An Operational Framework Using Information Systems to Mitigate Risks and Improve Decision Making in the Manufacturing Industry

Research dissertation presented in partial fulfilment of the requirements
for the degree of
MSc in Procurement and Supply Chain Management

Griffith College Dublin

Dissertation Supervisor: Turlough Kieran

Student Name: Pamela Brigitte Esparza Valerio

August 28th 2020

Candidate Declaration

Candidate Name: Pamela Brigitte Esparza Valerio

I certify that the dissertation entitled: An Operational Framework Using Information Systems to Mitigate Risks and Improve Decision Making in the Manufacturing Industry

Submitted for the degree of: **MSc in Procurement and Supply Chain Management** is the result of the my own work and that where reference is made to the work of others, due acknowledgment is given.

Candidate signature: Pamela Brigitte Esparza Valerio

Date: August 28th 2020

Supervisor Name: Turlough Kieran

Supervisor signature:

Date: August 28th 2020

Dedication

I dedicate my dissertation work to Ian Reddin, who gave me unconditional support and whose words of encouragement and push made me believe in myself even when I doubted of my skills. Thank you for being my partner in this chapter of my life, for your love and kindness and always being by my side in the toughest days when I needed someone to relay on. You have influenced my life in such a positive way words cannot express my appreciation.

A special feeling of gratitude to George Reddin and Mide Quinlan Reddin for being such beautiful kind-hearted people, for giving me advice in every step of my Masters and specially for always making me feel part of their family.

Acknowledgements

Foremost, I would like to express my sincere gratitude to my supervisor Turlough Kieran for the continuous support in my Masters research, for his patience, motivation and immense knowledge.

I would also like to acknowledge the participants in my interviews, who have willingly shared their time and contributed to my research with their extensive knowledge.
Finally, I must express my very profound gratitude to my parents for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis. This accomplishment would not have been possible without them.

Abstract

An Operational Framework Using Information Systems to Mitigate Risks and Improve Decision Making in the Manufacturing Industry

Pamela Brigitte Esparza Valerio

In this study, an Operational Framework for the Manufacturing Industry was shown, which condensates key information and allows supply chain professionals to have a broader perspective on all the elements that compose Supply Chain Operations, as well as the risks within those operations, and a generic Decision-Making approach which can be applied to any of the Drivers of Supply Chain defined in this research study.

This research also found that IS contributes to Supply Chain Operations by enabling the processes to flow in harmony and it was pointed out that they are significant in order to improve communication in an organisation, as well as to be able to identify possible disruptions in the Supply Chain Processes to eventually support supply chain professionals making decisions to mitigate potential risks. It has also been shown that the possibilities of risks in supply chain processes are very broad and are connected to various areas of the company.

The research methodology for this study was of a qualitative nature. The data was collected using semi-structured interviews. Thus, a technique of data display and analysis was implemented to interpret the study's primary outcome.

The main objectives for this research were to develop a clear understanding of how IS can aid in better decision making to support manufacturing companies improving Supply Chain Operations flow; to Identify the drivers in the Supply Chain that support Supply Chain professionals to make decisions; to provide a clear visual relationship between the drivers of supply chain, taking into account the supply chain processes for risk prevention and decision making; and to eventually develop a framework that can support risk mitigation and decision making in the Supply Chain Processes.

Table of Contents

List of Figures

1 Introduction

1.1 Overview

The present research study focuses on the fields of Supply Chain Management (SCM), looking at how the Drivers of Supply Chain, Information Systems (IS), Decision Making and Risk Mitigation are connected and work together to improve the Supply Chain Operations flow.

Bozarth and Handfield (2019), notes that SCM is the active management of supply chain activities and relationships to maximize customer value and achieve a sustainable competitive advantage. Besides, it represents a conscious effort by a company to develop and run supply chains in the most effective and efficient ways possible. Therefore, this research aims to develop a new Operational Framework to improve Supply Chain Operations processes, focusing on the Manufacturing Industry.

The definition of manufacturing sector includes economic units mainly dedicated to the mechanical, physical or chemical transformation of materials or substances in order to obtain new products; to the serial assembly of manufactured parts and components; to the serial reconstruction of industrial, commercial, office and other machinery and equipment, and to the finishing of manufactured products through dyeing, heat treatment, plating and similar processes (INEGI, 2020).

1.1 Research Purpose

Essentially, by creating a new framework it is expected to have a clear understanding of the importance of IS to improve visibility and responsiveness in SCM, focusing specifically on the Decision-Making processes and risk mitigation. This framework will provide a clear visual relationship between the drivers of supply chain and supply chain risks to improve decision making.

In this research study, it will be possible to find new aspects of the supply chain that were not being accounted for in the decision making and risk mitigation processes in the existing literature, and that is how it will be possible to expand an analysis between the real-life context in the Manufacturing Industry with the existing theories and concepts, as a result of this analysis the outcome will be an improved and expanded operational framework.

Ultimately, the main questions that will guide this research are:

1) What is the relationship between the drivers of supply chain and supply chain risks for decision making?
2) How do IS contributes to Supply Chain Operations?
3) How will this framework improve the Supply Chain processes in a company?

1.2 Significance of the Study

According to Deloitte (2020), manufacturers are at continued risk for disruption. Indeed, the coming year promises to be an ever-changing environment for manufacturers as they seek to recover their footing amidst continued volatility in costs. While the potential for uncertainty may continue for the foreseeable future, manufacturing leaders should begin examining current supply networks and considering how they could build additional agility throughout, including adding digital technologies that improve visibility and transparency to drive the ability to flex production and resources as required.

Bozarth and Handfield (2019), emphasize that Operations Management refers to the planning, scheduling and control of the activities that transform inputs into finished goods and services. Actually, through sound operations management, organisations hope to provide the best value to their customers while making the best use of resources.

Accordingly, in order to develop a framework that can help make decisions to optimize the supply chain, it is important to analyse its operations. Chopra (2019) identifies six divers of the supply chain performance: (1) Facilities, (2) Inventory, (3) Transportation, (4) Information, (5) Sourcing and (6) Pricing.

Furthermore, IS are used to gather and analyse data, therefore they can help to better understand the behaviour of the drivers previously mentioned. IBM (2020) noted that 60-70% of finance and operations teams' time, is spent on data collection and validation. This is valuable time that could be spent on transforming data into information that can assist the managers to gain better insights from each step of the supply chain, in order to make more informed decisions based off the data gathered.

IBM (2020) noted that 60% of Sales & Operations professionals say they lack timely data. The Supply Chain goes through constant changes, and they are too vulnerable to rely on out-of-date information, which is why it is vital for managers to have IS to be able

to develop strategies, improve visibility and response time, to any event that may affect the processes co-ordination flow.

Christopher (2016) argues that there are five sources of risks across the Supply Chain Network. Which are; (1) Supply Risk, (2) Demand Risk, (3) Process Risk, (4) Control Risk and (5) Environmental Risk.

The supply chain can be affected by different areas of the company as it works together with different departments, and if one part of the chain is affected as a result, the other parts of the chain could also be affected. Therefore, the companies should focus on improving the supply chain visibility to develop strategies that can improve co-ordination within the different areas in the chain. These strategies can be developed through the use of IS by maintaining constant monitoring and control and obtaining real-time information, which allows managers to analyse the processes, to identify bottle necks and possible disruptions. Consequently, Technological, Financial and Physical resources are the main pillars to consider in order to develop this Framework.

This operational framework may be adapted and variable in its implementation time, depending on the needs of a company, based on the phases of decision making in supply chain mentioned by Chopra (2019), which are: (1) Supply Chain strategy or design, (2) Supply Chain planning and (3) Supply Chain operation.

1.3 Research Objective

The aim is to investigate how IS can aid in better decision making, so that I can develop an operational framework to support manufacturing companies to manage the Supply Chain Operations.

The objective is to identify and assess the drivers in the Supply Chain, which will support Supply Chain professionals managing Supply Chain Operations by taking more qualitative and accurate decisions whilst also mitigating risks.

Figure 1 (Soni and Kodali, 2008) demonstrates how the Supply Chain Management (SCM) concept has emerged through time, from being a war strategy to a business domain, shifting from physical distribution management, to logistics, to integrated logistics, and eventually to SCM.

Figure 1: Supply Chain Management definitions

Year	Author	Definition	Focus of Definition
1982	Oliver and Webber	Supply chain management covers the flow of goods from supplier through manufacturing and distribution chains to end-user.	Flow of goods.
1990	Ellram and Cooper	SCM is an integrative philosophy to manage the total flow of distribution channel from supplier to ultimate user.	Integration and flow of goods.
1994	Berry *et al.*	SCM aims at building trust, exchanging information on market needs, developing new products, and reducing the supplier the supplier base to a particular Original Equipment Manufacturer (OEM) so as to release management resources for developing meaningful long-term relationship.	Relationship management, agility and information exchange.
1998	Lambert *et al.*	SCM is the integration of the key business processes from end user through original suppliers that provides products, services and information that add value for customers and other stakeholders	Integration, value addition and holistic approach
2003	Simchi *et al.*	SCM is defined as a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandize is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements.	Integration, efficiency and responsiveness.
2006	Handfield, Bozarth	SCM is defined as the active management of supply chain activities and relationship in order to maximize customer value and achieve a sustainable competitive advantage. It represents a conscious effort by a firm or group of firms to develop and run supply chains in the most effective and efficient way possible.	Value maximization, competitive advantage and network of supply chains.

Source: Adapted from (Soni and Kodali, 2008)

The term SCM was first noticeably used by Oliver and Webber in 1982. SCM principles were put into practice by Kurt Salmon Associates in 1985. They focused on delivery lead time, and then devised ‘quick response strategy’. In this, manufacturers and suppliers worked together with a common goal of responding quickly to consumer needs by sharing information. Later, Electronic Data Interchange (EDI) was developed, which supported the success of this strategy. (Soni and Kodali, 2008)

In 1990, Ellram and Cooper described SCM as a function, integrating philosophy in a supply chain. Berry et al. (1994) focused more on maintaining long-term relationships between members in the supply chain. Lambert et al. (1998) and Simchi et al. (2003) accentuated on the holistic view i.e., the importance of overall optimization in supply chain, rather than functional optimization, thus adding one more aspect to SCM.

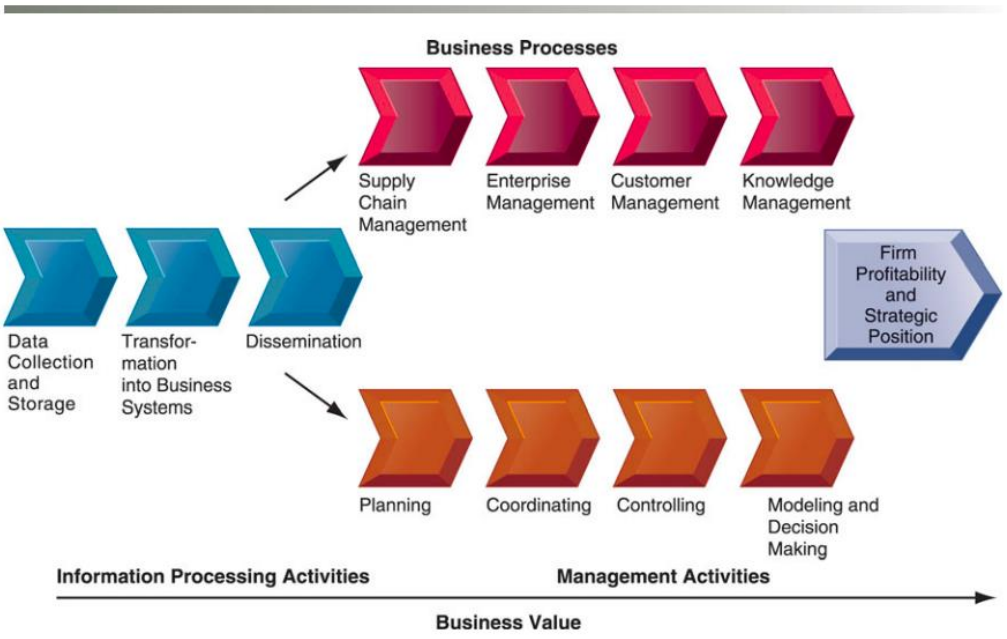
Ultimately, Handfield (2006) described SCM as one that focuses on competing supply chains in which all players of a supply chain thrive to maximize the value transferred to their customers. As a result of the evolution of the SCM concept, the implications of the supply chain have evolved, and because of this, as we can see in Figure 1, more responsibilities and new activities have been put in charge of SCM, which makes it more complicated to manage, and increases its costs.

As a consequence, total supply chain costs are the bulk of operating expenses for many companies, and in some industries it approaches 75% of the total operating budget. Therefore, reducing supply chain costs can have a major impact on the company profitability. (Laudon & Laudon,2012). Ultimately, due to globalization and the growth of markets, SCM has become more complex, and one of the best tools to handle large amounts of information and control constant changes, are IS.

There are a lot of different definitions for IS. However, Laudon and Laudon (2012) define IS as interrelated components working together to collect, process, store, and disseminate information to support decision making, coordination, control, analysis, and visualization in an organization. As a result, they support managers and workers to analyse problems, visualize complex subjects, and develop strategies.

Looking at the business information value chain (Figure 2), it is possible to visualize the chain starting from the information processing activities, to the business processes and management activities, involving the analysis of information, in order to achieve the company’s profitability and strategic position.

Figure 2:The Business Information Value Chain



Source: Laudon & Laudon,2012

In other words, from a business perspective, IS are part of a series of value-adding activities for collecting, transforming and distributing information that managers can use to improve decision making, re-enforce organizational performance, and consequently increase the company profitability.

As can be seen in the background and in Figures 1 and 2, there is a connection between SCM and IS in decision making. Essentially, the areas that relate to this research are SCM, IS in Supply Chain and Strategy.

Currently there are many frameworks to support the processes of decision making in business, but within these frameworks, they have not specifically taken into account, all the aspects that need to be considered, to make better decisions in SCM. There are no explained relationships between the connection of the supply chain drivers, taking into account the supply chain macro processes for risk prevention, and deciding the time in which a decision will be effective depending on whether it is long, medium, or short term. For this reason I would like to develop an operational framework that involves this connection, to be able to make more accurate decisions and help to optimize the supply chain.

Ultimately, the main objectives for this research are:

- Develop a clear understanding of how IS can aid in better decision making to support manufacturing companies improving Supply Chain Operations flow.
- Identify the drivers in the Supply Chain that support Supply Chain professionals to make decisions
- Provide a clear visual relationship between the drivers of supply chain, taking into account the supply chain processes for risk prevention and decision making.
- Develop a framework that can support risk mitigation and decision making in the Supply Chain Processes.
-

1.4 Structure of the Study

This dissertation is structured into 5 chapters, each relating to the research objectives and contributing to the process of exploring the research study.
The first chapter presents and introduction to the research, the research purpose, significance of the study and objectives.

The second chapter provides a literature review on IS in Supply Chain, Drivers of Supply Chain, Risk Management process and Decision-Making process. This chapter includes a conceptual framework that encloses the most important aspects from the literature review in order to explore and test the research study.

The methodology and research design chapter clarifies the strategy and methodology used to collect the qualitative data. An abductive approach was taken for the purpose of this research and online interviews were conducted as a data collection method.

The findings chapter provides and discusses the findings of the qualitative data. This chapter is designed to explore the results of the study, the reliability and the researcher's assumptions based on the interviews responses.

The final chapter includes the implications, limitations as well as recommendations for future research to indicate how a research similar to this can be undertaken in a better perspective. At the very end, the references and citations used for this research are included.

2 Literature Review

2.1 Introduction

The literature review has been structured by first looking at the core terminology, including the Divers of Supply Chain Performance, IS in Supply Chain, Supply Chain Risks and the Decision Phases in a Supply Chain; followed by the concepts and theories that frame the conceptual framework for this research study, which includes Information Value Chain, Types of IS, ISO:31000.2018, Four Critical Pillars to build SRM maps, SCOR Model and the Decision-Making process.

2.2 Core Terminology

- **The Drivers of Supply Chain Performance**

According to Chopra (2019), there are six drivers in the supply chain performance and they are divided into two groups as below:

A. Logistical Drivers:

1. Facilities
2. Inventory
3. Transportation

B. Cross-Functional Drivers:

4. Information
5. Sourcing
6. Pricing

The Logistical Drivers are responsible for the effective production, storage and movement of goods, and the Cross-Functional Drivers play a role in every supply chain activity, and each of these drivers affect the balance between responsiveness and efficiency. Therefore, it is important for managers to make accurate decisions to better design the structure of the supply chain.

Regarding to Facilities, Chopra (2019) refers to them as physical locations in the supply chain where products are stored, fabricated or assembled. He makes a valid point stating companies have the opportunity to increase responsiveness by increasing their number of facilities. Thus, making them more flexible, or increasing capacity because they are able to provide a better service and improve times in deliveries. However, by focusing

on improving the response time he is not addressing that the companies have to make a large investment on acquiring resources to make this possible. So this may not be feasible for many companies.

Regarding Inventory, Chopra (2016) includes all raw materials, work in process and finished goods within a supply chain and argues that inventory is the result of a mismatch between supply and demand. He maintains that a higher level of inventory facilitates a reduction in production and transportation. I agree, however, this decision increases the holding inventory cost. Since this research is focusing on the Manufacturing Industry and many of these companies handle much inventory, it is crucial to also consider the holding cost of inventory. Also, if a company is not able to have high levels of inventory, they have to consider the possibility of losing sales in a situation where they don´t have stock available for their customers due to low inventory levels.

In terms of Transportation, Chopra (2019) refers to the action of moving inventory from point to point in the supply chain. He claims that faster transportation is more expensive, but allows a company to be more responsive. Although a valid point, he also needs to consider that not all companies have the budget to pay for expensive transportation. The available resources will dictate the decisions made.

Chopra (2019) also suggests that supply chains using faster transportation may carry lower inventories and have fewer facilities. One question that needs to be asked, is whether this option is convenient for the company, since some companies like having more facilities, to make distribution more flexible and be closer to the customer. So although having faster transportation supports in reducing inventories and facilities, it is important to align the companies strategies and objectives in order to make better decisions.

According to Chopra (2019) the term *Information* in the supply chain, consists of data analysis concerning facilities, inventory, transportation, costs, prices and customers throughout the supply chain. He suggests that major information related decisions include formulating a demand plan, as well as a sales and operations plan, that optimally matches supply and demand. However, this concept involves potential measurement errors, because it is focusing on planning. It is also necessary to consider a possible distortion of the information between the different stages in the supply chain. So communication becomes paramount in the organisation for activity coordination.

The term *Sourcing* according to Chopra (2019), refers to the choice of who will perform a particular supply chain activity such as production, storage, transportation, or information management. He argues that the major sourcing related decisions, include deciding if an activity will be insourced or outsourced. I agree that it would be the first decision to make when it comes to sourcing. One question in this case, is whether it is more convenient for the company supply chain flow and budget to perform an activity in-house, or outsource it and also do research to identify if there are suppliers able to provide the product or service needed.

Consequently, all the divers previously mentioned will help dictate the sales and marketing team on product pricing. This will change depending on demand and marketing strategies implemented in the company. Ultimately, by coordinating the six drivers of the supply chain, I agree that a company can achieve a balance between responsiveness, effectiveness and increase the company´s profits.

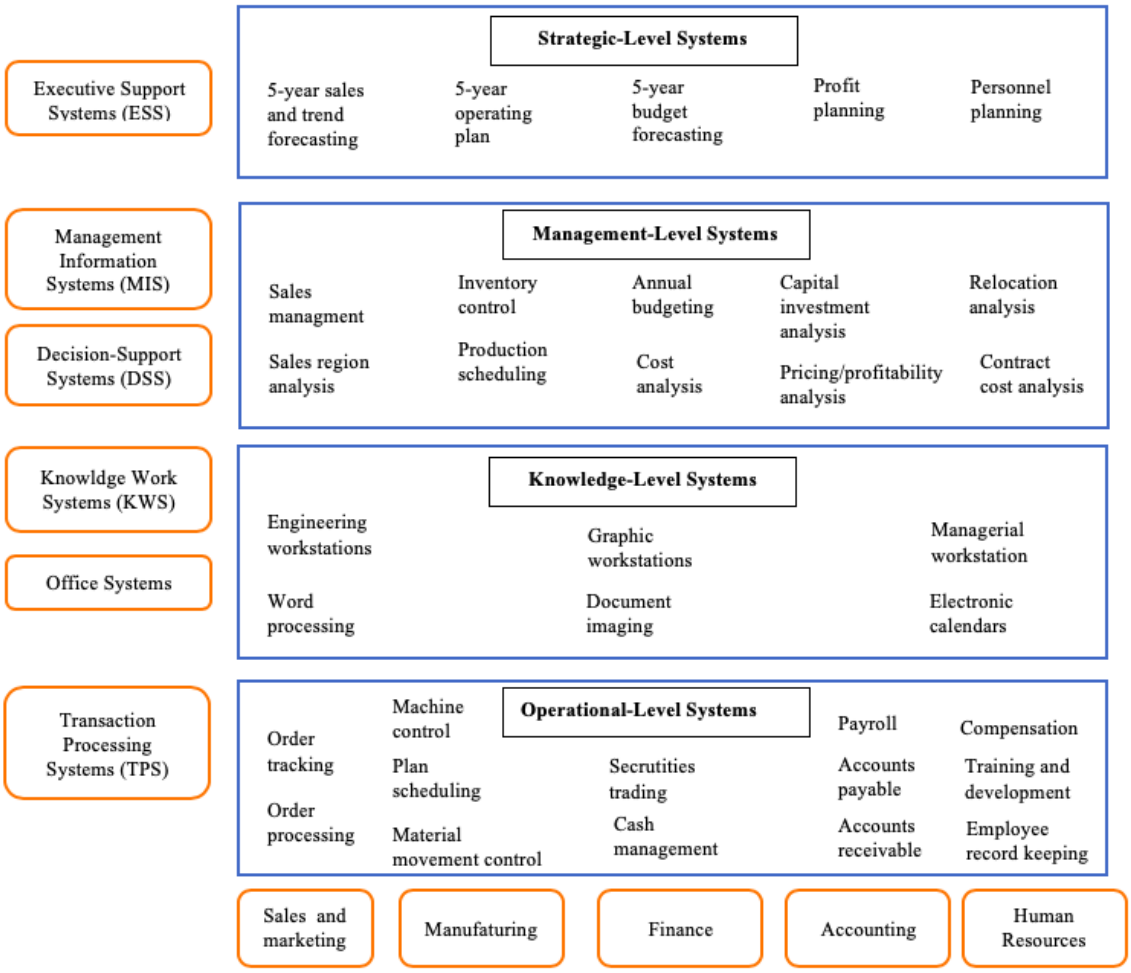
- **Information Systems in Supply Chain**

Olson and Kesharwani (2009), argue that information represents the organisations tangible and intangible resources and the transactions related to those resources, which influences the way the business operates. Accordingly, if the right information is delivered to the right person, in the right manner, and at the right time, it can contribute to change and make organizational effectiveness and competence more certain. Furthermore, Olson and Kesharwani (2009) agree that an information system is the mechanism used to deal with and control the information resource. They describe IS as a set of interacting artefacts and human activities that perform one or more functions involving the handling of data and information, including data collection, creation, editing, processing and storage; and information selection, filtering, aggregation, presentation and use.

⇒ Types of Information Systems

According to Olson and Kesharwani (2009) there are different types of IS which can be observed below in Figure 3.

Figure 3: Types of Information Systems



Source: Adapted from (Olson and Kesharwani 2009)

This Framework defines four different Systems Levels, which are: Strategic-Level Systems, Management-Level Systems, Knowledge-Level Systems and Operational-Level Systems.

Moreover, each level is classified further into six types of systems. First, the Executive Support Systems (ESS), which are useful for planning in the long term. I agree with the authors in this point of view since the decisions for a business in the long term should be

taken carefully by the high executives with experience in the companies and after analysing every points of risk, in this research especially focusing in Supply Chain. Then the Management Information System (MIS) and Decision-Support System (DSS) are classified in the same category which focuses more on managers taking decisions for their teams and analysing information obtained from different areas of the company. Although decisions are made in all the different levels of the organisations, the management level decisions play a critical part of the way companies operate, which are based on the information analysis made by the managers who receive support from an Information System to make more accurate decisions. Furthermore, Knowledge Work Systems (KWS) and Office Systems support knowledge and data workers to design products, distribute information and handle paperwork in an organisation. In addition, the Transaction Processing Systems (TPS) which refer to the operational systems for each area in a business, keep track of the fundamental activities and transactions of the company. In other words, they support the day to day activities.

By focusing specifically in Supply Chain it is possible to compare the types of IS with the previously mentioned phases of decision making in supply chain considered by Chopra (2019), which are: (1) Supply Chain strategy or design, (2) Supply Chain planning and (3) Supply Chain operation. There is a similarity as in the type of decisions made in each level of the business, I agree with the authors separating each area of the business and the type of decisions taken and I believe that this analysis is based on the level of responsibility that is carried from the strategic to the operational levels, which all have an essential purpose in an organisation.

In short, it is possible to say that IS are a valuable tool for every area of a business and that is why in order to develop a framework for this research it is essential to consider the important role that IS has when it comes to decision making and risk mitigation.

- **Supply Chain Risks**

The supply chain risks, according to Christopher (2016), takes into account five main resources of risks across the network which are; (1) Supply Risk, (2) Demand Risk, (3) Process Risk, (4) Control Risk, (5) Environmental Risk. These risks are an adaptation of the supply chain uncertainty cycle from (Manson and Towill,1998).

Christopher (2016) is correct in mentioning that is important for senior management to understand that the risks are directly and indirectly impacted by the strategic decisions that they take. This point needs to be emphasised, as it is essential for a company to align their strategies with current and possible future risks for the supply chain. This is why it is important to have information available, to improve the decision making for a business, and have a bigger picture of every area in the supply chain.
In short, risk management must be part of the decision-making process. It deals with uncertainty. It is based on having the best possible information. It must be dynamic and must adapt to possible changes and it contributes to the process of continuous improvement of the company.

- **Decision Phases in a Supply Chain**

Chopra (2019), categorizes the decisions in the supply chain in three phases: (1) Supply Chain Strategy or Design, (2) Supply Chain Planning and (3) Supply Chain Operations. In other words, long term, medium term and short-term decisions.

Strategic decisions, relate to the design of the supply chain. They have a long-term affect which lasts many years. Planning decisions span a duration of several months to one year. Operational decisions vary from minutes to days which include production and the filling of specific orders. (Chopra,2019).

He emphasises that successful SCM, involves various decisions concerning the flow of information, goods and the budget available. I agree on this point, although, a lot of companies have the intention to improve their processes but in many cases, they lack the budget or information in order to improve operations, which is why in this research, the relationship between IS and decision making, it is being studied.

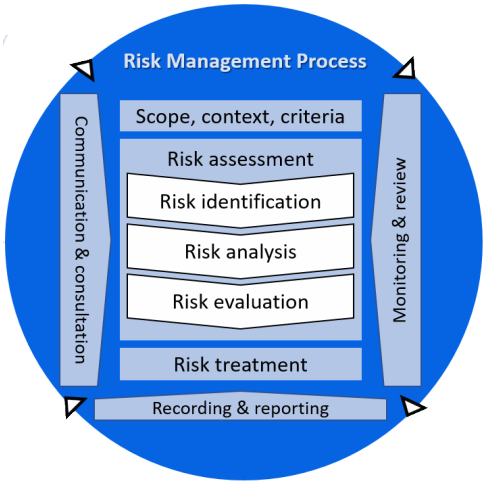
2.3 Risk Management Process

- **ISO: Risk management-Principles and Guidelines**

ISO 31000 *Risk management – Guidelines* was developed by the ISO Technical Management Board Working Group on risk management. It provides principles, a framework and a process for managing risk. Using ISO 31000 can help organizations

increase the likelihood of achieving objectives, improve the identification of opportunities and threats, and effectively allocate and use resources for risk treatment. (ISO,2018)

Figure 4:Risk Management Process



Source: ISO, 2018

This framework aims to identify a company's exposure to uncertainty and mitigate risks. By analysing the Risk management process in Figure 4 although it is not directly mentioned in the framework, risk management process should be an integral part of management and decision making and integrated into the structure, operations and processes of the organization.

The risk management process has many applications within an organization. It can be customized to achieve objectives and suit the external and internal context. For instance, the ISO 31000 Risk Management framework can be applied to the activities of the supply chain.

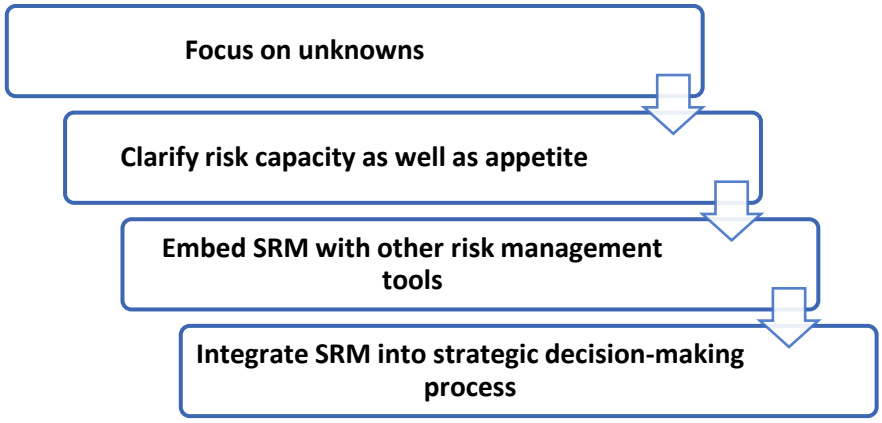
- **Strategic Risk Management**

Strategic Risk Management (SRM) is a set of principles, processes, teams and tools that allow firms to manage strategic risks, which are those uncertainties, events and exposures that create threats or opportunities to expand their core competitive advantages (Godfrey *et al.,* 2020).

In fact, Godfrey et al., (2020) argue that building the right mental maps is essential for making SRM an effective effort and helping organisations to make more precise decisions.

However, as it can be observed in Figure 5, successful SRM maps build on four critical pillars that stand as compass points to define and give direction.

Figure 5:Four critical pillars to build SRM maps



Source: Adapted from (Godfrey et al., 2020)

Firstly, focus on unknowns refers to the process of identifying and assessing strategic risks so that they can be monitored and managed, either mitigated or exploited. Accordingly, searching out uncertainty is the first principal of the SRM mental map, and to achieve that task, teams must focus on unknowns.

Secondly, risk appetite refers to a subset of capacity and should specify how much a company is willing to invest in any single project or initiative. Risk appetite helps leaders develop a strategic risk profile and the optimal balance between risk and return. It also helps to prioritize among competing needs and opportunities and to make smarter choices around both strategy and implementation.

Nonetheless, when risk appetite flows from risk capacity, boards and executive teams have a holistic perspective that informs decisions about responding to strategic threats and pursuing opportunities.

Thirdly, embed SRM with other risk management tools point out the Enterprise Risk Management (ERM) and Traditional Risk Management (TRM).

SRM and ERM complement each other in two ways. First, ERM provides an organisation wide capability for thinking about risk, while SRM attends to uncertainties. Second, ERM helps companies preserve existing value, while SRM aids in the search for creating new value.

TRM and ERM provide important threat prospection tools as they ensure compliance with existing rules and regulations, design systems to avoid risks and hazards when possible, and adequately mitigate or transfer known risks through insurance, hedges, or other financial instruments. On the other hand, SRM allows an organisation to frame, consider and respond to new strategic uncertainties in their environment.

Finally, Integrate SRM into strategic decision-making process focuses on how SRM and the organisation´s existing strategic planning function complement each other.

SRM complements traditional strategic planning because it requires a clearly communicated vision of competitive advantage to do its own work. The clarity and open communication around strategy spills over to other functions, including strategic planning, and allows those functions to do their jobs better.

In general, the compass points previously mentioned are useful for the organisations to develop a mental map as a guidance to decide how to act when facing uncertainty and prevent and identify risks in supply chain. I believe that the authors of the four pillars are right about incorporating risk in decision making. In this research, these compass points can be used to give direction to this study on how to analyse information before determining a solution to any issues that come up within the supply chain.

- **Researchers' Perspectives on Supply Chain Risk Management', Production & Operations Management**

This is an empirical research, presenting a study of the diversity from the perspectives of operations and SCM. For this research (Sodhi et al., 2012) surveyed two focus groups (members of Supply Chain Thought Leaders and International SCRM groups) with three questions as we can see in Figure 6.

Figure 6:Supply Chain Management Questionnaire

Questionnaire for the First Survey (SCTL and ISCRiM)

No.	Questions
Q1	What is supply chain risk management (SCRM)?
Q2	How is SCRM different from supply chain management?
Q3	What is the link between SCRM and Enterprise Risk Management (ERM)?

Response to Q1: What is Supply Chain Risk Management? (*N* = 42; Some Responses Fell into More Than One Category)

Q1: What is supply chain risk management (SCRM)?	
Dealing with supply-demand stochastic (probability)	33.3%
Dealing with risk within supply chain operations	31.0%
Focus on low probability-high impact events	19.0%
Dealing with the unknown	14.3%
Dealing with disruptions/disasters	11.9%
Dealing with risk within supply chain strategy	7.1%
Dealing with stochastic, but need new probability-based approaches	4.8%
Dealing with financial risk	4.8%

Response to Q2: How is SCRM Different from Supply Chain Management (SCM)? (*N* = 42 Respondents. Some Responses Fell into More Than One Category)

Q2: How is SCRM different from supply chain management?	
SCRM is a subset of SCM	52.4%
SCRM is a subset of SCM, with additional focus on risk elements	28.6%
SCRM has something outside SCM	16.7%
SCRM is a subset on SCM but additional focus on supply sources	2.4%
SCRM overlaps with SCM and risk management, finance	2.4%

Response to Q3: What is the Link between SCRM and ERM? (Percentage was Calculated out 31 Respondents. Some Responses Fell into More Than One Category)

Q3: What is the link between SCRM and Enterprise Risk Management (ERM)?	
SCRM is a subset of ERM	41.9%
SCRM is an extension of ERM	32.3%
SCRM is separate from ERM	19.4%
SCRM is the overlap between SCM and ERM	9.7%

Source: Adapted from (Sodhi *et al.*, 2012)

By looking at the results, it is possible to observe that there are many different answers around the meaning of Supply Chain Risk Management (SCRM) in question one. Although the people who answered this questionnaire are professionals, they have a different understanding of this concept. In question two, the diversity decreases as more people have similar ideas about the difference between SCM and SCRM. However, in question three, the answers show that there is a better idea between the link of SCRM and Enterprise Risk Management (ERM).

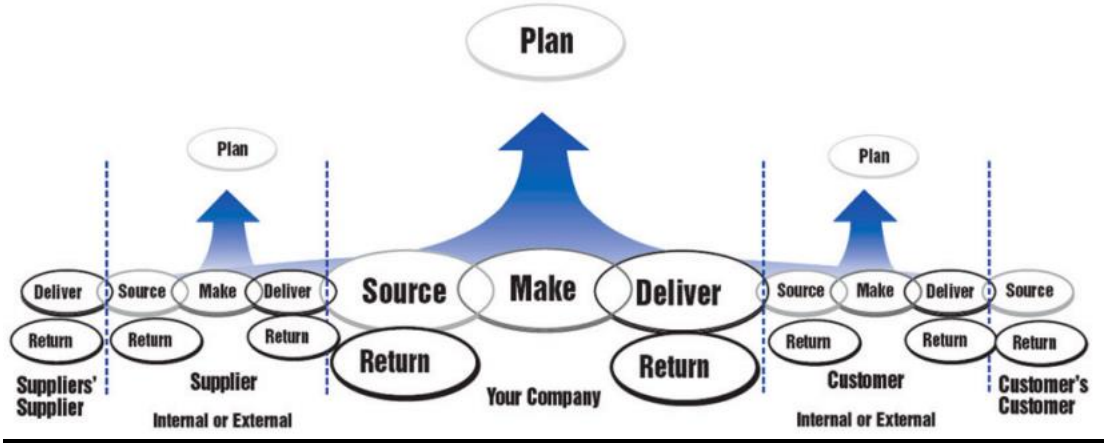
Supply chain executives in IBM believe that SCRM is the second most important issue for them (IBM 2008). Also, the research by AMR in 2007 reported that 46% of the executives believe that better SCRM is needed (Hillman and Keltz,2007). Price Waterhouse Coopers (PWC) and insurance companies such as Zurich Insurance established SCRM as a new area of practice. Zurich's SCRM practice provides consulting services for reducing supply chain failures and insurance coverage including supplier defaults. (Sodhi *et al.*, 2012).

After looking at the results in this research, I would agree to say there is a gap between the definition of ERM,SCM and SCRM. It is fundamental for companies to clarify the meaning and implications of these concepts, in order to have better management system across the business.

2.4 The Decision-Making Process

- **Supply Chain Decision Categories: SCOR Model**

Figure 7:Supply chain decision categories mapped to the SCOR-model



Source: Supply Chain Council ,2009

The Supply Chain Operations Reference model was developed by the Supply Chain Council (SCC). Figure 7, presents a schematic framework that illustrates supply chain interrelationship. According to the SCC, the SCOR model integrates the concept of business process re-engineering, benchmarking, and process measurement, into a cross-functional framework.

This model encompasses all customer interactions, from order entry to paid invoice; encloses all product transactions, from the manufacturer to the customer; and across all business interactions, from understanding the demand to fulfilling each order. (Supply Chain Council ,2009)

Previous research on supply chain performance, focuses more on cost and financial performance. I agree that a supply chain's financial performance is vital to the supply

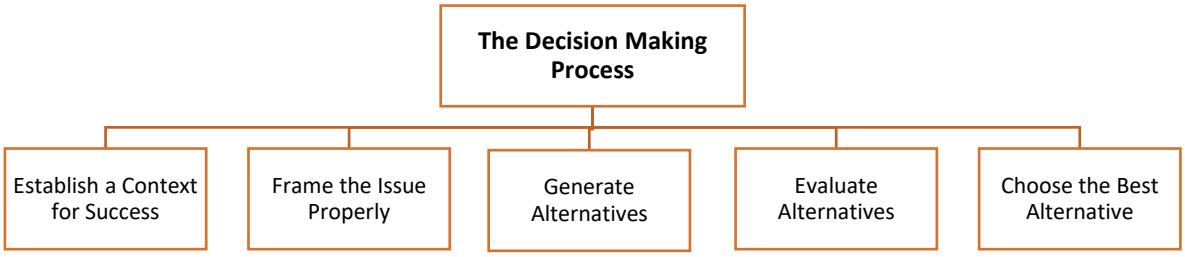
chain's existence. Nonetheless, customer base is key to achieving good financial performance in today's consumer-driven environment, because a customer-driven approach, represents a clear understanding of delivering high-quality products, maintaining a consistent process, and customer retention. That is why the SCORE model is an excellent model to apply in a company's operations. After all, it focuses on the interaction between key activities in the supply chain that have the objective of achieving customers satisfaction.

- **The Decision Process**

Harvard Business School (2005), suggests that the purpose of making decisions is to achieve a meaningful objective and that having a process for decision making is critical for effective results. As a result of having the right process, quality will improve. If an organisation adopts an effective process and train people in its use, output will improve and will be consistent.

Accordingly, Harvard Business School (2005) proposed the following framework pointing at 5 steps for decision making, which aims to get better results in the businesses operations (Figure 8).

Figure 8: Decision Making 5 Steps to Better Results



Source: Adapted from (Harvard Business School,2005)

Harvard Business School (2005), emphasizes that establishing a context for success is essential to create an environment in which effective decisions are possible. A part of this process implicates involving the right people, which are those who are knowledgeable, have experience, and have a stake in the outcome.

After establishing the context, it is key to frame the issue properly by determining the nature of the problem. According to Harvard Business School (2005), a frame is a mental window through which we view a particular problem, situation or opportunity. I agree with the authors point of view saying that if you frame the problem the wrong way you will never solve it, but frame it correctly and you are halfway to the solution. In my view it is extremely useful to have a clear picture of the issue to find the best solution.

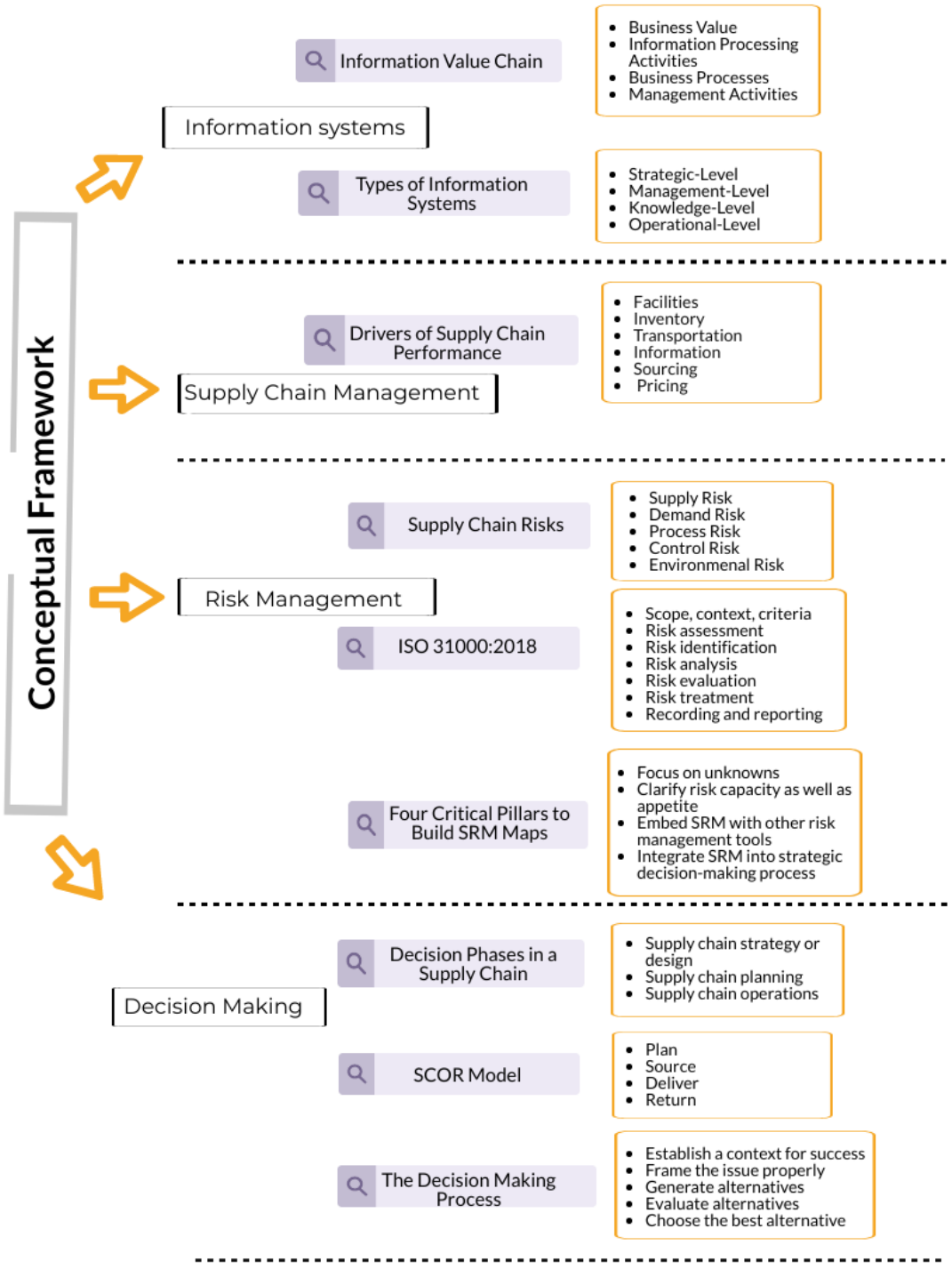
Once the frame has been issued properly, generating alternatives to solve the issue is crucial. Harvard Business School (2005), argues that good alternatives are broadly constructed, genuine, feasible, and sufficiently numerous to give decision makers a real set of choices. I agree with the authors saying that decision making demands good judgment and creativity in addition to technical proficiency. It is important to have both technical skills and the ability to interact with teams in an empathetic manner to make better decisions.

In line with the SCORE model and the Decision Phases in Supply Chain previously mentioned, this framework for decision making is a complement to the contextual literature for this research. These 5 steps refer to the decision-making process in general within an organisation, but in this study these steps will be analysed and applied to the Supply Chain processes.

2.5 Conceptual Framework

Having looked through the literature and background for this research study, I have developed a diagram as the Conceptual Framework for it, which can be observed in Figure 9.

Figure 9:Conceptual Framework



Accordingly, in this diagram it is possible to see the concentration of the main concepts and information that will be analysed in order to develop an Operational Framework for Supply Chain and eventually, answer the research questions.

However, while looking at the literature review I found different models for risk management and decision making but the majority of the models are not accounting the importance of IS within these processes, so I will analyse these models including the importance of IS. Moreover, the models and concepts are pointing at different operational processes within the supply chain but these processes complement each other, therefore it is important to analyse the connection between them in order to have a better understanding and coordination of SCM processes.

Accordingly, having looked at the literature and the conceptual framework, it can be observed that there are many similarities between the processes of each model. For instance, in the Information Value Chain process it is possible to observe information processing activities while one of the Divers of Supply Chain Performance is information. On the other hand, it is also possible to observe the supply chain planning phase, in the Decision Phases in Supply Chain Process, which is similar to the planning process in the SCOR Model. Likewise, there are many similar processes between the models displayed in the conceptual framework (Figure 9) for this research.

For this reason, I will concentrate and analyse the overall information for each model and concepts mainly based on each driver of supply chain performance and I will carry out a comparison between the processes of each model. In addition, through interviews with various people involved in different areas of the supply chain, I will collect data in order to obtain a deeper understanding of the specific processes used in different companies regarding the use of IS, decision-making processes and supply chain risk management. As a result, this investigation will lead to the creation of a new model and eventually when the new framework is built at the end of this research study, businesses will be able to use it as a guidance to make an extent analysis of each part of the supply chain operational processes in terms of risks and decision making.

2.6 Conclusion

This chapter provided a detailed overview of the core terminology and key elements of the research objectives, having conducted an extensive research on the main theories and models in regard to Risk Mitigation Processes and Decision-Making Processes in Supply Chain and connecting these elements with IS and the Drivers of Supply Chain which gave feasibility to the research. Ultimately, these concepts were further explored and described in order to create a conceptual framework that could be used to test the research study.

3 Methodology and Research Design

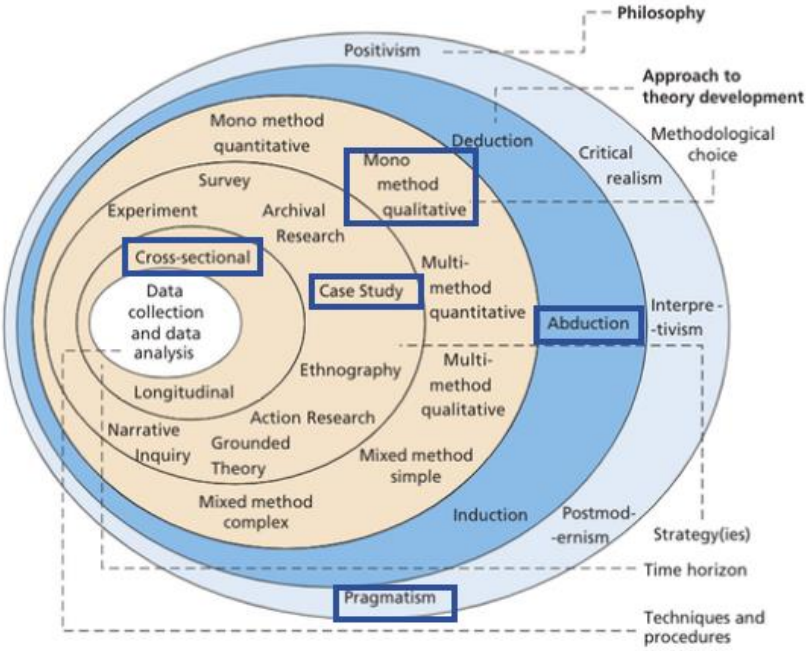
3.1 Overview

Saunders et al. (2007), defines the term research as the process that is undertaken in a systematic way with a clear purpose, to find things out. This chapter outlines the research philosophy, research strategy as well as the data collection and analysis, which contributes to the research by providing a better understanding on the approach to analyse the real context of the research study.

3.2 Research Philosophy and Approach

Saunders et al. (2007), suggested the following framework known as the research onion as a guidance to better understand the stages involved in the development of a research design (Figure 10). Accordingly, this framework was used in this research study to define the research paradigm, overall approach and the research design.

Figure 10: Research Onion



Source: Adapted from Saunders, Thornhill and Lewis, 2019

Having analysed the aims and objectives previously mentioned, the paradigm for this study research is guided by a pragmatist philosophy. According to Saunders, Thornhill and Lewis (2019), in a pragmatist philosophy, reality matters as practical effects of ideas and knowledge is valued for enabling actions to be carried out successfully. Accordingly, in this research, concepts and theories were used to investigate the existing knowledge, and the data collected was used to contextualise experiences in different organisations.

Moreover, since the main objective is to develop an operational framework that companies can use for decision making in SCM, it is important to mention that in the pragmatist philosophy, it has been recognised that there are many different ways of interpreting the world and undertaking research, and that not a single point of view can give the entire picture, and that there may be multiple realities(Saunders, Thornhill and Lewis, 2019). Following this analogy, the operational framework developed in this research is flexible in order to be adapted according to the business needs. On top of that, it is also be a guidance which will be seen from different perspectives depending on the business where it is being applied and depending on the person who is interpreting the information. Besides, the utilisation of the framework may be undertaken by organisations that consider it appropriate for their business.

Saunders, Thornhill and Lewis (2019), mentioned that pragmatism focuses on problem solving, flux of processes and practices. In this case, as previously mentioned one of the objectives of this research is to help companies to improve their decision-making processes, by considering and analysing the connection between decision making, Information Systems, the drivers of supply chain performance and risk management. These practices were revised and modified in order to obtain an improved framework that organisations can adopt to change their Supply Chain Management processes.

Consequently, the overall approach for this research according to the philosophy is abductive, where known premises are used to generate testable conclusions, which in this research will be an operational framework. In addition, Saunders, Thornhill and Lewis (2019), claimed that a topic about which there is a wealth of information in one context but much less in the context in which the topic is being investigated, might lead to an abductive approach that would enable the researcher to modify an existing theory. In this case, there is wide range of information regarding decision making in general business processes but they do not focus in SCM processes which is the main focus in

this research. So, this leads the research to have an opportunity to create a new framework based in data collection and existing theories and concepts.

Furthermore, the methodological choice for this case was a qualitative research design using a mono method qualitative study, which means that a single data collection technique has been used. In this study, interviews are the most appropriate method, using open questions to conduct the research in order to obtain information about IS, decision making and risk mitigation processes in SCM in various organisations, which was described from different perspectives by the participants and the questions were based on the literature previously investigated and the objectives of the research study.

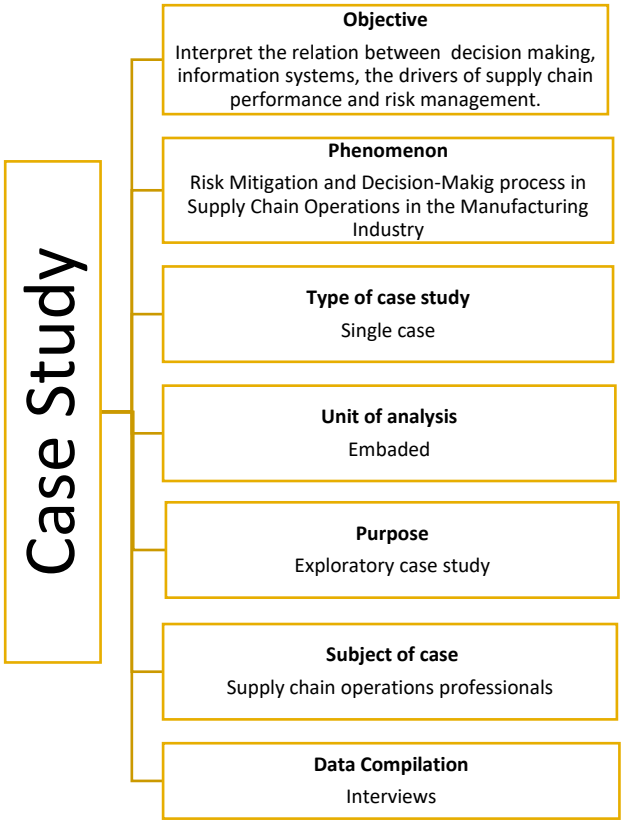
According to Saunders, Thornhill and Lewis (2019), a qualitative research can use an abductive approach to theory development where inductive interferences are developed, and deductive ones are tested constantly throughout the research. This research study, mainly developed an inductive approach, since the operational framework was created based on qualitative data collection and looking at exiting theories and concepts. However, in terms of the deductive approach, the framework will be available to be tested after the research study is completed.

Ultimately, this research has been designed to fulfil an exploratory purpose, since it includes an analysis on the literature to better understand the main theories and concepts in this research, and interviewing experts to investigate further in the subject, in order to get a better insight on how supply chain professionals operate in different companies.

3.3 Research Strategy

According to Saunders, Thornhill and Lewis (2019), research design refers to a general strategy of how the research questions will be addressed and transformed into a research project. The most appropriate research strategy identified for this research is a case study. According to Yin (2018), a case study is an in-depth analysis of a topic or phenomenon within it´s real life context. Specifically, this research study points out the phenomenon in manufacturing companies processes of decision making, focusing on supply chain operations in its real time context, for this reason the supply chain operations professionals are the case subject (Figure 11).

Figure 11: Research strategy



The type of case study suitable for this research is a single case which according to Yin (2018), represents a critical, extreme or unique case and typically provides an opportunity to analyse a phenomenon that few have considered before. In this case, the single context that was analysed is the field of Supply Chain Operations in the present specifically in the Manufacturing Industry, meaning that the time horizon for this study is cross-sectional.

Even though only a single industry was explored, an embedded unit of analysis is the most suitable for this strategy because different logical sub-units within the case of study were examined to a certain extent. For instance, as it has already been mentioned the drivers of supply chain, decision making, information systems, and risk management are the main aspects to be considered within this research and would be the sub-units for this case.

Additionally, after viewing the implications for this research, it has been imperative to develop an analysis to study the relationship between distinctive aspects in supply chain by using existing theories and considering various professionals perspectives. That is why I believe that operating interview's and shaping questionnaires is the appropriate data collection approach for this case.

3.4 Collection Primary Data

3.4.1 *Sources*

Methods and sources for collecting data

As previously mentioned in the overall approach, this research adopted a qualitative approach. According to Saunders, Thornhill and Lewis (2019), qualitative research studies the meanings and the relationship between the participants, to develop a conceptual framework and theoretical input by using different types of data collection techniques.

Having said that, considering that one of the present research main objectives is to develop a new operational framework and adopt a case study research strategy where it is possible to analyse the real operations in an organisation and the relationship between different variables within its operations, the most suitable approach for this research is a mono method qualitative study.

Therefore, a set of questions were designed in order to gather the necessary data to explore the case study. The research study was conducted by performing interviews as a single data collection technique and the purpose of conducting an interview in this case, was to obtain more detailed information by designing open questions in order to explore responses that are relevant to the research subject.

According to Zikmund (2003), personal interviews enable the researcher to obtain more detailed and reliable details and to analyse the participant's postural and gestural movements to direct the questions and explore the answers further. However, face to face interviews were not be able to be performed because of the Covid-19 pandemic but the interviews were managed by video calls using platforms like Skype, Zoom and Microsoft Teams.

The criteria for selecting participants was for them to be supply chain professionals in the Manufacturing Industry currently working in any area within the Supply Chain Operations. In addition, considering that this is a qualitative research study, the sample size was small, conformed by 8 participants who were selected through the researcher network, taking the role of external researcher.

Furthermore, in order to answer the research questions in this case study, primary and secondary data has been gathered. So, primary data refers to performing interviews with supply chain professionals who were the source to obtain this type of data. Meanwhile, secondary data refers to reviewing the relevant literature for the research, which was accessed through books, websites, journals, peer reviewed articles, and academic magazines.

Nature of data

As it was previously mentioned, the use of interviews was adopted for this research study, which intends to gather data that is valid, reliable and relevant to the research questions and objectives.

The purpose of this research study is exploratory, which is why the interviews are non-standardised and semi-structured. In this type of interview, the researcher has a list of themes as possibly key questions to be covered, although their use may change in each interview and additional questions may be required to explore the research questions and objectives given the nature of events in particular organisations (Saunders, Thornhill and Lewis, 2019). These questions were open-questions that allowed participants to describe a situation or event using their own words , while also supporting the researcher to understand the context of the research study and what is happening in the business processes that are being studied, which in this case are supply chain activities. Accordingly, the interviews were conducted on a one-to-one basis, between the interviewer and a single participant.

The general sources to conduct the interviews were internet- mediated, using mobile and computing technologies, which are considered as electronic interviews. The documentary sources for the interviews were refined via e-mail, internet messaging or conferencing. In this case, as it was previously mentioned services such as Skype, Zoom, Microsoft Teams and E-mail were used to perform interviews. In this particular

case, synchronous electronic interviews have been conducted in real time using e-mail and web conferencing because of the current Covid-19 pandemic, and in general considering the three previously mentioned sources to conduct an electronic interview, they gave the researcher more options to adapt the interviews to the participants schedules and also a broader panorama on the various options to approach the participants. Nevertheless, the interviews were be audio-recorded with the participants consent, which according to Saunders, Thornhill and Lewis (2019), allows the interviewer to concentrate on questioning and listening, and allows the interviewer to re-listen to the interview during the data analysis and to use direct quotes as the findings are being written.

3.4.2 *Access and Ethical Issues*

Regarding gaining access to obtain data, as previously mentioned because of restrictions produced by the Covid-19 pandemic, traditional access to sources is limited, so the access to data has been conducted through a hybrid access strategy, combining traditional and internet-mediated approaches. The pandemic affected the level of access in the research, since it was not be possible to have a physical access because organisations were not willing to participate in a traditional approach. Therefore, considering that this study was conducted by an external researcher and that the level of access was in risk to be limited, the researchers ability to demonstrate clearly the research study competency and integrity and the ability to explain the research project clearly and concisely was critical to negotiate access at each access level, which are: Physical, continuing and cognitive (Saunders, Thornhill and Lewis, 2019).
According to Saunders, Thornhill and Lewis (2019), ethics refer to the standards of behaviour that influence the researcher conduct in relation to the rights of those who become the subject of the research study, or are affected by it.

Having said that, the ethical issues have been approached with a consent form and plain language statement, which was be presented to the participants before they agreed to be part of the research study. In order to prevent ethical issues, these documents contain specific information, such as:

- The confidentiality on the participants personal information
- An explanation of the participants required involvement in the research study
- Assurance that there is no potential risk to participants from the involvement in the research study

- Confidentiality of the information provided in the interview
- Assurance that the data provided will only be used for the purpose of this case study
- Notification to the participants affirming that the involvement in the research study is voluntary, and therefore the participants may withdraw from it at any point

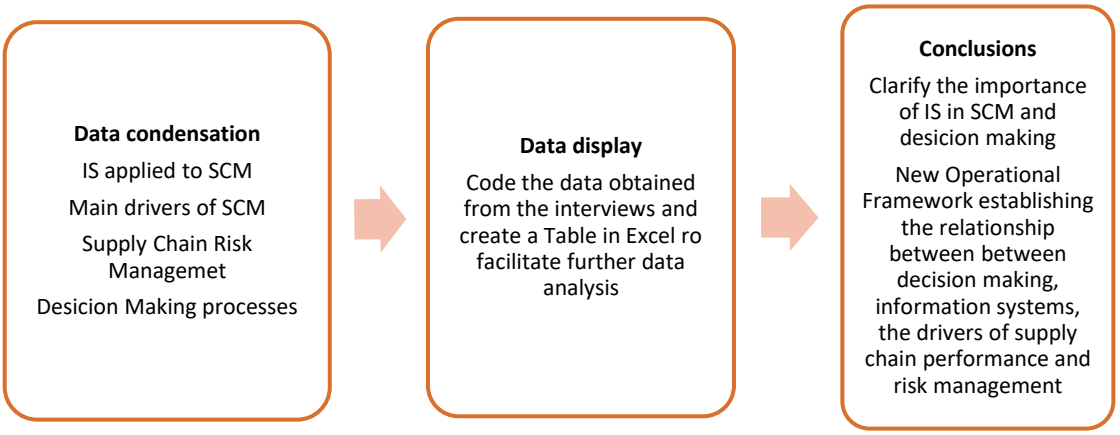
Ultimately, within the plain language of statement it was also explained the benefit of participating in this case study, which is receiving the Operational Framework for decision making that was developed in this research design and they can benefit from it by using it to identify and understand possible disruptions in the supply chain in the company they are currently working for, or as a guidance for decision making in the supply chain operational activities.

3.5 Approach to Data Analysis

According to Saunders, Thornhill and Lewis (2019), the quality of qualitative research depends on the interaction between data collection and data analysis in order to allow meaning to be explored and clarified. However, meanings are mainly driven by words and images in a qualitative research and this is why they need to be analysed with considerable care.

The data display and analysis approach has been adopted for this case study. This approach is based on the work of Miles et. al (2014) and consists of three processes: Data condensation, where the data collected is simplified, coded and categorised; data display, which implicates to organise the data in a visual display, using matrices or networks to facilitate further data analysis; and drawing and verifying conclusions where relationships and patterns will be recognised in the data in order to make comparations. In Figure 12, it is possible to observe a proposal of the data display and analysis approach for this case study.

Figure 12: Proposed Data Display and Analysis



After collecting data from the interviews, the data was transcribed in a Word document and analysed to identify the codes and categories within the information obtained. In this case, a flexible Hierarchical Coding Frame was developed in order to organise codes based on how they relate to one and other. Subsequently, the simplified data extracted from Word was transferred to Excel in order to create a Table for data display analysis.

Ultimately, the final phase of the process was to associate and link the result of the data collection with literature review concepts and theories to be able to elaborate the findings and recommendations as a result of the research study.

3.6 Conclusion

This chapter outlined the research design, including distinctive aspects of the methodology such as the research approach and the main philosophy of the study. Accordingly, the chapter detailed aspects of the data collection, which referred to the conduction of the research and the type of interviews held and the profile of the participants. The findings and recommendations formulated as a result of the data obtained after conducting the data display analysis are presented in the following chapter.

4 Presentation and Discussion of the Findings

4.1 Overview

Qualitative researchers purposefully examine and make note of small cues in order to decide how to make sense of the context and build larger knowledge claims about the bigger picture (Tracy, 2019). This chapter sets out the findings of the interviews conducted in this research study. Sections such as data collection, data analysis, conclusions and recommendations are presented in this chapter as well.

4.2 Findings

4.2.1 *Participants Profile*

As mentioned in the Research Methodology chapter, the respondents in the research consisted of eight participants working in Supply Chain Operations in the Manufacturing Industry. An insight into the profile of the participants is presented in the Figure 13.

Figure 13: Participants Profile

Respondents	Business Type	Position in the company
Respondent 1	Aerospace, Building technologies, Performance Materials & Technologies (PMT), and Safety & Productivity Solutions (SPS)	Sr Procurement Project Specialist
Respondent 2	Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology	Purchasing Projects Manager
Respondent 3	Air conditioning manufacturing company	Sr MRO buyer/planner
Respondent 4	Automotive Industry	Global Sourcing /QMT
Respondent 5	Home comfort and security solutions	Sr Logistics Analyst
Respondent 6	Yarn, Home Textiles, Paper, Chemicals and Captive Power Manufacturer	Head of Procurement
Respondent 7	Transportation Equipment Manufacturing	Logistics Coordinator
Respondent 8	Robotics, power, heavy electrical equipment, and automation technology areas.	Category Specialist

4.2.2 *Research Objective One*

"Develop a clear understanding of how IS can aid in better decision making to support manufacturing companies improving supply chain operations flow"

For the purpose of introducing IS as a key element to improve Supply Chain Operations flow, the participants were asked to describe the connection between IS and Supply Chain. Findings from the interviews supported by all 8 participants demonstrate that IS are considered as enablers for Supply Chain Activities. Respondents 1,5 and 7 respectively stated:

"Information Systems enable the processes that we have in Supply Chain Processes"

"IS helps us to drive the whole systems in the company and set everything in place to standardise processes"

"IS support Supply Chain to manage all the data, improve communication and have a better workflow "

As it follows, the participants were asked about the importance of IS in their companies and how they contribute to their jobs. Respondents 1,3 and 5 agreed that IS supports their jobs to drive and improve decision making. For instance, respondent 1 and 3 respectively specified:

"IS allow us to have information at hand which can help us to drive decision making and avoid some unforeseen situations , so having the information at hand at the correct time can drive better results on how we handle our Supply Chain and mitigate some of the risks that we could have"

"The data obtained in the different IS we use, is the information that I manage to make the best decisions and without that information our inventory would be a disaster so I think IS are one of the main tools that we use in my area"

Furthermore, the main aspects outlined by the respondents regarding the importance of IS in the companies were: Decision-Making Process, Managing Data, Sharing Information and Real Time and Accurate Information. Specifically, Respondents 3 and 8 stated:

"IS support the company to have the correct information and to organise and manage all the data that the company generates , so I think IS are one of the main tools that we have in our supply chain"

"IS help me to manage information in an organised way and to share this information with other areas of the company"

Indeed, respondents 6 and 8 spoke about the Importance of IS making the following statements:

"I think IS are very important for an enterprise because that is how enterprises nowadays run, essentially referring to the flow of goods, information, finances, suppliers, employees, customers, etc"

“A lot of companies are currently investing on IS implementation because in they are key for the future in businesses”

4.2.2.1 How do IS contributes to Supply Chain Operations?

By looking at the previous statements obtained from the interviews, it is possible to observe that IS contributes to Supply Chain Operations by enabling the processes to flow in harmony. According to the participants, they support the decision-making process because through IS it is possible to obtain real time and accurate information, manage the data generated in the company and share information with other areas of the company. The findings from the first objective point out that IS are significant in a company in order to improve communication, as well as to be able to identify possible disruptions in the Supply Chain processes to eventually support supply chain professionals making decisions to mitigate potential risks.

4.2.3 *Research Objective Two*

“Identify the drivers in the Supply Chain that support Supply Chain professionals to make decisions”

In line with the second objective of this research study, the participants contributed by identifying the drivers of supply chain from their perspective. The main drivers of supply chain considered by the participants can be observed in Figure 14.

Figure 14: Respondents Interpretation of Supply Chain Drivers

Drivers of Supply Chain	Respondents							
	1	2	3	4	5	6	7	8
Knowledge								
Facilities								
Information Systems								
Sorucing								
Pricing								
Production								
Inventory								
Transportation								
Information								
People								
Suppliers								

However, what stands out in the figure above, is the dominance of 6 main drivers which were mentioned by 3 to 6 participants, while 5 drivers were mentioned by a single participant. The purpose of identifying these drivers is to be able to design the Operational Framework in the objective 4, which includes the process of decision making and risk mitigation in Supply Chain.

4.2.4 *Research Objective Three*

"Provide a clear visual relationship between the drivers of supply chain, taking into account the supply chain processes for risk prevention and decision making"

Having defined the drivers of supply chain in the research objective two, it is now fundamental to explain the findings on supply chain risks and decision making, which will also contribute to the design of the operational framework in objective four.

4.2.4.1 Supply Chain Risks

In order to analyse the supply chain risks, the participants were indicated to point out the sources of risks internally and externally in their company's supply chain.

In terms of the internal risks, the main answers were related to managing information and inventory disruptions.

Respondents 1,3 and 6 noted that some of the risks regarding Information are: having accurate and on time information, communicating information, loosing data and having a single place to store the information. For instance, respondent 1 stated:

"Not having a single place where we can get all the data means that I have to run several reports in order to get a rough idea of what is my spend. First, I need to reach different users that have different access to the other systems and ask them to run a report for me, once I have the reports I need to do an analysis for each one of them and consolidate the information in one single place and finally send it out to the managers and that is not efficient at all"

The key risks respecting inventory according to Respondents 2,3,7 and 8 can be listed as follows: Having over-stock, materials can be lost or damaged, handling materials when moving from one point to another and having the correct package for a product. For example, Respondent 3 mentioned:

"My company is currently having a lot of issues with the inventory, sometimes the materials are lost or damaged and this is causing the company to lose money"

Nevertheless, aside of the elements mentioned before, there were additional aspects mentioned by the respondents but they were not repetitive as the factors previously mentioned. In Figure 15 it is possible to observe these factors.

Figure 15: Internal Risks Participant Perspective

Factor	Respondent
Suppliers and Customers Location	2
Planning	4
Communication	5
Manufaturing Processes	6
Supplier Relationship	7
Quality Issues	8

However, in terms of external risks the answers were more consistent. The key risks include aspects such as: Market behaviour and changes, demand, customs barriers, political and economic conditions and pandemics. The most relevant comments in relation to this subject are displayed in Figure 16.

Figure 16:External Risks Participants Perspectives

Respondent	Comment
R1	"We were impacted the end of the the first quarter because we had too many suppliers in APAC, so at the beginning of the COVID-19 pandemic these countries were not shipping any products to us and we did not have many sources in America or Latin America which was an issue for the company"
R2	"If you consider what is happening now with the pandemic in 2020, I would say the main risk for us is the drop of volume in the orders from our customers because of the economic crisis , because we have a plan in sales, which is based on certain numbers and when those numbers go down it is a huge loss for the company"
R3	"In logistics, we can have a big impact in the part of delivering material and there are a lot of things we can´t control like now with the COVID-19 pandemic, which caused a lot of issues with customs"
R6	"For me the internal risks are competition in the market and the constant changes in customers' needs beacuse one of our objectives is to retain customers and create customer loyalty"
R8	"The internal risks can be the change in the market needs, demand changes and currently the pandemic that we are facing which we cannot control and affects company´s"
R7	"I would say that the external risks that suppliers face can affect directly to the company. For example, political and economic situations as well as customs barriers"

Another significant aspect of supply chain risks that supports gathering relevant information for this finding is related to identify the bottlenecks in supply chain activities. Accordingly, the participants were asked to describe the main bottlenecks in their company´s. The main points recognised by the respondents as bottlenecks can be summarized in three main elements: Information handling, information systems and communication.

This section of the finding supports objective one, as it shows the relevance of IS in supply chain activities. In this research study information handling was considered by 4 out of the 8 participants to be a bottleneck. Therefore, this factor can become an obstruction for improving the Supply Chain Operations flow, which is one of the main objectives in this research study, so this analysis opened an area of opportunity for improving information management by adopting IS tools.

Furthermore, this finding also supports objective four because one of the main bottlenecks identified by the respondents is communication, therefore this factor was displayed in Figure 20 as one of the main components at the top of the operational framework.

For instance, in order to demonstrate evidence of this part of the findings respondents 1,6 and 8 respectively stated:

“Our bottle necks would be having several IS systems instead of having just one were we can concentrate all the information”

“One of our bottle necks is to improve our data analysis tools and standardise more of our processes to increase our efficiency”

“In my organisation the bottle neck is the information handling because this is a big company and this company has its own divisions and each division has their own way of work so sometimes we don´t share important information between the different divisions even tough we have a common goal, so it is a challenge to have everybody informed and have better communication within the differnt divisions”

In addition, with the purpose of better understanding of risks across the different Supply Chain Operations, the participants identified the main risks based on Chopra´s (2019), Six Drivers of Supply Chain, which were previously mentioned as part of the framework in the literature review chapter. It is important to mention that the information obtained in this section of the finding is directly related to the major findings in objective four. A summary of outcome obtained can be observed in Figure 17.

Figure 17: Participants perspectives on Supply Chain Risks based on Chopra´s Six Drivers of Supply Chain

Driver: Facilities							
	Respondent						
Risk	1	2	3	4	6	7	8
Location	x		x				
Safety measures		x		x			x
Secutiry					x		x
Layout		x				x	
Driver: Information							
	Respondent						
Risk	1	2	3	4	6	7	8
Accurate Data	x		x	x	x	x	
Information Overload					x		
Communication						x	
Information Confidentiality							x
Information Management		x					
Driver: Inventory							
	Respondent						
Risk	1	2	3	4	6	7	8
Overstock	x		x	x		x	
Shortage	x	x		x			
Safety Stock			x			x	
Lead Times				x			
Lack of Information/forecasting							x
Handling Cost							x
Driver: Pricing							
	Respondent						
Risk	1	2	3	4	6	7	8
Market Conditions	x	x			x		
Quality			x			x	
Political or economic events				x			x
Driver: Sourcing							
	Respondent						
Risk	1	2	3	4	6	7	8
Products Quality	x	x	x				
Suppliers Location		x			x		
Suppliers response time		x	x				
Time difference	x						
Over reliance in one supplier					x	x	
Understand the business and clients needs							x
Driver: Transportation							
	Respondent						
Risk	1	2	3	4	6	7	8
Delivery time		x	x				
Choose the correct transport			x		x		x
Products Damages					x		x
Transportation Cost						x	
Packaging		x					
Roads Safety	x			x			

By looking at Figure 17, it is possible to say that there is a balance between the respondent's answers and the risks related to facilities and pricing. However, there is one aspect standing out regarding information, which is accurate data, while the remaining factors are not recurrent within the participants answers.

In terms of inventory, there are three main risks mentioned by the participants which are: Overstock, shortages and safety stock. In the case of sourcing, the main element for the respondents is products quality, followed by supplier's location, response time and over reliance in a single source. Finally, in regards to transportation, the main risk identified by the participants was choosing the appropriate transport mode for the materials that are being moved, followed by delivery time and product damages during the transportation transit.

However, while 7 out of the 8 participants answers are included in Figure 17, participant 5 answers are not included because the response obtained from this participant was very general as it follows:

"The main risk for all of them is communication and the risk of misunderstanding customers"

Moving on now to consider Supply Chain Risk Management, the participants contributed by providing information about principals/tools/processes for risk management that they are currently employing as part of their jobs. One of the observations in this section of the finding is that 7 out of the 8 participants follow a different principal/tool/process for risk management (Figure 17).

Figure 18: Participants processes for risk management

Respondent	Principals/tools/processes for risk management
R1	UNSPSC (United Nations Standard Products and Services Code)
R3	ERP
R3	MRP
R3	Kanban
R4	LFMEA (Failure Mode and Effect Analysis of Logistic Processes)
R6	Management demand forecast model
R8	SAP Ariba

By looking at Figure 17 it is possible to notice that within these tools there are 4 different IS that the participants use to manage risks in the different enterprise's, which are: ERP, SAP Ariba, MRP and Kanban. Accordingly, considering the first research objective, it is

possible to evidence the importance of IS in this objective as well, but in this case for supply chain risk management.

Although most of the companies follow a process for risk management, it is important to mention that respondent 5 stated:

"I´m not aware of any principals to manage risks in my area"

In addition, the participants were asked about their company´s strategy to prevent risks. The most significant aspects recognised by the participants were planning and information security.

In terms of information security, respondents 6 highlighted the utilisation of high quality tools and documenting everything they do, while respondent 8 pointed out to developing campaigns in order to secure internal information.

As regards planning, respondents 3 and 4 provided the following statements:

"We have different ways to prevent risks, like planning according to the demand and having the correct lead time for the components we buy so we can plan the production according to the material we have available"

"I need to list all your activities and also you give them a value or ponderation and this way you can classify which your highest risks are in your entire processes and then you can build a backup plan for each activity"

4.2.4.2 Decision Making

In order to analyse de decision-making process in different enterprises, the participants were asked to specify if their company´s employ any methodologies for decision making.

The data collected sets out that most of the participants do not use any methodologies for decision making, as 6 out of the 8 respondents did not mention any particular methodologies. For instance Respondent 6 and 7 respectively said:

"We don´t have an specific methodology for decision making in my area but I follow my own steps"

"We don´t have an specific methodology to make decisions but we base our decisions in our priorities and the information that we have available"

However, both respondents 1 and 4 use an specific methodology that their company´s follow which are: Pareto Analysis and the PDCA (plan, do, check and act) methodology. In addition, the participants contributed by mentioning the steps for decision making they individually use in their jobs. The most mentioned steps outlined by the participants were information gathering and data analysis. It is possible to say that there are similar steps within the respondent's processes but they do not follow exactly the same steps. The evidence of the most significant answers is outlined below:

Respondent 2: "First, I get information, then I evaluate the information and think about the consequences the decision may have and based on that you can either proceed to make a decision. I also use lessons learned from previous decisions that I have done and previous experience"

Respondent 5: "First, I identify the goal I´m trying to get to and gather any relevant information that we may have. Then I analyse what are the alternatives we have and after that I choose out of those alternative what is the best option for us"

Respondent 8: "I put in perspective a list of pros and cons , after that I identify the key information based on the pros and cons and then I go further in details for every key piece of information in order to have the complete overview of a situation and then from there I decide what is affecting my supply chain the most , I prioritize the main issues and I start working on them"

Moreover, the respondents contributed to the research by mentioning the criteria they apprise as to know that they succeeded after making a decision. The main answers obtained in the interview were related to achieving goals, customer satisfaction and achieving KPI´s (Key Performance Indicators).

Seeing that 6 out of the 8 participants base their decision making success on achieving goals , this factor is taken into consideration in the decision-making process in Figure 20, and it is interpreted as "establish a context for success" from the beginning of the analysis in the decision making segment. Even though, comparing KPI´s and achieving goals is measured at the end of the process of decision making, it is essential to have an objective or a target from the beginning. So, at the end of the decision-making process the information can be compared, as to the results obtained out of the decisions made with the goals established from the beginning of the process, which is also a step displayed in objective four as part of the operational framework (Figure 20). As an illustration of the participants contributions to this point, some of the relevant comments made by respondents 1,4 and 8 are outlined below:

"My criteria for this point would be to achieve my KPI´s and measuring previous results with current results"

"We prepare a business case and we need to have a target or expectation of the results that would be considered as successful and at the end we need to compare the results against our goals to see if we achieved our target and revise if we got the results you were expecting in our KPI´s"

"My criteria is based on the results we obtain . In this case, you can set up a time frame to achieve your goals which will help you to monitor if your decisions are working for the business and you achieved your goals"

4.2.4.3 What is the relationship between the drivers of supply chain, supply chain risks and decision making?

To this purpose, the participants have been asked to give their perspective about the connection between risk mitigation and decision making and they all agreed that these two concepts have a connection. In this case, every participant provided their personal view of the reason why these two concepts are connected. For instance, a summary of the respondent's comments can be found in Figure 19.

Figure 19: Connection between risk mitigation and decision making participants perspectives

Respondent	Comment
1	"A lot of the decisions we make are related to mitigating the risks in your supply chain, which is why decision making is a central piece for risk mitigation"
2	"Basically, every decision that you make it could either cause risk or prevent risk and this is a part of the whole methodology of making a decision to prevent from something bad happening"
3	"When you mitigate risks you also have to decide the changes to be made in your processes and choose the right partners to put a plan in action in order to have a healthy supply chain"
4	"They have a direct connection because one will always impact the other"
5	"In order to make a decision you have to consider the risks within the alternatives you have to make the best decision for the business"
6	"When you are making decisions you are looking at how to prevent a risk so I think you cannot separate these terms because they are very connected and they complement each other"
7	"To have good process to detect risks and a good reaction plan to these risks, you need to involve decision making the choose the best possible decisions "
8	"Every decision has its own risk "

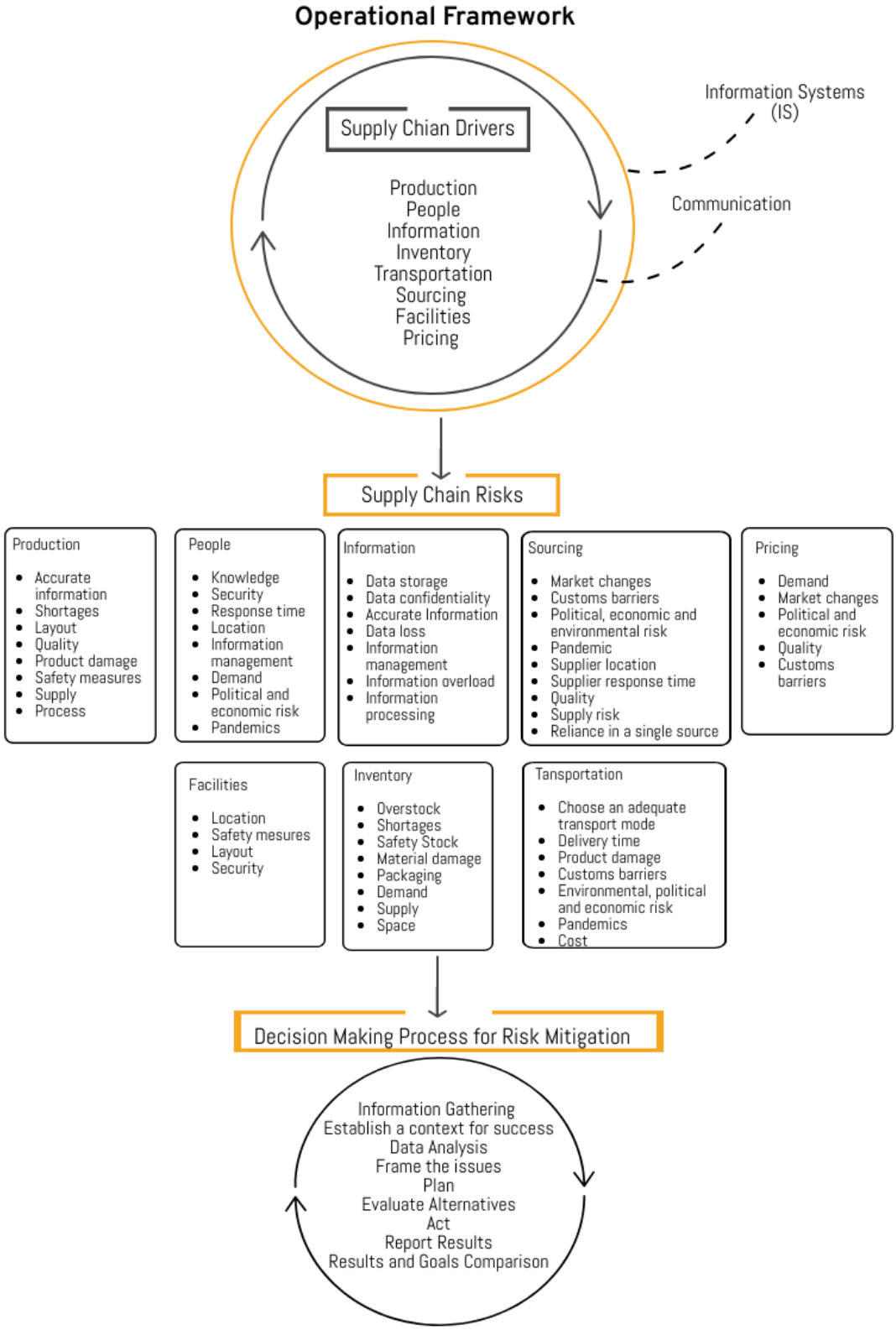
Finally, the drivers of supply chain are connected with risk mitigation and decision-making because each driver has its own risk as it has been demonstrated by the interview participants in this finding. And eventually, in order to prevent risks, it is possible to observe in the results of Figure 19 that making decisions is essential to act accordingly.

4.2.5 *Research Objective Four*

"Develop a framework that can support risk mitigation and decision making in the Supply Chain Processes"

In line with this objective and considering the information presented in the previous findings, an operational framework to mitigate risks and make decisions is presented in Figure 20. This framework was designed as the outcome of the interviews as well as information obtained in the literature review.

Figure 20: Operational Framework to Mitigate Risks and Improve Decision Making in the Manufacturing Industry



In order to encompass this research question, the participants provided their perspective as on how to find the balance between risk and efficiency. Actually, it is imperative to mention that the most significant comments in regards this subject were used to help building the operational framework in Figure 20. For instance, some of these comments are displayed below.

Respondent 1: "Using process modelling can help you to identify bottle necks or processes that you can automate, which can help you to do things more efficiently"

The answer above was used to complement the decision-making process section in the operational framework, on the point of using process modelling being interpreted as "frame the issues".

Respondent 3: "Once you have your risks under control you can assure your efficiency so you have to consider risk management in all the departments across the company and try to plan your activities according to the risks"

The statement given by respondent 3, contributed to the framework by saying that risk management needs to be consider in all apartments, which it is has been applied when building the operational framework and also planning activities was included in the decision-making process segment.

Respondent 7: "You can balance risk and efficiency by identifying a risky situation for the business and design an efficient risk mitigation strategy working along with your team and the suppliers. It is very hard to have that balance but getting support from different departments within the supply chain can make the difference"

The answer above was interpreted as communication and people in Figure 20. Communication is one of the main components in the first section in the operational framework and people are one of the main drivers of supply chain.

Nevertheless, the comment below given by respondent 2, more than providing new information to build the framework it supports one of the main objectives of this research, which is identifying the main drivers of supply chain to what the participants sees as a way to improve efficiency.

Respondent 2:" Identify the main drivers and evaluate them to know what issues are possible to solve in the short term or in the long term can help to improve efficiency and to set priorities accordingly"

The structure presented in the operational framework in Figure 20, condensates key information that allows supply chain professionals to have a broader perspective of all the elements composing Supply Chain Operations as well as the risks within these operations and a generalised method for decision making which can be applied to any of the drivers of supply chain identified in this research study. As it has been mentioned in objective three, most of the participants did not follow a methodology for decision making or risk mitigation, so this framework can be adopted by enterprises to better understand Supply Chain Operations and take action when necessary.

4.3 Discussion

Having looked at the primary research in this section it is possible to demonstrate that there are connections between the primary and secondary research. The objective four is the outcome of the analysis made in objectives one, two and three, also including significant information from the secondary research.

Regarding Information Systems, in the findings IS are recognised enablers for supply chain activities, while in the secondary research information chain is represented by a set of activities that add business value (Figure 2). Therefore, by using IS as an enabler in supply chain activities, it can be feasible to manage the businesses information to add business value. On account of this analysis and the findings presented in objective one, IS are the main element at the top of the operational framework in Figure 20.

In terms of the Drivers of Supply Chain, in the primary research it was possible to identify two new drivers other than the mentioned in the literature review by Chopra (2019). The drivers added to the research are people and production. However, the main drivers recognised by the participants as well as by the secondary research are: Inventory, transportation, information and sourcing. In this case, the drivers of supply chain are displayed in the operational framework (Figure 20), with the purpose of helping supply chain professionals to analyse all supply chain activities and identify the major risks in each area.

In the case of Supply Chain Risks, the relation between the literature and the primary research can be seen in the fact that the six divers provided by Chopra (2019), were used in the interviews to guide the participants in order to identify the risks in each driver. Also, Supply Risk, Demand Risk, Process Risk, Control Risk and Environmental Risk

which are the main Supply Chain Risks identified by Christopher (2016), were mentioned in several occasions in the interviews as part of the internal and external risks as well as risks in the drivers of supply chain. By analysing the findings and the secondary research it is possible to say that the amount of risks within the supply chain activities is very wide and all the risks are connected with different areas of the businesses. Additionally, after gathering all the information regarding supply chain risks, it was possible to see that communication was always in the way of every driver of supply chain, supply chain risks and decision-making process. For this reason, communication became one of the main elements at the top of the operational framework in Figure 20.

In regards to Decision-Making Process, referring to the primary research, even though most of the respondents have their own process to make decisions, it was possible to obtain the main elements for decision making, which are: Information gathering, data analysis, planning and act. On the other hand, in the secondary research it is possible to observe some similarities with the information obtained in the interviews and the secondary research. For instance, the coincidental elements respecting the decision process outlined in “The decision process 5 steps” by Harvard Business School (2005), the SCOR Model by the Supply Chain Council (2009) and ISO:31000:2018 (ISO,2018) are the following : Planning, Deliver, Assessment/Evaluation, Analysis, Context, Reporting. In this case, by doing this analysis and associating factors, it has been possible to create a general process for decision making, which can be seen in figure 20.

4.4 Conclusion

The findings presented in this chapter showed how each of the objectives was approached and achieved, as well as the answer to each one of the research questions. This chapter has reviewed the primary and secondary research of four key aspects: Information Systems, Drivers of supply chain, Supply chain risks and decision making.

In this section, it has been explained that IS contributes to Supply Chain Operations by enabling the processes to flow in harmony. It has been said by the respondents that through IS it is possible to obtain real time and accurate information, manage the data generated in the company and share information with other areas of the company. The findings from the first objective point out that IS are significant in a company in order to improve communication, as well as to be able to identify possible disruptions.

In this chapter, it has been shown in the primary research that there is a lack of methodologies or processes in the company's, regarding decision making since the respondents normally use their own judgment to make a decision. However, after further analysing primary and secondary it was possible to develop a general process for decision making including: Information Gathering ,Establish a context for success, Data Analysis, Frame the issues, Plan, Evaluate Alternatives, Act and Report Results.

The findings also showed the importance of taking into account the supply chain risks in decision making and demonstrated that the possibilities of risks in supply chain processes are very broad and are connected with different areas of the organisation.

Ultimately, the chapter has presented an operational framework that condensates key information and allows supply chain professionals to have a broader perspective of all the elements composing Supply Chain Operations as well as the risks within these operations and a generalised method for decision making which can be applied to any of the drivers of supply chain identified in this research study.

5 Contribution of this Research, its Limitations and Suggestions for Further Research

5.1 Implications of Findings for the Research Questions

The implications of the findings described in the previous chapter focusing in the research questions, are related to the following aspects:

- Information Systems: In this section of the previously findings it was possible to observe that IS contribute to Supply Chain Operations by enabling the processes to flow in harmony. An implication of this point, is the possibility to improve the flow in supply chain activities. Also, it was outlined that they support the decision-making process because through IS it is possible to obtain real time and accurate information, manage the data generated in the company and share information with other areas of the company, which implicates to have a very high level of coordination and organisation between the different areas in the company so IS can contribute in a positive way in the decision-making process.

  The findings from the first objective point out that IS are significant to be able to identify possible disruptions in the Supply Chain processes to eventually support supply chain professionals making decisions to mitigate potential risks. An implication of this, is the time that needs to be invested in monitoring data and analysing the data provided by IS, in order to be able to identify and mitigate risks. As well as the time invested in mapping a plan to mitigate these risks, since this whole strategy is time consuming.

- Supply Chain Drivers: Looking at the findings and research question regarding this section, it is possible to say that since each driver has its own risk as it has been demonstrated by the interview participants in this finding, an implication for the analysis of each driver can be information overload because supply chain implicates many different areas of manufacturing companies, which explains why using IS to manage information is significant in supply chain activities. Therefore, using IS to analyse the drivers of supply chain can also be an implication for a company because in order to implement an IS it would be essential to train the personnel which implicates financial resources and time.

- Supply Chain Risk: The findings of this research study indicated the importance of considering the supply chain risks in decision making and demonstrated that the possibilities of risks in supply chain processes are very broad and are connected with different areas of the organisation. Having said that, the implication for supply chain risks is to be able to control all the risks across the different areas in Supply Chain Operations and owing to the fact that its areas are very broad it can be easy to overlook the risks, which at the end also implicates financial risks for the company.

- Decision-Making process: In this point, it has been shown in the primary research that there is a lack of methodologies or processes in the company's, regarding decision making since the respondents stated that they normally use their own judgment to make a decision. An implication of this is the possibility that the companies have to train their personnel to implement a new methodology as well as the consequences of being wrong or right and the amount of effort required to analyse a situation in order to make a decision.

Ultimately, considering the above terms it was possible to develop an operational framework, which implicates the supply chain professionals clear understanding of the framework concepts in each part of it, so they are able to adapt it to their needs.

5.2 Contributions and Limitations of the Research

The study findings contributed in the field of supply chain, specifically in the Manufaturing Industry by creating a wide operational framework to contribute in the Decision-Making process in Supply Chain Operations as it was the main objective in this research study. Accordingly, one of the main contributions within the operational framework is related to the supply chain risks that were mainly indentified in the primary research, as well as a deeper understanding on the role of IS in supply chain operations. This new understanding should help to improve risk mitigation and the Decision-Making process for supply chain professionals.

On the other hand, even though the findings of the study support previous research conducted on the subject, there are several aspects that can be seen as limitations to take under consideration for this research study.

This research consisted of an exploratory study; it was gathered in a short period of time, which didn't permit for the research to look for more candidates to participate and have more variety of data to show a deeper understanding in each area of supply chain. The study used a qualitative approach along with a small sample of participants, there is a limitation in this case because of the amount of existing manufacturing companies, so it was challenging to build an operational framework having a small sample. Also, as some of the questions in the interview were quite complex and some of the questions referred to very specific terms, that created some confusion among the participants.

Moreover, the research was limited to investigate risk management and decision making specifically in supply chain activities but there are more areas in the businessess to be explored.

Afer all, it is hoped that the data that has been collected within this research paper will encourage supply chain professionals working in the Manufaturing Industry to explore further and deeper into the variaety of risks across in Supply Chain Operations and decision-making methodologies.

5.3 Recommendations for Practice and Further Research

This research provides a platform that explored the supply chain operatios in the conext of risk mitigation and Decision-Making but it is possible to expand this research in different industries or taking into consideration other processess operated within the Supply Chain activities.

A recommendation for future researchers that are hoping to address the subject matter of this research would be to look at this topic with more samples to explore deeper into the risks across the supply chain networ. It may be that there should me more risks to be considered within the supply chain that may not be visible in this research study.

An other recommentation for future researchers is to try to gather participants working in various areas of supply chain if it is possible, so they can get a wide variety of perspectives for their research.This will enable the understanding of the different areas in supply chain and will also provide a better insight of the actions taken regarding risk mitigation and decision making by different companies, which can support to develop a broader research.

References

Bendoly, E., Craig, N. and DeHoratius, N. (2018) 'Consistency and Recovery in Retail Supply Chains', Journal of Business Logistics, 39(1), pp. 26–37. doi: 10.1111/jbl.12174.

Berry D, Towill D R and Wadsley N (1994), "Supply Chain Management in the Electronics Product Industry", International Journal of Physical Distribution and Logistics Management, Vol. 24, No. 1, pp. 79-100.

Bozarth, C.B. and Handfield, R.B. (2019). Introduction to Operations and Supply Chain Management, Global Edition. 5th ed. [ebook] Pearson Education Limited. Available at: https://www.perlego.com/book/962893/introduction-to-operations-and-supply-chain-management-global-edition

Christopher,M. (2016) LOGISTICS AND SUPPLY CHAIN MANAGEMENT. 5th Edition. New York: Pearson Education.

Godfrey, P.C., Lauria, E., Bugalla, J. and Narvaez, K. (2020). Strategic Risk Management: New Tools for Competitive Advantage in an Uncertain Age. [ebook] Berrett-Koehler Publishers. Available at: https://www.perlego.com/book/1257036/strategic-risk-management

Harvard Business School (2005). Decision Making 5 Steps to Better Results. Harvard Business Review Press. Available at : https://www.perlego.com/book/837211/harvard-business-essentials-decision-making-pdf

Handfield R B and Bozarth C C (2006), Introduction to Operations and Supply Chain Management, Pearson Education, Inc. , New Delhi.

Hillman, M., H. Keltz. 2007. Managing Risk in the Supply Chain: A Quantitative Study. AMR Research, Boston

IBM(2020) IBM Analytics. Available at: https://www.ibm.com/downloads/cas/VDLNDBDY (Accessed: 27th February 2020).

IBM 2008. Supply Chain Risk Management: A Delicate Balancing Act. IBM Global Business Services, New York.

INEGI (2020) Industria manufacturera. Available at: https://www.inegi.org.mx/temas/manufacturas/ (Accessed: 20th Aug 2020)

Lambert D M, Emmelhainz M A and Gardner J T (1999), ''Building Successful Logistics Partnerships'', Journal of Business Logistics, Vol. 20, No. 1, pp. 165-181.

Laudon C. and Laudon P. (2012) Managing Information Systems: Managing the Digital Frim. 12th Edition. New Jersey: Pearson Prentice Hall

Lyon, B. K. and Popov, G. (2017) 'Communicating & Managing Risk: The Key Result of Risk Assessment', Professional Safety, 62(11), pp. 35–44. Available at: http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=126051175&site=ehost-live

Mak, H.-Y. and Shen, Z.-J. (2012) 'Risk diversification and risk pooling in supply chain design', IIE Transactions, 44(8), pp. 603–621. doi: 10.1080/0740817X.2011.635178.

Miles, M.B, Huberman,A.M and Saldana,J (2014) Qualitative Data Analysis: A Methods Sourcebook (3rd edn).London: Sage

Olson, D.L. and Kesharwani;;;, S. (2009). Enterprise Information Systems: Contemporary Trends and Issues. [ebook] World Scientific Publishing Company. Available at: https://www.perlego.com/book/853107/enterprise-information-systems

Sunil,C. (2019) Supply Chain Management . 7th Edition.NY: Pearson

Simchi-Levi D, Kaminsky P and Simchi-Levi M (2003), Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies, Erwin Mc-GrawHill, Singapore.

Soni, G. and Kodali, R. (2008) 'Evolution of Supply Chain Management: Developmement in Academia and Industry'. ICFAI Journal of Supply Chain Management, 5(4), pp. 7–40.

Supply Chain Council, 2009. Supply Chain Operations Reference model version 9 [online]. Available from: www.supply-chain.org (Accessed 29th February 2020).

ISO (2018), ISO 31000:2018 Risk management-Principles and guidelines. Available at : https://www.iso.org/obp/ui/#iso:std:iso:31000:ed-2:v1:en. (Accesed: 27th of Feburary)

Sodhi, M. S., Son, B. and Tang, C. S. (2012) 'Researchers' Perspectives on Supply Chain Risk Management', Production & Operations Management, 21(1), pp. 1–13. Available at: http://web.b.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=5&sid=ed980072-01b2-4883-b505-34d5bd694cd3%40pdc-v-sessmgr01. (Accessed: 29th Feb 2020)

Simchi-Levi, David. (2019) Designing and managing the supply chain : concepts, strategies, and case studies. Third edition. Chennai : McGraw Hill Education

Sanders, N. R. (2016) 'How to Use Big Data to Drive Your Supply Chain', California Management Review, 58(3), pp. 26–48. doi: 10.1525/cmr.2016.58.3.26.

Saunders, M., Lewis, P., & Thornhill, A. (2007). Research Methods for Business Students, (6th ed.) London: Pearson.

Saunders, M.N.K., Thornhill, A. and Lewis, P. (2019). Research Methods for Business Students. 8th ed. [ebook] Pearson. Available at: https://www.perlego.com/book/971477/research-methods-for-business-students

Tracy, S.J. (2019). Qualitative Research Methods: Collecting Evidence, Crafting Analysis, Communicating Impact. 2nd ed. [ebook] Wiley. Available at: https://www.perlego.com/book/1148745/qualitative-research-methods

Yin,R.K. (2018) Case Study Research and Applications:Design and Methods (6th edition). London: Sage

Zikmund, W.G., 2003. Business research methods 7th ed., Mason (OH): Thomson/South-Western.

Appendices

Appendix A: Interview Guide

I. Opening

A. My name is Brigitte Esparza and as I looked at your background I thought it would be a good idea to interview you, so that I can better frame my research study.

B. I would like to ask you some questions about some of your experiences at work. The topics within these questions are about Supply Chain, mainly focusing on Information Systems, Risk Management and Decision-Making processes.

C. I hope to use this information to be able to build a conceptual framework that supports manufacturing companies through the process of Decision Making and Risks Mitigation in Supply Chain.

D. The interview should take about 30-40 minutes and will be recorded. Are you available to respond to some questions at this time?

(Transition: Let me begin by asking you some questions about Information Systems)

II. Body

A. Information Systems

1. Do you consider IS to be an important tool for the company? Why?
2. How does IS contributes to your job?

(Transition to the next topic: Let me continue by asking you some questions about Risk Management)

B. Risk Management

3. What do you consider to be the drivers of Supply Chain?
4. Based out of the following drivers of Supply Chain: Facilities, Inventory, Transportation, Information, Sourcing and Pricing. What would you consider to be the main risks for each driver?
5. What are the sources of risks across your Supply Chain Network both internal and external?
6. What are the bottle necks in your Supply Chain?
7. Does your company have a strategy to prevent risks?
8. How do you think you can find the balance between risk and efficiency?
9. Are there any principals, processes or model /tools that your company uses to manage Supply Chain Risks?

(Transition to the next topic: Let me continue by asking you some questions about Decision Making)

C. Decision Making

10. What steps do you follow in order to make a decision?
11. What do you do in order to analyse your supply chain for improvements?
12. What methodologies for decision making does your organisation subscribe to if any?
13. What criteria do you use to deem that you are successful after making a decision?

(Transition: Well, it has been a pleasure finding out more about your work experience)

III. Closing

14. What do you think is the connection between Risk Mitigation and Decision Making?
15. How would you describe the connection between Information Systems and Supply Chain processes?
16. I appreciate the time you took for this interview.
17. I should have all the information I need. Would it be alright to e-mail you if I have any further questions? Thank you.

Appendix B – Plain Language Statement

Plain Language Statement

The research study title is ¨An Operational Framework Using Information Systems to Mitigate Risks and Improve Decision Making in the Manufacturing Industry¨ . The purpose of this research is to **develop an operational framework that can help make decisions to optimize the supply chain by analysing** its operations, involving supply chain risks and decision-making processes.
The study is being conducted by MSc student in Procurement and Supply Chain Management, Pamela Brigitte Esparza Valerio, e-mail pamelabrigitte.esparzavalerio@student.griffith.ie , from the Graduate Business School in Griffith College Dublin.

The research study involves an online interview, which will be recorded and will take approximately 30-40 minutes to be completed. The participants name and workplace will remain anonymous if necessary, in this questionnaire supply chain professionals will answer a few questions regarding operational activities and decision making.

There is no potential risks to participants from the involvement in the research study, since the questions will be focused in their personal experience and knowledge in the area and this will not affect their day to day operations.

After the research study is completed, the participants will receive the Operational Framework for Decision Making which will be designed as the outcome of this research. They can benefit from this Framework by using it to identify and understand possible disruptions in the supply chain in the company they are currently working for, or as a guidance for decision making in operational activities and it may be adapted and variable in its implementation time, depending on the needs of a company.

Furthermore, the sample size for the research is small, therefore the data will only be stored in one place on my laptop, which is security coded. The information will remain confidential and only be used with the purpose established in this statement and managed only by the researcher and the researcher's supervisor. The data collected will be held until December 2020 for the research purposes. In addition, all participants will be given the researcher contact which they can use in case they need access to the data they provided.

Certainly, it is important to inform that the involvement in this Research Study is voluntary, and therefore the participants may withdraw from it at any point.

If participants have concerns about this study and wish to contact an independent person.

Please contact:

Dr Garrett Ryan,

Griffith College Research Ethics Committe
South Circular Road, Dublin 8, Ireland
Mail: garrett.ryan@griffith.ie
Tel: +353 1 4163324

Appendix C – Informed Consent Form

Informed Consent Form

The research study title is ¨An Operational Framework Using Information Systems to Mitigate Risks and Improve Decision Making in the Manufacturing Industry¨ . The study is being conducted by MSc student in Procurement and Supply Chain Management, Pamela Brigitte Esparza Valerio, e-mail pamelabrigitte.esparzavalerio@student.griffith.ie , from the Graduate Business School in Griffith College Dublin.

The purpose of this research is to develop an operational framework that can help make decisions to optimize the supply chain by analysing its operations, involving supply chain risks and decision- making processes.

Please circle Yes or Not for each statement		
I consent voluntarily to be a participant in this study	Yes	No
I have had an opportunity to ask questions and discuss this study	Yes	No
I have received satisfactory answers to all my questions	Yes	No
I have read the Plain Language Statement	Yes	No
I understand the information provided in the Plain Language Statement	Yes	No
I understand that even if I agree to participate now, I can withdraw at any time without any consequences.	Yes	No
I understand that participation involves answering an online questionnaire	Yes	No
I am aware that the data I provide will be managed only by the researcher and the researcher's supervisor for the research study purpose	Yes	No
I understand that all information I provide for this study will be treated confidentially	Yes	No
I understand that I am free to contact the researcher to in case I need to access the information I provided for this research study	Yes	No

I have read and understood the information in this form. My questions and concerns have been answered by the researchers, and I have a copy of this consent form. Therefore, I consent to take part in this research project

- Participants Signature:
- Name in Block Capitals:
- Witness:
- Date: