, we can adopt the appropriate strategy. For example, for the frozen food we can build some stock. On fresh products, we cannot stock them; therefore, we make sure that they have contingency plans by establishing strategic relationships".

Choosing the best supplier relationship strategy is regarded to be related to the market situation and the type of industry that the company wants to place an order with, D2 explained this as:

"If it is an industry that must be over sold to survive, then we have two decisions to make. First, if we know that we own a large number of the supplier business, then we know that we are the customer of their preference. The second situation is that we own 2-3% of their business. In this case, we do not risk, and secure the product availability with contracts which have penalties. It depends on the industry, product, and it depends on the relationship".

On a related point*,* M1 added that*, "understanding the product and understanding the length of your supply chain is the most important thing".*

Notably, four out of the six respondents considered that their approaches towards risk management are proactive and, as D2 claimed, the reason for this is because:

"We usually punch above our weight. The reason for that is that we sell chicken 52 weeks a year, 7 days a week consistently. Whereas the retailer cannot guarantee the consistent sale of chicken and their volumes go up and down".

In contrast, D1 and SM1 considered their approach towards risk as somewhat reactive. However, it was also conceded that it would be ideal for the business to have a proactive approach:

"We cannot afford to run out of chicken. In a case where we see that we are going to run out, we have to pick up the phone and start the calls to find the chicken. You have to have a strong relationship with your suppliers and we are lucky that usually the suppliers work with us. We try to offer assurance of consistency for the orders. When we go into tender, we have a few matrices in which we check some factors such as the quality and availability".

5.3.3 Thematic Category: Supply Chain Resilience related questions

The second part of the interview questions were posed to the participants to evaluate their understanding of resilience, its importance in the food supply chain, and the factors which can enable or hinder a company to become resilient. The following themes have emerged from the responses of the interviews:

Thematic Categories/Constituents	Number of participants	% of participants to offer this experience
Organisational cross functionality	Six	100%
Risk awareness creates resilience	Six	100%
Reduction of disruption time, increases resilience	Six	100%

Table 31 Themes emerging from the interviews on resilience

5.3.3.1 Organisational Cross Functionality

The first theme to emerge in direct relation to resilience is *organisational cross functionality and organisation culture*. Indeed, all the participants acknowledged that organisational culture is essential in the development of a resilient and robust company. It was observed that in answering these questions, the interviewees were very eager to share their academic and practical experiences, and somehow proud to prove that their organisation does possess the resilience needed to succeed.

D2 emphasized the role of cross-functional accountability as the most important factor to be resilient:

"If the problem is within the supply chain, we look upstream in the supply chain to see where the problem lies. If we have to change or substitute a product we need to have cross functional accountability to solve the problem. Being able to solve the problem with joint accountability. Past experiences and scars make people realize the importance of cross-functional team work".

SM1 endorsed the comments of D2 and added that,

"In our organisation, there is a cross-functional appreciation of the importance of the supply chain. Culturally, we are a company that is not creating a crisis. In our supply chain, when there is a minor problem we make sure that the problem goes away. However, if the problem is a major problem, then we have to call on other functions".

SM2 referred to the contingency plans for several predicted situations such as system disruptions. M1 and M2 added that, it is a requirement for their business partners (suppliers, distributors and franchisees) to demonstrate their contingency plans:

"We ask our distributors to have a documented back up plan and contingency plan. We also have procedures in case our systems go down and we expect our suppliers to have the same capability and document and tell us what their back-up plan is".

D1 acknowledged that cross-functional team work is very important:

"We are lucky that the number of people active are relatively low and when a crisis occurs, we can assemble quickly and we know who needs to be involved. We can very quickly ask people to get into a meeting and try to solve the problem".

All participants indicated that, all the stores of the case study company in the UK and Ireland, follow the exact same processes and procedures. Accordingly, in this way, the case study company has created a flexible work force, that can be used all over the country, if needed. SM2 explained that:

"We follow the same processes in material, money handling, food preparation, cleaning, safety / security and customer service in all our stores in the UK and Ireland. That means, once a staff receives and is signed off from the company training programme, S/he can work in any store within the UK".

During a visit to the company owned store in Manchester Arndale, the store manager explained the staff training system. Adding that, before opening a new franchise, star employees who have mastered the company's quality and safety procedure, are deployed to new branches to train and coach new staff. The store manager at case

study number one in the Arndale shopping centre stated that, store managers of the new stores are either trained in the case study number one owned branches, or sent to the case study number one's headquarter training centre, to learn the processes and procedures.

During the observational studies, as well as during the interview process, it was noted that, in this company, the offices are open planned and there are no brick walls separating the team working in the headquarters. The separations are made by clear glass walls and D1 said that, this has enabled them to interact with staff and business partners easily. Moreover, there is no blame culture and this was highlighted by SM2 when it was explained that:

"What we have is forward-thinking people who want to solve the problems. We have a crisis management team and if any crisis occurs, we call the team together. We select people against the criteria of this culture".

5.3.3.2   Risk Awareness Creates Resilience

The second theme to emerge in this part of the interview process was *the relationship between risk awareness and resilience.*

In relation to this issue, D2 reiterated the importance of employing appropriate staff:

"When I hire people, I need a person who can see the risk and identify the risk quickly and understand what needs to happen to mitigate the risk. I want a person who is a logical and a practical thinker who can see risk in anything. Supply chain management or procurement is always, for me, risk management".

D2 defined a resilient company as:

"a company who understands that there are risks and supports supply chains to mitigate those risks and, more importantly, where there is an issue they learn from it and progress and at no point go looking for blame or looking for scape goats and panic".

D2 continued to explain with some interesting metaphors:

"What we want is that the problem does not happen again. We do not want to put a bandage on the wound. We do root cause analysis and find the base of the

problem. This will help us to create resilience. We are never going to be able to foresee risk, but we foresee the most we can and put in measures to manage that risk. It is like the fire fighters; now-a-days they are called fire prevention officers".

SM1 believed that;

"Resilience is a realisation of the existence of risk, and when it occurs, that the sky has not fallen down. We try to fix the problem and put 110% in the first time rather than seeing the problem recurring again and again.

D1 and SM2 both reported that good relationships with franchise companies can be useful. It was mentioned that, receiving good feedback from franchisees was a good barometer for resilience. Because of these relationships, it was realized that much high quality and safe to eat food, is wasted in the kitchens. Subsequently, the company has developed and reviewed the production process and has developed a food waste programme. D2 indicated that:

"We prepare fresh chicken on the bone in our store kitchens all around the world, our quality, health and safety procedures, mandate us to hold the cooked food for a certain amount of time in hot cabinets or hot lamp areas. Once these (edible and high quality) chickens pass the allowed time, we collect the food and freeze them. The frozen food is then collected by a charity that defrosts the chicken, and uses them in their food, on the day".

D1 mentioned the importance of this initiative, by adding that in this way it is possible to use high quality food to feed the people who need it most. More importantly is that there is now a wider control of the products.

5.3.3.3   Reduction of Disruption Reaction Time Increases Resilience

The third theme to emerge from the interviews is the reduction of disruption time and the importance of resilience in the company. M1 and M2 explained that:

"Time is money and the quicker we get up and start running the better. We develop a team to solve the problem, solve it, and at the same time we designate another team to make sure that this problem does not happen again. In this way, we have one team which is about results and one which is about resilience".

D1 referred to an earlier point, which was establishing strategic relationships with suppliers, and explained that keeping the strategic and critical suppliers close to the company is very important. Therefore, invitations are offered to attend the company's business ceremonies to show appreciation for their efforts in helping the company to run its businesses.

D2 gave an example of this relationship:

"Once a supplier came to me and said that they had a contract with another major retailer and, therefore, our company will not receive the level of attention that we had in the past. The relationship that we had with this supplier made them come forward and tell me beforehand rather disappointing me later. They gave me the choice".

SM1 recognised that every incident is different and it is not possible to classify any organisation based on the incident. *"Essentially learning from your mistake and trying to get to a newer, higher state is the essential point".* This comment demonstrates the importance of knowledge management and the documentation of experiences.

5.3.4 Thematic Category: Risk and Mitigation Strategies Questions

The first set of research questions were put forward to the senior directors of the case study company and the following themes have emerged.

Thematic Categories/Constituents	Number of participants to offer this experience	% participants to offer this experience
Risk understanding and awareness	Two	100%
Effective suppliers and customers' relationship reduces risk	Two	100%

Table 32 Themes emerging from interview questions on risk

5.3.4.1 Risk Understanding and Awareness

The first theme emerging from the interview is "*understanding the risks in supply chains*". D3 mentioned that one of the most important roles in the company's procurement department is to identify risk and minimize it.

Adding that "*risk is a threat to the business; we have issues of cost, continuity of supply and quality. Therefore, if we do not manage it correctly it would become a threat for us. This threat becomes an opportunity, if we can manage this threat well and better than our competition, we can manage to offer better service to the customers than our competitors.* In short, a risk in the supply chain "*when managed well can become an opportunity*".

D3 believed that "*the biggest internal risk could be the lack of understanding of our external risk where we don't put mitigation plans*". D3 continued as mentioned before, "*accurate forecasting, can have a direct effect on the availability of raw materials that we might have or not, to cover the demand*" The other risks that D3 added are the "*quality controls*", if inbound quality issues are not managed then the company will put itself directly at more risk. With the main external risk being the availability of crops.

"In our business, we particularly are dependent on crop related products such as wheat, flour and dried fruit. If there is dry weather or a disease, we would then pay more for those products or the producer might not have the volume that we need".

In short, case study number two's main business risk is the availability of raw materials. Therefore, D3 added that risk must be managed around crop availability. Concluding that *"in general we are trying to de-risk our supply chain".*

D4 gave a similar response to the question and mentioned that: *"In my perspective, I believe that supply chain risk is a threat and an opportunity".* Justifying this by adding that risks are dealt with in the internal supply chains. For instance, risks that can disrupt the operations. However, D4 also claimed that;

"Our company can spin those to become opportunities. In my company, we are aware of the threats that can affect our internal operations and we can convert them to opportunities".

D3 identified forecasting as one of their main challenges, that can have a direct effect on the availability of raw materials. Not having the forecast accurately can affect the ability to cover the demand; leading to business and reputation loses. D3 also stated;

"We can say that in the moment of the launch of new products we can have greater risk, and it is because we want to know where this product goes. In this case, forecasting is very difficult as we do not have any information on the market behaviour toward the product".

In line with this, D4 added;

"Our business is we bake the product before receiving the orders. It means we bake based on the forecast. So, it is very difficult to decide how much to bake before receiving the actual order".

By looking at case study number two's forecast procedures, it is possible to see that the principal forecast is worked out in a two-year horizon. D3 mentioned that the accuracy of this forecast *"is far less accurate than a one or two-week cycle".*

D4 mentioned that one source of concern in their business is the "*availability of drivers*". Another source of risk in D4's point of view is "*changing of customer habits, in short, buying online and trying different channels of retailing that we might have not seen and we need to adapt to. Both of those can affect our strategies to reengineer our supply chains to reach the markets*".

D3 noted that the company has contingency plans for certain predicted risks. Adding that:

"A *major mitigation strategy will be dual sourcing for external points to the company. This could be the dual approval of manufacturing sites or dual approval of alternative suppliers within different countries of origin. That will alternatively mean if we face any problem with any supplier or manufacturer we can switch volume between those suppliers*".

Other sources of contingency plans were named, such as keeping safety or buffer stocks and fixing price agreements that cover the company during the period of pricing. This point was clarified by adding that "*we fix our volume with that supplier for a certain amount of time*". Moreover, hedging practices are also sometimes being practiced.

However, D3 went on record by saying in case company number two;

"*We would not try to buy more than 20 percent of a supplier's turnover. The reason for this, is in case we change our strategies, and we want to change the supplier, it will affect their business and will harm our reputational risk rather than quality risk*".

According to D4, with regard to the manufacturing and distribution sites, there are probably two critical factors which are: having the "*flexibility of resources to switch things around between different locations*" and "*managing the relationship with our retail customers and making them understand why we cannot fulfil some orders*". D4 added that this business is a family business and therefore, customer service ethics is highly important.

D4 continued this theme by adding that;

"We probably over resource and we are not as efficient as we could be; but we do this to protect the quality and reputation and the service that we offer to our customers".

In addition, D4 highlighted another potential serious health risk, which is when the product reaches its "Used by Date". The difference between "Best Before" and "Used by Date" on their products was highlighted. If a product passes the used by date it cannot be used, it is not safe for consumption and should not be sold. It has been reported that some retailers give these products to food banks, however, this company does not have control of this part, and if an individual falls ill because of using an expired product, it would damage the brand's reputation. Therefore, *"we work with our customers so that they ensure that no product is sold or donated after it reaches its used by date"*.

5.3.4.2 Effective Supplier and Customer Relationships Reduces Business Risk

The second theme that emerged from the first set of interview responses was the company's reliance on "*managing supplier relationships"*.

D3 mentioned that: "*to avoid any financial risk, at least once a year and definitely before going out and giving the contract, we ask our external parties to help us and review their (suppliers) financial stability"*.

In the observational studies, gathered during a tour around the company's facilities, D4 highlighted the importance of quality checks for each product that is received by the company. Case study number two constantly monitors the quality of the ingredients of its bread, that is received from its supplier in their laboratories. The audit procedure and process were explained and D3 added that, in the case of a current supplier:

"*If we notice some risks we work with them (suppliers) to understand where these risks are located. In case that we notice that they are unable to improve, then we try to decrease the volume and move away from them*".

New suppliers undergo a thorough audit process and technical approval process. D3 claimed that due to the thoroughness of their audit processes it will take them much longer to approve and appoint a new supplier. Consequently, it is reported that case study number two have less need to change its daily supplier base. Another reason for their rigorous examinations according to both interviewees, is the importance of food safety and elimination of ingredient fraud. They emphasise that a series of tests are carried out at case study number two's laboratories, to determine that the sourced material is what it should be.

"We are in a fresh product business, quality and service is as important as price. Hence, we see less volatility in our business as a brand than other businesses in label because we keep our relationships quite strong and become the customer of choice for those suppliers".

D4 on the other hand believed that the secret of their success lies in their ability to *meet their customers' orders*; as other suppliers are not able to achieve this. D4 believed that to manage the risk of any new entrants to the business such as new suppliers and retailers, it is vital to stick to its core values.

Emphasising that:

"Our core value is that we are not going to enter into a price war, we are not about being the cheapest bread in the market. We make sure that every product that we serve to our customers is the best quality. We try to maintain our customer loyalty, even if they are tempted to switch to another product, as they have found another product that is on promotion, they will return as we deliver good quality for our products".

D4 believed that their customers are quite loyal and do not switch because of price that often. *"We always make sure that we have always on-shelf availability, which sometimes some of our competitors don't, the consumer finds our product always on the shelf available"*.

It appears that proactively working on *category planning* to understand their supplier base is one of their critical tasks. D3 emphasized that;

"I think, fundamentally you have never got to get away from being reactive. This is because you can have all the understanding of the risk, but you cannot understand when this risk might happen".

D4, however, stated that:

"*All this can be done through having the right people to have decision authority to make changes, as soon as they see risk coming into the business*".

5.3.5 Thematic Category: Supply Chain Resilience Related Questions

The second set of questions were also put to D3 and D4 as previously explained in section 4.2.2 above. By analysing the responses to the interview questions (Table *29*) the following themes have emerged.

Thematic Categories/Constituents	Number of participants to offer this experience	% participants to offer this experience
Role of procurement in resilience	Two	100%
Flexibility in resources and employee empowerment	Two	100%
Risk management processes	Two	100%
Information exchange increases SC transparency	Two	100%

Table 33 Themes emerging from interview questions on resilience

5.3.5.1 Procurement Empowers Resilience

The first theme to emerge in the response to the first interview question is *the role of procurement* in creating the resilience capability. D3 mentioned that procurement or purchasing function does play an important role in creating resilience within the company. Highlighting that the procurement department's primary and important role is that the bakeries get their raw materials. According to D3:

"*The way to do that is to make sure that the forecast is as accurate as possible and our suppliers have the highest visibility and we have placed the mitigation plans in place where we face extreme supplier failures*".

According to D3 the procurement role plays an important part in maintaining the relationship with their customers, and links this to a previous response given on the risks and vulnerabilities in the supply chain. Providing an example in the case that

some of their bakeries are down due to servicing and a lack of parts, which is expected to happen from time to time. Significantly, the capability of a procurement department is to ensure the highest customer service delivery, despite short term changes in costing. D3 added that:

"We never ask how much it is going to cost us to maintain the customer service. The question will be how we are going to keep the customer service".

D4 also considered the procurement function as an enabler of resilience within the company. By referring to examples on operational risks and stating:

"Procurement by establishing a close relationship with our suppliers and customers enables us to have a better understanding of our business partners i.e. suppliers and customers".

5.3.5.2 Flexibility in Resources and Employee Empowerment

The second theme that arose from the interviews, is the organisations *"flexibility"*. Most of the risks happen in the material flow of the supply chains. D3 highlighted that for case study number two, quality and price are considered as their ultimate issues. Stating that:

"Quality makes us different to others. We will never compromise to put a poor-quality product out there, to maintain supply or to maintain price. Fundamentally, the important issue for us is whatever we get out there has to be high quality and if we cannot deliver quality we will not ship the product".

Flexibility to switch between the suppliers or reengineer the supply chain, in case something goes wrong, or if there is any rise or decrease in the volume of orders, is paramount to the organisation.

D4 also considered flexibility in resources and processes, as important enablers of resilience. According to D4, in operations, an exact certainty of when things occur does not exist. Regarding machinery for example, it is more likely to fail, but there are continuous maintenance programmes, which make sure that the machinery owned is the best and the vehicles that are on the road are well serviced.

From D4's point of view,

"It is all about having the flexibility and empowerment of the people, who are managing it on the first line, to actually do something about it and drive on the service levels regardless of what else has happened".

D4 believed that, as case study number two is a family owned business, the costs of creating "*visibility*" is an investment for the future. Adding that:

"*The costs are seen in a medium to long term view, to maintain the customer service for the customers and the retailers, as well as maintaining their loyalty. Rather than actually thinking about the pound notes and how we are going to justify these investments to the shareholders*".

5.3.5.3   Risk Management Enables Resilience

The third theme that was highlighted from the interviews with senior directors at case study number two, is the role of *risk management processes* in the creation of resilience.

D3 considered risk management processes and procedures as proactive approaches. It is believed that investing time in understanding business risks and having the correct measures to check the performance, are enabling factors of resilience in the company. D3 believed that risk management and resilience are different; with resilience as an ability, when a risk is out there in the market, for the business not to be affected by it.

From D3's point of view:

"If you have got a good risk management process, then hopefully your resilience will dramatically increase".

When faced with the question of "*does risk management eliminate the risk*?" D3 argued that, it did not mean that risk management will take all the risk away, but it can take 75 to 85 percent of the risk away. So, it enables a faster reaction to the unexpected risks and that risk management should massively improve the resilience.

D4 also considered risk management processes, as part of creating resilience capability in the company. It is emphasised that "*one cannot manage what you cannot measure*". D4 explained that;

"*We measure the products against the risk and then we see what can generate the risk. We then use a matrix to see frequency and the impact for that particular risk. Then we put our focus on the things that have a high likelihood of happening or a high impact*".

In D4's opinion, risk managers are people, who are trained to spot risks, that impact the business and actually are tasked in their job to put mitigation plans together.

5.3.5.4 Information Exchange Increases SC Transparency

The fourth and final theme to emerge from the interview responses, is the importance of the *exchange of information* amongst SC partners, that will lead to *transparency of supply chains*. D3 considered this theme as a facilitator to resilience. It is believed that sharing the information (forecast details and challenges) with suppliers, leads to better visibility of the supply chain. However, D3 highlighted that:

"*On the flip side, we want to make ourselves less dependent on them at the same time. We want to keep our supplier in a very competitive place by finding different routes of supply and driving their quality up all the time*".

D3 indicated that case study number two has 2000 suppliers and that, it is not possible to work with all of them in the same way. Instead the company try to work with the top 20 to 30 suppliers, because it is the suppliers in the top percentiles that can have an impact on its business. D4 reported that from the customer side, the organisation has a close relationship with 6 to 10 major retailers. However, stressed that:

"*We probably have got very good relationships at commercial level and category management level for instance. At a supply chain level our relationship is not that strong*".

It is considered that establishing close commercial relationships with major retailers can add to the company's business visibility, which in turn leads to better resilience capability.

5.3.6 Thematic Category: Supply Chain Risk Related Questions

By analysing the responses on the first set of questions (Table *21*), taken from the interview respondents of the third case study company, the following thematic categories were highlighted.

Thematic Categories/Constituents	Number of participants to offer this experience	% Participants to offer this experience
External risks harmful also opportunity	Two	100%
Information flow breakdown creates disorder SC	Two	100%
Financial risks could be more damaging than operational risks	Two	100%

Table 34 Themes emerging from interview questions on risk

5.3.6.1 External Risks Harmful also Opportunity

The first theme to emerge from the interviews is *external business risks*. D5 emphasised that with over 30 years' experience of working in the logistics and transport industry, external threats are the main sources of danger to their business. In his opinion, supply chain risk is related to the safety of the supply chain. This point is reiterated by D5 stating that:

"Supply chain risk is related to the extent of safety of the supply chain, and how safe the systems and processes and solution is to deliver to the customer; based on their supply and demand programme".

Nevertheless, supply chain risk is considered as both an opportunity and threat. It is believed that business risks are always going to exist. With D5 adding that;

"You can't stop the rain from falling, but you can look for holes in your roof".

Therefore, risk can be a threat. However, it can be considered as an opportunity to identify what the risks are and to improve the supply chain performance. From an

operational point of view, D5 named the diesel strike in the year 2000 as an extreme example of an external risk.

"This was a massive example of supply chain risk because it stopped the supply chain virtually dead in its tracks".

D5 named information risks such as *hacking* and *information disappearance* as some of the serious new threats to their business environment.

SM3 concurred with D5 and reiterated that supply chain risk can be considered as both a threat and opportunity. According to SM3, external risks are uncontrollable and that makes them more dangerous to business continuity, while internal risks are more manageable.

"External risks such as strikes or tsunamis are not controllable. Therefore, I would say external risks are much more significant. In case something goes wrong in the supply chain, you are required to put together a new supply chain. In this way, you can build trust. With trust, you can build your relationships, which all leads to a better supply chain".

SM3 who has been working in Third Party Logistics (3PL) and Fourth Party Logistics (4PL) for over 18 years, gave an example, that in 2008-09 in the shipping market, due to oversupply, there was a mass lay-up of vessels. Which then impacted the global supply of materials, which restricted some certain supply routes into the UK. Another present example of risks provided by SM3, is the current re-routing of overland transport, due to French port blockages, related both to migration and industrial action. SM3 reported that, in the case of European transport systems; cross European road infrastructure changes (such as road works/road closures) are not currently factored into overland supply chains. Therefore, these (re-routings) are driving higher inventory holding policies to come into place, intensifying business risk in terms of capacity, cost, obsolescence and security.

5.3.6.2 Information Breakdown Creates Disorder

The second theme to emerge from the interview responses, is the breakdown of *information flow.* D5 indicated that in their industry information is vital.

"Information is the force that triggers the transaction. Information is what causes something to move. By information I mean any kind of information including traceability".

This theme was continued by D5 adding that, their business is global, and is the link that connects supply and demand, as it operates in different countries with different culture and time zones.

D5 named some of the difficulties that poor visibility can bring to them namely:

"Increased inventory cost resulting from inventory build-up, increased freight costs from premium shipping, loss of revenue and demurrage surcharges that are being paid to customers".

D5 mentioned that the level of visibility and information exchange, has a direct effect on the percentage of complete and on-time orders received from suppliers. Also, the number of orders delivered to customers on time in a full manner.

SM3 also considered *information flow* as a vital factor in their industry. Explaining that in his role as the divisional head, it is important to personally engage with suppliers and customers. This was continued by SM3, explaining his role in 4PL business, stating that suppliers play an important role in the success or failure of business. Therefore, there is a procedure in place for selecting global suppliers. SM3 added that he personally travels around the globe and selects their business partners and mentioned that in this industry, the biggest thing that plays against them is time.

"The geographic distances make it very difficult, we have time differences with some of our partners, so we have only one or two hours to communicate".

SM3 highlighted the importance of information flow by adding that, if something goes wrong in the supply chain and news is received from the customers, it will destroy their business and the trust that has been built with their customers throughout the years.

5.3.6.3   Financial Risks Could Be More Damaging Than Operational Risk

The third theme that emerged from the interview responses of the logistics and freight forwarder company, is the *financial risks*. D5 highlighted the fact that, financial risks can have a more detrimental effect than operational risks. Indicating that "*some of the operational risks include energy supply (fuel and electricity)*". Financial risks become more important when partnerships with other companies are entered, as they may not be as equally financially sound, which may result in an increment to their own levels of risk. D5 gave some examples of a supplier in (South America), highlighting the reason that they selected the company, was due to a recommendation from other business partners. D5 added;

"*We needed urgently a partner in that part of the world and we were not able to check the financial profile and capacity of the supplier. Unfortunately, this supplier went down and has affected our business, we had to find a substitute for this agent in a short period of time*".

D5 reported that the company aim to solve any problem in their roots, in less than 24 hours. For example, if something goes wrong now, there is not enough interface into that supplier for it to be corrected instantly. D5 claimed that their approach toward business risks is becoming more proactive compared to previous years.

SM3 highlighted the importance of financial stability in their business and added that in the 4PL business everyone falls into a tier 1 category.

"*We usually conduct a credit check on them and the rate has to be above a certain number. If they are not above that number, then we decide that their business is not viable enough for us and we will not use them as a supplier*".

SM3 added that from a financial point of view, there is simulation software used, which is similar to *Monte Carlo*. A Monte Carlo analysis is one specific multivariate

modelling technique that allows organisations to run multiple trials and define all potential outcomes of an event or investment. Running a Monte Carlo model creates a probability distribution or risk assessment for a given investment or event under review. SM3 mentioned that when a risk comes along and it has to be corrected, it costs money. So, the business would be 70 percent reactive and 30 percent proactive. This is based on SM3's experience and view. It was reiterated that the estimates given are not based on any diagram or algorithm.

5.3.7   Thematic Category: Supply Chain Resilience Related Questions

From the responses to the interview questions on resilience, the following three themes have emerged.

Thematic Categories constituents	Number of participants to offer this experience	% participants to offer this experience
Unambiguous KPI measurement enables control	Two	100%
Visibility across all the supply chain	Two	100%
People (human resources) capabilities	Two	100%

Table 35 Themes emerging from interview questions on resilience

5.3.7.1   Unambiguous KPI Measurement Enables Control

The first theme to emerge from the interview responses is *performance management*. D5 highlighted that in 3PL and 4PL, measuring the performance is paramount. The primary and principal Key performance indicator (KPI) is On Time in Full (OTIF).

D5 added that:

> "*In case study number three, we are running now at 99.975%, this is purely calculated based on delivery time*".

During a visit to the company's headquarters, this figure was verified and SM3 explained the process of measuring this KPI.

"*When the container lands on the quay, we inform our customer that we get clearance within three days and delivery within five days; these are the targets that we need to hit day in and day out*".

SM3 added that in the 4PL section, there is assurance that a margin of flexibility is left within the KPIs, in case of issues that are outside of its control. D5 highlighted the importance of the clearness of KPIs, for all the business partners involved in the process. And added that, in the company there is an extra capacity, that covers them against an unprecedented event. SM3 reasoned that:

"*If something goes wrong with the trucks, then we have the ability to bring the consignment to one of our 13 depots and try to ship them without any delay*".

5.3.7.2   Visibility All Across the Supply Chain

The second theme to appear from the interviews, is the importance of *visibility* in the creation of resilient supply chains. As mentioned in the previous section, information flow breakdown, is one of the main business hazards identified by the interview respondents of the third case study company. D5 highlighted the importance of visibility in supply chains, as one of the building blocks for resilience within the food transport supply chain. D5 also said that if something goes wrong with a new customer, credibility can go out of the window and they will not be used again. Emphasizing that:

"*Although this industry is very big in size and material runs fast up and down our transport routes, the word of mouth of unsatisfied customers runs even faster. We make sure that we are in total control and we do that by using GPS locate for all of our consignments in any given time* ".

D5 added that, technology is advancing at an unbelievable pace and has developed significantly since starting his career over 30 years ago. D5 highlighted this change by stating that:

"New technological advances such as Internet of Things (IOT) is going to improve the visibility, effectiveness and efficiency transport and logistics industry. Consequently, enabling us to operate in a more resilient manner".

SM3 also recognised visibility of consignments, as a fundamental part of creating resilience in logistic routes. Stating that:

"I can track my trucks with my PC or mobile and find out exactly where they are, at any time and moment, so I know this before my customer knows it. In my ocean containers, I work with companies who can tell me exactly where my container is".

During an observational tour of the company headquarters, it was made clear that the company refreshes their system every single morning to see where everything is. SM3 added that, this system and information enables the company to know exactly where the shipments are located, and in this way always be ahead of their customers. D5 highlighted that their Business to Business (B2B) solutions are different to Business to Customer (B2C). The main difference, according to D5, is that in B2C it is possible to track an item, especially for the last mile delivery. Whereas, in B2B it is a component. In line with this, SM3 added that:

"I give my customers a tracking number, where they can see when the container is due to arrive. But, they won't be able to see where the exact location of the container is. We have the detailed information of the container i.e. the vessel, the speed and the location of the container in the cargo ship".

During the company visit, it was noted that the company relies on email communication and telephonic communication with their customers. SM3 added that in the 3PL site, electronic data interchange (EDI) is used. Further adding that, the information in this platform is one way not two ways. For example, the order of several retailers is consolidated, this is called parent and child. For instance, a parent order is received, that says to deliver to ASDA Warrington. Then the child order for each supplier will come up. This is one way, not both ways, meaning that this information is not given out.

5.3.7.3 Human Resources Capabilities and Processes

The third theme to emerge is the company's *human resources capabilities*. D5 believed that visibility, information flow, performance management and relationship management, are essential to have a resilient supply chain. Yet, without the right people armed with the right knowledge and skill set, the before mentioned capabilities cannot be achieved. D5 highlighted the fact that, the case study company invests in staff training. Delivering a wide range of training, because of the importance of knowledge and experience in their industry. By experience, D5 explained:

> "*Having the knowledge and the ability to put the knowledge into practice. Knowledge in terms of educational knowledge and industry experience*".

D5 also gave examples of the career progression in transport planning by stating that although, "*novice transport planners can plan a route for a truck, S/he might not have the contingency planning experience when something goes wrong*".

Therefore, there is a necessity to teach and prepare employees to be able to decide quickly and correctly, when it comes to decision making. D5 reasoned that, their training programmes and supporting activities, have enabled case study number three's group, to retain their staff and reduce the number of staff leaving the company considerably. Stating that, the company has people who have worked all their lives there. Flexibility is added into the organisation, by using similar range technologies in the company owned trucks. In this way, the variation of technologies in the company owned freights is reduced.

D5 recognised risk as an initiator of resilience and claimed that:

> "*Resilience is created as a result of risk. Perceived risk will put something in your supply chain to make it resilient. Supply chain risk management allows the identification of our vulnerabilities. We can then plan a mitigation programme around it*".

SM3 highlighted the importance of having the right staff by adding that:

"*In 3PL business, we have assets that are operating, it is easy to go out there and sell them. But with 4PL, it is an intangible service, because you have to make it and then sell it*".

Both interviewees emphasised that, an employee armed with the right business acumen with a strong ability to evaluate the situations, and take the correct decision is paramount for their industry, especially in 4PL.

SM3 mentioned that, scenarios of possible unpredicted events are run with the team or what SM3 referred to as "*black swan events*". The team are tested on their speed of decision making and the ability to come up with reasonable solutions. Examples of previous scenarios and reports were demonstrated during the visit to the company headquarters. SM3 highlighted that, they have a strong transactional relationship with their customers and have established partnerships with their suppliers.

"*In 4PL if I don't have a supplier, I will go out of business. Having said that, to keep my business and avoid any bypassing from my suppliers, I work closely with my customers, because a lot of things that I have developed are being cross sold. 4PL is a very small industry (number of actors) in the UK and the word goes around very fast*".

Therefore, it is important that staff have a very good understanding of the business environment and are especially effective in communication and relationship building. SM3 highlighted that, the team are experts at establishing the right relationships in place with their business partners. Consequently, a problem can be solved in less than 24 hours. For example, if something goes wrong now, they do have enough interface into that supplier, so that it can be corrected pretty much instantly.

SM3 believed that, where there is a risk, there is opportunity. It is about managing the piece of opportunity. It is about managing the risk and converting it to opportunity. It appears that obtaining a resilient supply chain depends heavily on risk management practices and the organisational capability to use the risk management toward creation of resilience.
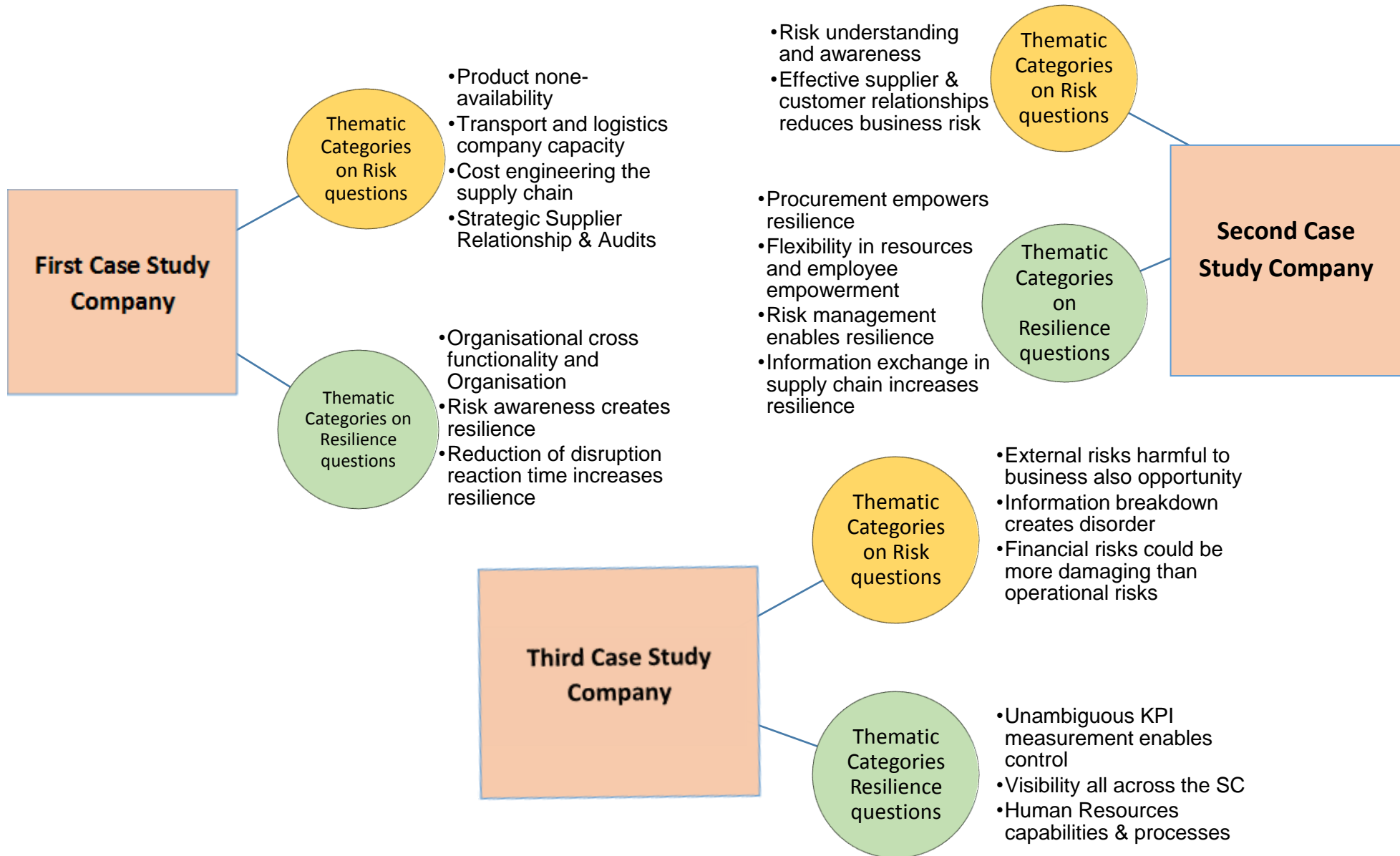
Figure 40 Overview of thematic categories extracted from interviews

5.4 Theoretical Framework: Resilience Building Blocks in British Food Supply Chains

The importance of supply chains, logistics and their management, in delivering a competitive edge for any organisation, was reviewed in section 2.2. In this empirical investigation, the researcher used different types of qualitative data collection tools (semi-structured interviews, observational studies, documentation and archival reviews), to identify the enabling factors of resilience in the major food organisations, that are actively involved within the British farm to food networks. Figure 40 illustrates the themathic cathegories that were extracted from the semi-structured interviews that were held with the interviewees of the case study companies. As mentioned earlier, supply chains entail the following Plan/Develop, Source, Make, Deliver and Return steps in introducing products or services. During the data collection processes carried out on participating case study companies, it was observed that the companies follow the same steps. From the moment of introducing a new product or service through to its life cycle and disposal. The relationship between the interview questions, the research components and the data collection tools was depicted in Figure **3**. As demonstrated in Figure **3**, other data collection tools were used, to verify the extent of existence of each enabling factor, in the steps of food supply chain design. Table **27** demonstrated the research findings and their links with the literature review findings of this research. Figure **41** is the theoretical framework for the enablers of resilience in British food supply chains. The figure below illustrates the enabling factors, that were identified through this doctoral research, and their relationships. Furthermore, it locates each enabler within the most pertinent step of supply chain design.

Plan/Develop

- Anticipating Demand before Introduction of Product
- Product Stewardship
- Visibility and Control
- Food Safety & Security
- Food Market Awareness (risk)
- Cost Engineering SC
- Product End of Life Cycle
- Organisational Cross Functionality

Source

- Procurement Buying Power
- Security in Sourcing/Transport
- Control on Sources of Supply
- Dual Sourcing
- Process Audit
- Flexibility in Sourcing
- Visibility/Information/Communication
- Collaboration & Strategic Alliance with Important Suppliers
- Temperature Controlled Products

Make

- Production Process Uniformity
- Staff Development & Training
- Production Postponement
- Maintenance Programmes
- Abundance of Supply (cold chain)
- Food Security
- Waste Reduction

Deliver/Return

- Food Safety
- Visibility all over the SC
- Traceability of the Products
- Communication with Suppliers and Customers
- Customer Service
- Control over Processes
- Visibility until Disposal

Food SCH Feedback Loop

Food SCH

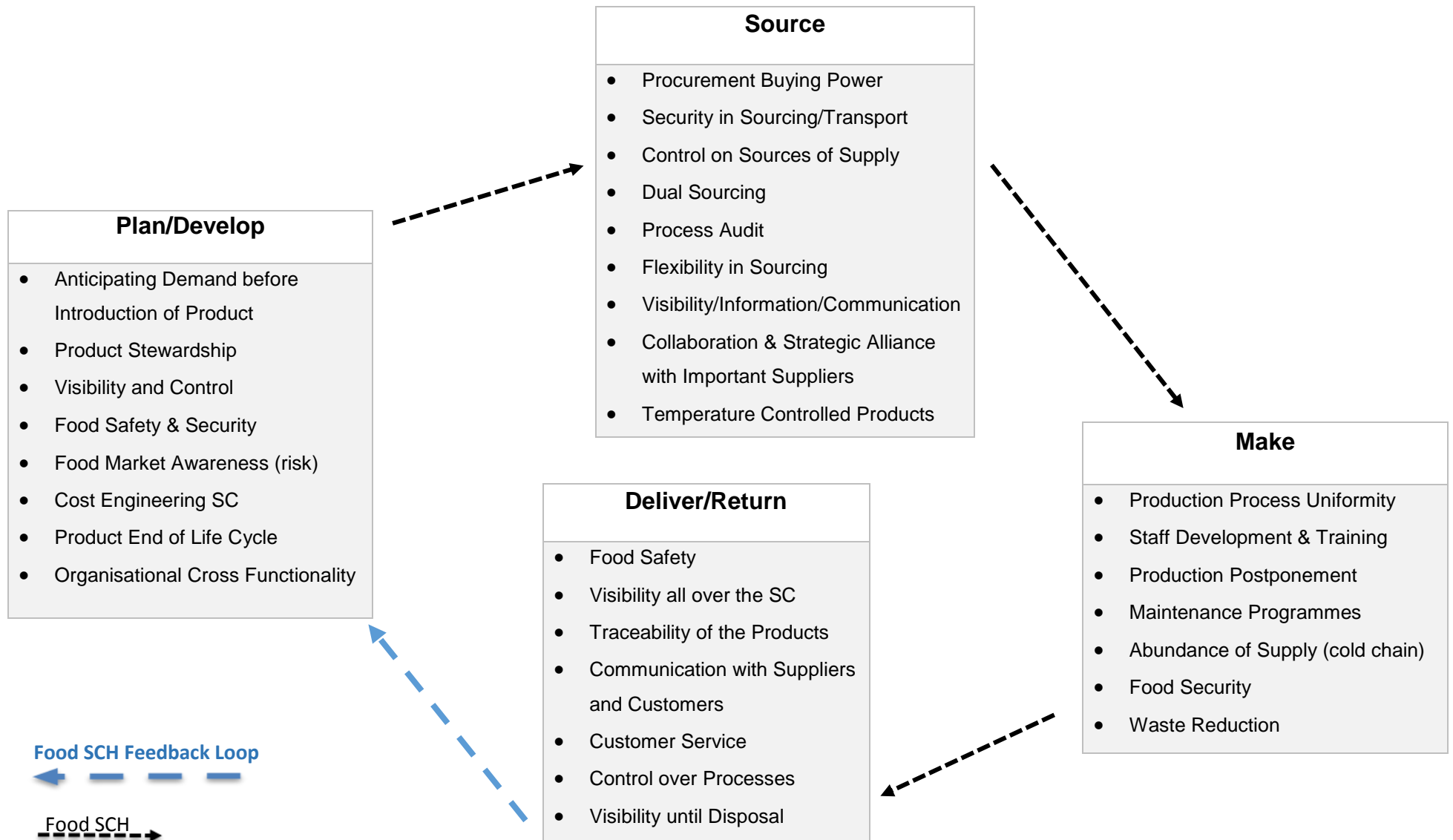**Figure 41** Theoretical Framework: Drivers of Resilience in British Food SC

5.5   Chapter Summary

This chapter commenced with an explanation and justification of the data analyses. The interview responses to each of the interview questions, along with the findings of other complementary data collection methods used in this thesis, were analysed through pattern matching analysis of qualitative data. Thus, the emerging thematic categories were identified and their relevance to the research questions were examined. Furthermore, an overview of the case study companies participating in this empirical doctoral research, as well as the interviewee profile, were presented. The case study companies participating in this research, have their supply chains expanded domestically and globally. More importantly, they have an active presence in the British food market and are the preferred brands with domestic consumers. The first and second case study companies are actively involved with production, processing and food sale in the UK. However, the third case study company is directly involved with multi modal food transport, within the UK and overseas.

As demonstrated in Table **19**, Table *20* and Table *21*; all the interviewees have extensive experience in food supply chains, so the participants presented their personal and professional insights on the topic of the research. The following findings were elicited by comparing the emerging thematic categories of the case study companies.

The first finding was that, none availability of products is an extreme SC risk, identified by the first and second case study companies. The extent of forecast accuracy is of utmost importance for both case study number one and two. As claimed by the interviewees, it is the difference between "*make or break*". Therefore, much time and resources is spent to overcome any possible deviation and to have the orders processed accurately. Hence, it was observed that despite all their best efforts, these organisations are still facing some trouble with the accuracy of their forecasting. Most interviewees believe that forecasts are prepared based on the "*rear-view mirror*" and this makes ordering difficult.

Supply chain risks (especially external risks) have been regarded as major sources of disruption in the food supply chain. Consequently, identification of these risks, and building contingency plans to overcome these risks, is considered as one of the main enablers of resilience in food supply chains. Strategies such as dual sourcing,

redundant supply, risk management processes and simplicity/unification of processes, were identified as the most effective strategies in the creation of resilience.

Another finding is the reliance of food supply chains to logistic service providers. Per the interviewees, the role of these companies towards On Time In Full (OTIF) delivery of products is vital (especially fresh food and temperature controlled food cargo) for the flow of material in food supply chains. This matter is of such importance that case study number two have their own dedicated transport fleet, that transports the baked products between the bakeries and the customer distribution centres. This initiative is justified by the company, as an assurance towards delivering the baked products to the customers, with the highest quality and minimum product handling and tampering. The interviewees from the logistics service provider company, who participated in this empirical research, consider their ability to deliver OTIF as their differentiator, which has a direct link to their reputation.

The importance of visibility at all stages of the supply chain, for all three case study companies, was highlighted by the interview participants. Accordingly, a lack of visibility could result in sporadic lead times, and a disruption to level scheduling processes, that need to be undertaken downstream in the supply chain. Subsequently, adding cost and complexity to an operation, which in turn, causes supply chain shocks, a possible impinge on service and in the case of food, wastage of product.

Senior directors of the case study companies have expressed the centric role of procurement in eliminating silo behaviour between departments, and creating closer relationships amongst their organisation and their business partners. Equally important, is the organisational culture as one of the enabling factors of resilience in their respective organisations. The ease of communication between team members, and the approachability of senior management in the event of any undesired incident, is considered as an enabling factor of resilience within organisations, that function at different stages of the food supply chain. Understanding the business working environment and company supply chain are regarded as factors, that can help the employees to reduce time to react. Therefore, staff training programmes

and running real life scenario exercises, is considered as an empowering factor of resilience.

Another finding is that dual sourcing and flexibility of resources are named as the main strategies of creating resilience in food supply chains. Therefore, case study number one and two have several sources of supply for their mission critical ingredients. All three case study companies have rigorous audit processes, that each supplier needs to undergo on a yearly basis.

The following chapter, discusses the findings of this empirical research. It commences with the research findings, that were mentioned in the body of literature and then continues to explore the specific research findings pertaining to this empirical research.

Chapter Six: Discussion

6.1 Introduction

The aim of this chapter is to discuss the findings of this empirical research, whilst taking into consideration the literary sources, that were reviewed earlier in the second chapter of this thesis. This chapter initially highlights the research findings of this empirical research, that were mentioned across the literary sources and which bridges them together. Furthermore, it will identify the specific findings of this empirical research, that may not have been recognised within the investigated literature and are unique to the context of this study.

The structure of this chapter will be in the form of the research findings, that were derived from the two thematic categories, as explained in chapter Five. Thematic categories were extrapolated from the initial research questions and the literature review.

6.2 Discussion on Supply Chain Risk Related Findings

The first set of interview questions on risk were posed to the interview participants to construe their understanding of supply chain risks. As well as to identify the most pertinent ones and distinguish the differences between supply chain risk management and resilient supply chains.

The integration of supply chain partners in creating collaborative forecasting is regarded as essential. Whilst the type and quality of information shared between the supply chain partners is considered as indispensable for the creation of accurate forecasts (Rajesh & Ravi, 2015). Moreover, the literature on forecasting strategies demonstrates the pivotal role of forecasts in the creation of forecast horizons between manufacturers and retailers. Finally, the group forecasting techniques applied to generate consensus forecasts in *collaborative forecasting* are considered highly important (Eksoz, Mansouri, & Bourlakis, 2014). These points were reaffirmed when the interview participants regarded none availability as one of the major supply chain risks, that can directly affect company performance and considered *none availability of products* as a major result of supply chain risks. Per the interview findings, none availability is a direct result of the *accuracy of the purchase orders*

and *on time in full availability* of products. Therefore, to increase the quality and accuracy of the forecasts; they are sent out 12 months in advance and are updated on a weekly basis to remove any anomalies.

According to Jüttner and Maklan (2011) the impact of one party in the supply chain failing financially, can lead to several entities closing and in some instances the whole supply chain shuts down. The risk implications of the entwined global marketplace, that characterise today's supply chains, have also been evidenced vividly during the recent global financial crisis. Thus, it is claimed that financial weakness can be a risk for the buyer company:

"if a supplier is not profitable, it may not stay in business for very long"
(Zsidisin et al., 2000, p. 188)

According to the findings of this research, *financial risks* can be more detrimental than *operational risks*, especially in the case of the transport industry. Hence, credit and financial account checks prior to engaging in any partnership with the companies, is regarded as paramount. Consequently, the findings of this empirical research have demonstrated that one of the capabilities, that allow companies to ensure continuation of supply is by *cost engineering* their supply chain. According to a senior director of the first case study company, this can be achieved by the reduction of profit chances and investing more in the financial capital of the company. This initiative allows the company to find reliable sources of materials and transportation from suppliers, who under normal circumstances would not be financially justifiable. In addition, a senior director of the first case study company explained that, a simple 3*3 diagram with axels of risk impact, probability of materialization and money, can assist with the decision-making process; in case something goes wrong along the food supply chain.

As noted in the literature review chapter, Christopher and Peck (2004) classify SC risks into three categories: internal to the firm, external to the firm but then internal to the SC network and, lastly, external to the network. While, other renowned academics consider SC risks to comprise of organizational, network and threats of natural or man-made disasters (Ghadge et al., 2012; Jüttner et al., 2003; Lockamy & McCormack, 2010). Meanwhile, Asbjornslett and Rausand (1999) classify threats

to systems according to two key factors which are internal and external. Internal factors include staff factors, maintenance factors, human factors, management and organisational factors, technical failures and system attributes. Whilst, external factors are made up of financial factors, market factors, legal factors, infrastructure factors, societal factors and environmental factors. In this research the interviewees from all three case study companies, stated that the *external risks to supply chains* are more difficult to control and can have a direct effect on product availability. In line with this, interview participants believed that one of the most important challenges of the companies which are active in the food supply industry is, *understanding of the product*, *familiarity with the length of food supply chain* and *the extent of external risks* within their supply chain.

Therefore, similar platforms to the innovative supply chain risk management platform such as Resilience360®, that allows DHL to have '*eyes on the ground'*, operating 24 hours a day, seven days a week, are considered as an essential tool for understanding the ever-changing circumstances within the supply chains. Accordingly, this important resource enables DHL to continuously track, collate and analyse the world's most disruptive events, using this data to inform its, Resilience360 platform (DHL, 2015). Creating such a platform, despite the huge financial commitment, is regarded as crucial for the food industry. The necessity for this type of platform for food supply chains is even more important for the United Kingdom with its £200 billion financial sized food and drinks industry. As mentioned in section 2.4.2 above, there is a £17bn trade gap in UK food supply chains (Figure **25**), which has created complex and diverse threats to the UK food and drinks sector (DEFRA, 2015).

In the wake of Britain's referendum results, which will lead to the UK leaving the European Union, the pressures on British food supply chains to obtain *safe* and *secure* sources of supply has increased. As a result, the concept of *power balance* and *relationship management* among supply chain partners has been given more importance. According to Gaski (1984), power is defined as the capability of an organisation to sway its counterpart's decision-making. The importance of power in the management of supply chain relationships has been stressed by many authors (Ulstrup Hoejmose et al., 2013). Furthermore, it is argued that unevenness in the balance of power is created, when entities with different sizes, financial strengths or

expertise enter a supply chain relationship (Nyaga, Lynch, Marshall, & Ambrose, 2013) resulting in the stronger entity gaining a higher level of the benefits of established relationships (Maglaras et al., 2015; Ulstrup Hoejmose et al., 2013).

Thus, it is construed that this type of imbalance in power amongst supply chain partners, is a negative characteristic of supply chain relationships (Hingley, 2005). The findings of this empirical research extend this beyond supply chain partners. Moreover, it was observed that *buying power* and *buying behaviour* of large companies can not only affect their direct and indirect partners in supply chains, but also affect other companies, that are not in any supply chain relationship with the organisation. The interviewees highlighted this point and gave examples of promotions and price wars by the big four supermarkets, that has adversely affected the availability of products, despite not being linked with these supermarkets.

Another important factor is *collaboration* amongst supply chain partners, such as the relationship between buyer and supplier organisations, which requires *information sharing* between managers from both sides (Pereira et al., 2014). These partnerships are based on co-operation, a full exchange of information, and a commitment to improve quality and reduce price. Although suppliers still need to be highly competitive; under partnership arrangements, cost reductions are achieved through co-operation rather than confrontation. Fearne, Hughes, and Duffy (2001) state that bargaining is not based on price per se, but on how to reach the target price, while maintaining a reasonable level of profit for the supplier. So, the focus of these relationships is on mutual benefit and as a result, trust and collaboration replace mistrust and antagonism. In the eyes of interview participants of the case study companies, the ease of *collaboration* with supply chain partners allows them to identify possible supply chain risks and profit opportunities. It was highlighted that frequent meetings with strategic suppliers monthly and removing the barriers of communication is used to identify cost reduction methods and saving opportunities.

In summary, this research identified *external risks* as a major concern for companies working in the British food supply chain. Accordingly, *none-availability* of products due to various *external*, *internal* factors can effectively distort food supply chains and jeopardise the flow of activities of companies. *Financial strength* of supply chain partners is considered as an essential criterion for entering business relationships,

especially for the transport and logistics companies within the food supply chains. Familiarity, *understanding* and *cost engineering* the supply chain by the reduction of profit opportunities, and investing more into capabilities, can ensure the continuity of supply and a reduction of the none-availability of products. These factors, amongst others, were highlighted in the first set of thematic category.

6.3   Discussion on Resilient Supply Chain Findings

It is reported that one approach to the mitigation of risks is via a closer analysis of organizational culture (Schwarz & Thompson, 1990). *Organizational culture* is well investigated and is defined as the shared and collective beliefs and assumptions as well as behaviours within an organization (Pettigrew, 1979). It is conceivable to view organizational culture as a predictor of supply chain partner riskiness versus non-riskiness (Keltner & Lerner, 2010). Studies on operational management have disputed that uncertainty avoidance, future orientation and performance orientation dimensions of organizational culture are the most relevant in understanding and categorizing the riskiness of actors within the chain of supply (Borekci, Rofcanin, & Sahin, 2014; Naor, Linderman, & Schroeder, 2010). The results of this empirical research restated this and revealed that the organisational culture of the companies can act as an enabler to support organisational resilience. Furthermore, this research highlighted that *organisational cross functionality* and *organisational culture* are essential in the development of a resilient and robust company.

The case study participants reported that, their respective companies are culturally risk averse, and the embedding of a no blame culture in the organisation ensures that any problem is solved as soon as possible. The observational studies conducted in this research demonstrated that, senior managers and directors of the case study companies were easily approachable to their staff, as well as their suppliers and clients. Allowing them to contact and relay any information and situation with ease.

As mentioned in chapter two of this thesis, supply chain risks are increasing and managing supply chain risks has become a more predominant issue for firms. This situation has been exacerbated by several developments, such as globalization and far-flung supply chains, that make supply chain management more challenging. Data breaches, now happening almost daily, were not a huge issue before the digital era.

Risk incidents have gotten more visibility and have had a wider impact, sending stock prices tumbling and tarnishing corporate reputations. With the Internet and social media, bad news travels quickly: melamine in Chinese milk, volcano eruptions, tainted drugs. The notoriety of supply risks has made supply chains become even more critical and certainly better known (Gordon, 2015; Jyri et al., 2014; Marchese & O'dwyer, 2014).

As Annarelli and Nonino (2016) note, it is an undeniable reality that resilience thinking can no longer be associated exclusively with defensive and reactive measures, but must involve the everyday activities of the organisation. Changing its nature and becoming a best practice to also avoid minor (if compared to disasters) problems. For this reason, the managerial challenge is transforming organisational resilience from a set of redundant preventive actions, involving resource management, into a proactive strategy funded on a set of practices capable of fostering the daily effectiveness of operations and processes. The findings of this research have highlighted the importance of *risk management* being regarded as a proactive approach, that allows the organisations to bounce back from any unforeseen event. Having said that, the interviewees have emphasised that, risk management activities cannot eliminate risks within the supply chain, however, they can reduce the probability and impact of risk occurrences.

New manufacturing strategies such as *'lean'* have allowed companies to increase their profit margins by reducing their waste process. Nowadays, these companies are facing two major threats to the effectiveness of this approach. Cost savings that used to be realized from JIT are much lower in the face of increased landed costs, lead times and fragmented global operations. At the same time, complexity is leading to a greater level of risk and disruption (Nexus, 2015). Companies are finding ways to overcome these challenges with new technology and strategies, that make them more agile, like segmenting their supply chains and increasing visibility (Fiksel et al., 2015; France-Presse, 2015; Sheffi, 2015b).

This research has highlighted the ever-increasing pressures on food supply chains and the importance of *visibility* in supply chains, to ensure the smooth function of processes. The interviewees have highlighted that, without visibility the chances that something goes wrong increases and it will take them longer to react. This leads to

damage of credibility and loss of business. New technological advances such as the Internet of Things (IOT) is recognised as a promising enabler for the improvement of visibility, effectiveness and efficiency. Consequently, enabling organisations to operate in a more resilient manner. It was noted that the transport and logistics company, that participated in this research, is using supply chain visibility as a tool that allows them to manage the situations more effectively. Accordingly, they leave a time buffer between the actual location of the shipments and the information that the customer is receiving through the tracking information. This allows the company to adjust and take appropriate actions in-case something goes wrong.

By the same token, *flexibility* and *abundance* in resources were named as enablers of supply chain resilience. It is reported that flexibility, guarantees that through effective responses, the changes caused by the risk event can be solved (Glenn Richey Jr, Skipper, & Hanna, 2009). According to Jüttner and Maklan (2011) flexibility refers to the ability of a system to face, resolve and, if necessary, exploit unexpected emergencies. Furthermore, it has been suggested that flexibility can amount to an organic capability, which also supports sensing disruptions and relates to the event readiness dimension of SC resilience. Consequently, it is believed that flexibility needs to be designed into the SC and is reflected in its structure and its inter-organisational processes, as well as its strategies (Azadeh, Atrchin, Salehi, & Shojaei, 2014).

The research findings confirm that companies are investing in factors (*production process uniformity*, *maintenance programmes*, *staff development* and *training*) that allow them to *switch between the suppliers* or *re-engineer the supply chain*, in case something goes wrong. *Abundant* supply is another strategic disposition of additional capacity and/or inventory at potential pinch points (Resilinc, 2016). It is argued that the extent of supply chain resilience in a company is largely dependent on what options a system has in place to react, when disruption occurs. As well as, how much safety is built into the system; through inventory reserves and redundant suppliers (Azadeh et al., 2014). This research has highlighted the fact that, the most frequent method used by the companies is the *dual sourcing strategy*. This could be the dual approval of manufacturing sites or the dual approval of alternative suppliers within different countries of origin. This strategy will alternatively mean that, if the case study company face any problem with any supplier or manufacturer, they can then

switch volume between those suppliers. Also, other strategies that were mentioned in relation to this were, keeping safety or *buffer stocks* and *fixed price agreements,* that can effectively cover the company during the period of pricing.

The procurement function with its direct role for purchasing specific resources from the external companies of the enterprise required by internal operations, is a primary function by leading companies in different industries. Accordingly, procurement is no longer considered a simple business function accountable for planning, implementing, evaluating and controlling purchase decisions. It also encompasses the management of resources and suppliers (Baily, Farmer, Crocker, Jessop, & Jones, 2008; Chopra & Sodhi, 2014). The role of procurement as an enabling role for resilient supply chains has been highlighted by Pereira et al., (2014). However, they concluded that the creation of supply chain resilience – may be encompassed by not only a procurement effort, but also a set of business function efforts, such as logistics, sales and marketing along members of the supply chain. The outcomes of this research have demonstrated that procurement does play a pivotal role in empowering resilience in supply chains. Accordingly, procurement performs an important role in maintaining the relationships with supply chain partners up and downstream of the focal company. Thus, the procurement function ensures that the forecast is as accurate as possible and suppliers have the highest visibility. Furthermore, the procurement function sets mitigation plans in place for any possible extreme supplier failures.

Another thoroughly researched and documented theory in managerial studies is *trust*. This concept can be used as a method of reduction of opportunistic behaviours, while acting as a vital component for establishing long-lasting relationships, that allow parties to grow from the relationships (Andreas & Carl Marcus, 2013). It is also considered as the corner stone of strategic partnership. Furthermore, some scholars perceive trust as an essential condition for the survival of any commercial system exchange (Skandrani, Triki, & Baratli, 2011). In this empirical research, although the importance of trust in the creation of strategic relationships was highlighted. It was noted that companies use *quality assurance programmes* and companies to verify the processes of their supply chain partners. So, every supplier is checked and goes through an audit program (two types of audit), that checks the suppliers before entering the tender process. "*We trust but verify our suppliers*" as one senior director

of the case study companies reported. Resultantly, supplier audits allow the companies working in the food supply chain not only to have availability, but also to have the same weight and uniformity of products.

In summary, an analysis of the thematic categories on resilient questions has highlighted that *organisational culture* can facilitate the ease of communication, amongst various levels of staff members of organisations, which consequently leads to a resilient supply chain. The capabilities of a *procurement* department in enabling resilience in food supply chains was highlighted and it was claimed that the extent of development of this role is closely related to the ability of the company, to fulfil its orders in the time of a strike of black swan event. Finally, the importance of a *transport and logistics* company regarding fulfilling the orders in a safe and secure manner, were emphasised by the interviewees. This was stressed by the second case study company which run their own haulage fleet.

Chapter Seven: Conclusions

"Rise to the level of events" Winston Churchill

6.4   Introduction

In this final chapter, the conclusions of this empirical research are highlighted, and the main research aim, objectives and research questions are revisited. Finally, the contribution of knowledge and limitations and recommendations for further research are presented.

6.5   Achieving the Research Aim and Objectives

This section reveals the way that the aim and objectives of this empirical research are fulfilled.

The aim of this empirical research was to investigate "resilience" as a form of capability for risk mitigation within British food supply chains. Along with, identification of the influencing factors, that can affect supply chain resilience, such as its enablers, SC vulnerabilities and their interactions. This was achieved by addressing the research objectives in the following manner:

The first objective was to review the relevant sources of literature on the topic of resilient supply chains, defining what resilient supply is, and drawing a line between its similarities and differences to supply chain risk management.

To achieve this objective, the literature review classified various types of supply chain risk/vulnerability, that can affect SC performance. It explored the characteristics of food SCs, especially, with closer attention to the current state of British food supply chain resilience. It was elicited that most of the literature on resilient food SC are concentrated on selected components of food supply chains (mainly agriculture), and do not tend to account for complex cross-level interactions in the farm to table supply chain.

The second objective of this research was to define and draw a conceptual framework, that encompasses all elements of resilient food supply chains.

To achieve this goal, the literature was analysed and it became apparent that, within the overall context of food supply chains, there is a gap in the current understanding of the conceptual meaning of resilience and its operational contributions to food supply chains. The systematic literature review, which was conducted in this research, identified the enabling elements of resilience, that are already known in a wider supply chain context. This helped to develop a conceptual framework, that was later tested in the exploratory research.

The third objective of this research was to explore the components of "resilience" in specific industrial contexts. In this case, British food supply chains, conceptualising the linkage between the enablers of resiliency.

This was achieved by considering governmental reports, white papers and various peer reviewed academic journals with high impact factors. The existing frameworks for resilient SC were evaluated through the findings of the primary data, that was attained through semi-structured interviews. Further data was obtained through secondary data such as documentation, archival records and direct observations, allowing the researcher to triangulate the data from various sources.

The fourth objective of this research was to conceptualise the understanding of, and linkage between, supply chain resilience, organisational capabilities and sourcing strategies within the major UK food supply networks.

To meet this and the previous objective, major companies that have an active presence in the British food SC contributed to this research. The interviewees ranged from senior directors/managers to middle managers in their respective companies, all with extensive experience in the field of food supply chains. Primary data was gathered through face to face semi-structured interviews with the interview participants, as well as, direct observations in visits to the participating case study company's headquarters. Based on the gathered data, various findings were identified and analysed. Some of these have emerged as unique to food supply chains and some of these have already been identified as resilience driving factors within the body of the literature.

6.6   Answering the Research Questions

This empirical research was conducted to answer the following questions: "What is the explicit definition of supply chain resilience and how does it differ from Supply Chain Risk Management? What are the main enabling and inhibiting factors for a food supply chain to become resilient? How do these factors interact and how are they mitigated? To what extent (and why) do these enablers and inhibitors exist within food supply chains in realistic scenarios? What strategies are more advantageous in creating a resilient food supply chain?"

The interviewees had different views on the drivers and definitions of resilience. However, all participants were keen to share their experiences on resilient supply chains. After reviewing the current literature on food supply chains and analysing the interview responses, interesting convergences in the interview responses were identified. Various important factors that were identified in this research are as follows:

➢ Resilience in food supply chains is defined as, supply chains that have a series of competences. In which all actors can, *Recognise*, *Report*, *React* and *Recover,* from any unforeseen event, leading to a *Rapid return* to a similar or better state of performance.

➢ Risk awareness, understanding business threats and vulnerabilities can enable companies within the food industry to become resilient.

➢ None availability of material is considered as a 'make or break' factor in the food industry.

➢ Buying behaviour of major food supermarkets directly affects other companies active in the food industry. Even those that are not their competitor or directly related to them.

➢ The extent of multi-modal capability and capacity of transport and logistics companies in delivering services and to meet the mutually agreed service levels, are regarded as crucial to business stability.

- Information and data exchange capabilities of all actors within the food supply chains were considered pivotal in overcoming unpredictable events.

- The financial strength of the organisation and its partnering tiers in the food supply chains is extremely important.

- The ability to cost engineer the SC and sacrifice profit for performance can allow companies to withstand any unpredictable hiccups.

- Unambiguous Key Performance Indicators between all the parties are regarded as a salient factor, that can increase SC resilience.

- Establishing close relationships with suppliers and customers up and down the SC, can lead to better identification of risks.

- The interview participants indicated that, the process of quality audits, company specific audits, utilising food safety and security certification organisations, are all effective tools to add control and enhance visibility.

- Human resources were regarded as an important enabling factor, that can allow resilience to be generated in the supply chain. Risk awareness, training and preparation scenarios were identified as vital tools, that can prepare staff to react timely and adequately in unforeseen events.

- The procurement function is named as the organisational function, that can boost inter/intra-organisational cross functionality and eliminate working silos.

- Unification of production processes, equipment and machinery, were mentioned as strategies that create flexibility in SC.

- Risk management processes and business continuity programmes are recognised as strategies, that can identify the vulnerabilities in SC and consequently generate resilience capability.

- Multiple sourcing for mission critical suppliers were regarded as one of the most common strategies, used by the case study companies. However, a few participants indicated that they would not block their supplier capacities due to ethical reasons.

- Use of cold chains and cold storage facilities were indicated as solutions for creation of abundance in supply, and creation of buffers within the food supply chains.

- Creation of disruption task forces, that can liaise with supply chain partners and align the processes per the situation, is another strategy, that reduces the time to react in the case study company.

It is important to highlight that, whist many of the enabling factors of resilience have been identified in different realms of study, some of the identified factors are unique to the case of British food supply chains.

The research question also enquires as "to what extent (and why) do these enablers and inhibitors exist within food supply chains in realistic scenarios?" The overall results of this research indicated that the UK, although being one of the pioneering countries in the investigations of resilience, (due to its dependence on food importation and the growing population), is obliged to focus on building resilience, specifically in food supply chains. The literature review and the results of this empirical research indicate that, resilience in food supply chains is still a contemporary concept, which requires further funding and development.

6.7 Originality and Contribution to Knowledge

To the best of the researcher's knowledge and the literature review on resilient food supply chains, this empirical research is the first relating to the identification factors, that are influencing resilience in British food supply chains. The author believes that this research can contribute to an existing body of knowledge by creating a theoretical framework, that can be developed further and tested. To the date of writing this doctoral thesis, very little empirical research on resilience food supply chains in the context of British food supply chains exists. Therefore, this research has contributed to the literature on resilient food supply chains in the context of Great Britain. A developed country with a high level of dependence on imported food.

Following the recent political events (that will potentially change the dynamics of British policy with its European partners and the wider world) and the ever-increasing supply chain threats (natural disasters, transmittable diseases and terrorist attacks), that can directly affect British consumers, there has been an increase in consciousness on food supply chain resilience. This research prolongs previous studies, which were predominately conducted on resilience in different realms of study (agricultural system resilience, environmental resilience, psychological resilience, organisational resilience and manufacturing processes resilience) and provides an understanding for British academics and practitioners, in specific. Furthermore, the results of this study can be generalised to a wider global context; predominately in developing countries where there is a shortage of knowledge in food supply chain management best practices. Additionally, contribution to knowledge has also been achieved, by identifying unique enablers of resilience in food supply chains, and reporting it back to the body of knowledge.

Table **36** exhibits some of the findings that were mentioned in the literature sources and highlights the unique enabling factors identified in this empirical research.

Enabling Factors	Cited in the Literature	British Food Supply Chain
Risk Management	(Golgeci & Ponomarov, 2013) (Dani, 2014, 2015) (M. Kamalahmadi & Parast, 2016) (Macfadyen et al., 2015) (Mandal, 2014)	✓
Cost Engineered SC	✗	✓
Organisation Purchasing Power	✗	✓
Collaboration	(Khan & Sepulveda Estay, 2015) (Jüttner & Maklan, 2011) (Pettit et al., 2013) (Ponomarov & Holcomb, 2009) (Pereira et al., 2014)	✓
Visibility	(Mandal, 2014) (Ponis, 2012) (Wilding, 2013) (Tukamuhabwa et al., 2015) (DHL, 2015)	✓
Organisation Culture	✗	✓
Transport and Logistics Capabilities	✗	✓
Abundant Supply	Christopher & Holweg, 2011) (Spiegler et al., 2012) (Pereira et al., 2014) (Tendall et al., 2015 (Cardoso et al., 2015)	✓
Control	(Khan & Sepulveda Estay, 2015) (Melnyk, Closs, et al., 2014) (Melnyk, Narasimhan, et al., 2014)	✓
Quality Assurance Audits	✗	✓
Flexibility	(Gunasekaran et al., 2015) (Marchese & O'dwyer, 2014 (Ponis, 2012) (Purvis et al., 2016)	✓
Trust	(Dani, 2014, 2015) (M. Kamalahmadi & Parast, 2016) (Pereira et al., 2014)	✓
Security	(Dani, 2014, 2015) (Fiksel et al., 2015) (Pettit et al., 2013)	✓

Table 36 Unique Resilience Building Blocks for British food SC

6.8   Research Limitations

The researcher knows every research study is restricted by certain elements of limitations. Therefore, the writer has followed the best practices mentioned by prominent authors on research methods to overcome these limitations. Nevertheless, it was not possible to control all the factors, that were likely to affect the quality of this empirical study. The limitations of this research are:

- ➢ It was evident that the entrants from the family owned businesses (even those who were in a higher level of organisational hierarchy) were hesitant to share the company's problems with the interviewer.

- ➢ Although three of the most respected companies in the British food supply chain have contributed to this empirical research. The research could still have benefited from interviews with the UK governmental authorities on food supply chains.

- ➢ The case study companies participating in this research were keen to demonstrate their success stories. However, when asked for operations and records of when they had failed, they were reticent about sharing these documents.

6.9   Recommendation for Further Research

Today's global supply chains are under a plethora of economic, political and environmental turbulences. These ever-increasing pressures do affect food supply chains. The United Kingdom due to its dependence on imported food, which is produced in global food supply chains, faces a wide array of serious challenges as mentioned in 2.4.3 above.

This research has impelled many interesting areas that could be investigated in future research. Significantly, with the current change of dynamics in relationships between the United Kingdom and its European community partners, this research could be a starting point for exploring further the concept of resilience, specifically in Agri-food supply chains. The investigator believes that the following areas should be developed further as research areas in the immediate future.

- Further investigation on resilient supply chains and their trade-offs with sustainable production is required.

- Just under fifty percent of the food required by the British population is imported from overseas. Therefore, further research on resilient food supply chains and their role in adding safety/security and a reduction of food waste is required.

- As part of a comparative study, this research could be replicated by involving the major food producers, processors and food retailers that are involved in British food supply chains.

- It is recommended that a similar study is carried out in other European countries, with similar economic size, population and level of dependency to imported food. This will create a horizon scanning across holistic European food supply chains, identifying areas of synergy and development of resilient food supply chains.

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Appendix One: Observation and Documentation Findings

Case Study number one: Observation and Documentation

The researcher alongside his research supervisor conducted the Observational and documentation review for case study number one on Monday 8th of December 2014. The process of conducting interviews was explained in section 4.2.2.

Furthermore, on Friday 12th of December 2014 the researcher visited a company owned store in the Arandale Shopping Centre in which further observations on day to day activities of the first case study company was observed.

Case Study Company One		Date: 08/12/2014 Location: Woking	
Resilience Enabling Factors identified in the Literature Review	***Existence of Identified Factors in Case study #1***	***Enabling Factors Identified in Documentation Review***	***Stage of Food Supply Chain***
Visibility	✓	Process audit	Plan/Source/Make/Deliver
Flexibility	✓	Logistical capabilities	Plan/Source/Deliver
Collaboration	✓	Forecasting and anticipating demand	Plan/Source
Agility		Abundance of supply	Source/Make
Risk Management Culture	✓	Risk management documentations	Plan
Product Stewardship		Waste reduction	Plan/Source/Make/Deliver/Return
Efficiency			
Control	✓		
Anticipation			
Recovery			
Security	✓		
Financial strength			
Trust	✓		
Observations: Security control of processes		Plan/Source/Make/Deliver	
Procurement buying power		Plan/Source	
Production process uniformity		Plan/Source/Make/Deliver	
Training and staff development		Make/Deliver	

Table 37 Observation and Documentation Review Case Study One

Case Study Number Two: Observation and Documentation

The researcher visited the head office of the second case study company in Bolton-Greater Manchester in 3rd March 2015. After conducting the interviews with senior directors of the second case study company, the researcher was accompanied with senior director and production manager of the case study company for a guided visit. The procurement department, production processes, quality control and truck dispatch control room were visited.

Case Study Company Two		Date: 03/03/2015 Location: Bolton	
Resilience Enabling Factors identified in the Literature Review	*Existence of Identified Factors in Case study #2*	*Enabling Factors Identified in Documentation Review*	*Stage of Food Supply Chain*
Visibility	✔	Process audit	Plan/Source/Make/Deliver
Flexibility	✔	Machinery uniformity	Source/make/Deliver
Collaboration	✔	Forecasting and anticipating demand	Plan/Source
Agility		Risk management documentations	Plan/Source/Make/Deliver/Return
Risk Management Culture	✔	Production Postponement	
Product Stewardship	✔		
Efficiency			
Control	✔		
Anticipation	✔		
Recovery			
Security	✔		
Financial strength			
Trust	✔		
Observations: Security control of processes		Plan/Source/Make/Deliver	
Production machinery uniformity		Plan/Source/Make/Deliver	
Training and staff development		Make/Deliver	

Table 38 Observation and Documentation Review Case Study Two

Case Study Number Three: Observation and Documentation

The head quarter of third case study company in Heywood-Greater Manchester was visited on October 1st, 2015. A guided tour into the administrative and operational departments of the company was conducted after holding the in-depth interviews with senior director and senior manager of the case study company. The researcher had the opportunity to observe the real-time truck and load management activities. Freight location and route management processes was explained to the researcher. Table 39 illustrates the researcher findings of documentation review and observations.

Case Study Company Three		Date: 01/10/2015 Location: Heywood- Greater Manchester	
Resilience Enabling Factors identified in the Literature Review	*Existence of Identified Factors in Case study #3*	*Enabling Factors Identified in Documentation Review*	*Stage of Food Supply Chain*
Visibility	✔	Process audit	Plan/Source/Make/Deliver
Flexibility	✔	Logistical capabilities	Source/Deliver
Collaboration	✔	Forecasting and anticipating demand	Plan/Source
Agility	✔	Risk management documentations	Plan
Risk Management Culture	✔	Temperature Controlled Products	Plan/Source/Make/Deliver
Product Stewardship			
Efficiency			
Control	✔		
Anticipation			
Recovery	✔		
Security	✔		
Financial strength	✔		
Trust	✔		
Observations: Security control of processes		Plan/Source/Make/Deliver/Return	
Traceability of Products		Plan/Source/Make/Deliver/Return	
Production process uniformity		Plan/Source/Make/Deliver	
Training and staff development		Make/Deliver	
Customer service		Deliver/Return	
Visibility/information/communication		Plan/Source/Make/Deliver	

Table 39 Observation and Documentation Review Case Study Three

Appendix Two: Participant Information Sheet

[Date of letter]

Dear [Senior Director Title and name]

First, I would like to take this opportunity to thank you and [Case study company name] for your kind support toward my PhD research.

Following on your conversation with my research supervisor (Dr Yiannis Polychronakis) last month, I have prepared the list of the questions that I will be putting forward to you and your team on the [Date of interviews]. I would very much appreciate it if you could review the questions prior to the interview date. Please kindly share with us any observations you may have pertinent to clarity and context of the interview protocol.

[Senior Director Title and name], assuming that most interviewees are available on the day we are happy to hold this as a group discussion or as individual interviews with your managers. We are absolutely happy either way. We expect the former to last approximately 60 minutes and the latter 20 minutes per interviewee. I would very much appreciate it if you could kindly allow me to tape-record the interviews; this will help me to transcribe and analyse the interviews more accurately. If that is a problem, please let me know and I will keep notes instead.

In order to add validity to research findings, research best practice highly recommends utilising other secondary data within the case study organisation. Therefore, I would very much appreciate it if we could have access to some of your organisation's documents (for instance documents pertinent to Supply Chain Strategies, Process Mapping Documents, Supplier Selection and Evaluation methodologies, Supplier Questionnaires, Business Continuity Plans etc.) for screening.

Finally, the University of Salford research ethics committee requires that every interview participant complete an "*Interview consent form*" which I also attach.

Please do not hesitate to contact Dr Polychronakis (0776XXXXX91) or myself in case you require further information.

I am very much looking forward to meeting you on the [Date of Interview].

Pouria Liravi

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Supply Chain Risk- 10 questions

1. What is you understanding of supply chain risk? Do you see it as a Threat or Opportunity?
2. Can you provide some examples of risks (external and internal) in your supply chain operations?
3. Out of those risks which one do you consider more important? How do you see them being relevant to material, money or information?
4. Would you say that those risks are interrelated? If so in what way?
5. Do you have contingency plans in case those risks occur? Which risk mitigation strategies do you use? *
6. How much risk is your company willing to bear and what are the tolerance levels?
7. How much information do you have about the financial and operational performances of your tier1 and tier 2 suppliers and customers? If so how do you use that information?
8. How do you identify, understand, and deal with risks occurring within tier 2 and tier 3 suppliers?
9. How quickly can you and your suppliers implement mitigation plans and ensure the resumption of normal daily operations?
10. Would you consider your approach to supply chain risk management as being reactive or proactive?

Supply Chain Mitigation and Resilience - 6 Questions

11. How do you ensure that customer service levels are maintained when disturbance occurs within your supply chain?
12. In your view, what are the important characteristics (capabilities) that your organisation must possess in order to be able to mitigate supply chain risk?
13. Out of these capabilities which ones do you consider more important? How do you prioritise in developing these characteristics?
14. What does supply chain resilience mean to you, and your organization? Would you say it is different to supply chain risk?
15. In your view, what way does supply chain risk management affect resiliency in supply chain?
16. How do you compare your current relationships (more/less dependent, transparent, etc.) with customers, suppliers and 3PL compared to say a few years ago?

*Supplier collaboration, Dual sourcing, increase inventory levels/safety stocks, written business continuity plans, demand collaboration with customers, forward buying/hedging, DC redundancy, Component substitution, Near-shoring manufacturing, delayed differentiation/postponement, other.

Interview Consent Form for PhD Research *Please tick the appropriate boxes*

	Yes	No
Taking Part		
I have read and understood the participant information sheet dated 21/11/2014.	☐	☐
I have been given the opportunity to ask questions about the project.	☐	☐
I agree to take part in the project. Taking part in the project will include being interviewed and recorded (audio).	☐	☐
I understand that my taking part is voluntary; I can withdraw from the study at any time and I do not have to give any reasons for why I no longer want to take part.	☐	☐
Use of the information I provide for this project only		
I understand my personal details such as phone number and address will not be revealed to people outside the project.	☐	☐
I understand that my words may be quoted in publications, reports, web pages, and other research outputs.	☐	☐
Please choose one of the following two options: I would like my real name used in the above I would <u>not</u> like my real name to be used in the above.	☐ ☐	
Use of the information I provide beyond this project		
I agree for the data I provide to be archived at the researcher's Archive.	☐	☐
I understand that other genuine researchers will have access to this data only if they agree to preserve the confidentiality of the information as requested in this form.	☐	☐
I understand that other genuine researchers may use my words in publications, reports, web pages, and other research outputs, only if they agree to preserve the confidentiality of the information as requested in this form.	☐	☐
So, we can use the information you provide legally		
I agree to assign the copyright I hold in any materials related to this project to Mr Pouria Liravi.	☐	☐

Name of participant   Signature   Date   Pouria Liravi   Signature   Date:

Participant information Sheet

Thesis title: "An empirical study on the building blocks of resiliency in British food supply chains".

This research is being conducted by the underwriter under the supervision of Dr Yiannis Polychronakis based at the University of Salford Business School, Greater Manchester, UK.

In more detail the aim of this study is to investigate "***Resilience***" as a form of Capability for Risk Mitigation within Food Supply Chains. We will identify influencing factors that can affect Supply Chain resilience i.e. its enablers and inhibitors and their interactions. The overall goal of this study is to identify the most influential food supply chain vulnerabilities as well as the pertinent organisational capabilities, which would enable companies to bounce back in unexpected disruption scenarios.

This research will use a case study strategy. The tools for collecting the data are semi-structured interviews. Secondary data will be gathered through screening the company data such as internal strategy or process documents, supplier evaluation tools and supplier questionnaires or business continuity plans.

If you wish to obtain more detailed information regarding this project, please do not hesitate to contact me directly. Alternatively, please note the email and phone number of Dr Yiannis Polychronakis (my PhD supervisor) at the University of Salford: y.polychronakis@salford.ac.uk, Tel: (0) 161 295XX56 Mobile: 0776 XXXXX91.

Pouria Liravi
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Appendix Three: Ethical Approval

University of Salford
MANCHESTER

College of Arts & Social Sciences
Room 633 Maxwell Building
The Crescent
Salford, M5 4WT
Tel: 0161 295 5876

16 December 2014

Pouria Liravi
University of Salford

Dear Pouria

Re: Ethical Approval Application – 140009

I am pleased to inform you that based on the information provided, the Research Ethics Panel have no objections on ethical grounds to your project.

Yours sincerely

Deborah Woodman
On Behalf of CASS Research Ethics Panel