



INSTITUTO
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DE LISBOA

Department of Marketing, Strategy and Operations

**SUPPLY CHAIN DISRUPTION: THE IMPACT OF THE COVID-19
PANDEMIC IN PHARMACEUTICAL MANUFACTURING
COMPANIES.**

Mariana Isabel Gonçalves Ribeiro Filipe

Dissertation submitted as partial requirement for the conferral of
Master in International Management

Supervisor:

Professor Abel Camelo, Department of Marketing, Operations and Management, ISCTE
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RESUMO

À medida que o número de eventos disruptivos aumenta, as empresas reconhecem a necessidade de planejar para a incerteza. No entanto, muitas empresas ainda não estão preparadas perante a disrupção, seja por não terem mecanismos preventivos ou porque esses mecanismos não estão preparados para a escala dos impactos. A continuidade de negócio como uma perspectiva holística ampla tem crescido em importância, como um mecanismo utilizado pelas empresas para prevenir e reagir a eventos disruptivos.

Os eventos disruptivos tendem a ter consequências vastas, prejudicando o fluxo normal das operações, afetando o desempenho e, dessa forma, a vantagem competitiva. Além disso, os eventos disruptivos podem até prejudicar o bem-estar humano se serviços essenciais forem comprometidos. A Pandemia do COVID-19 retrata o potencial que eventos disruptivos podem ter nos próximos anos, impelindo à necessidade de práticas de resiliência e de mecanismos de continuidade de negócio. Da mesma forma, reconhecer a necessidade de estar preparado para as incertezas é fundamental, principalmente para os serviços essenciais, como as Empresas Farmacêuticas.

Neste sentido, esta investigação pode ser descrita como uma análise setorial que visa analisar a percepção do impacto da Pandemia do COVID-19 na cadeia de abastecimento das empresas farmacêuticas e determinar a preparação do programa de continuidade de negócio para a gestão eficaz desse evento disruptivo. A abordagem de investigação baseou-se na revisão da literatura e num questionário, aplicado à população selecionada. Os resultados revelam a importância da continuidade de negócio na gestão dos impactos de eventos disruptivos.

Palavras-chave: Cadeia de Abastecimento, Disrupção na Cadeia de Abastecimento, Gestão de Continuidade de Negócio, Plano de Continuidade de Negócio, COVID-19, Pandemia.

Classificação JEL: M10 – General Business Administration; Y40 – Dissertations

ABSTRACT

As the number of disruptive events increases, companies acknowledge the need for planning for uncertainty. Nonetheless, many companies are still unprepared in the face of disruption, either by not having preventive mechanisms or because these mechanisms are not prepared for the scale of the impacts. Business continuity as a broad holistic perspective has grown in importance, as a mechanism used by companies to prevent and react to disruptive events.

Disruptive events tend to have far-reaching consequences, injuring the normal flow of operations, affecting performance and, therefore, competitive advantage. Moreover, disruptive events can even jeopardize human welfare if essential services are compromised. The COVID-19 Pandemic portrays the potential that disruptive events may have in years to come, pressing the need for resilience practices and business continuity frameworks. Similarly, acknowledging the need of being prepared for uncertainty is fundamental, particularly for essential services, such as the Pharmaceutical Companies.

Accordingly, this investigation can be described as a sectoral analysis that aims to analyse the perception of the impact of the COVID-19 Pandemic on the supply chain of pharmaceutical manufacturing companies and determine the readiness of the business continuity programme for effectively managing this disruptive event. The approach to the investigation is based on a literature review and a questionnaire, applied to the selected population. The results reveal the importance of business continuity in managing the impacts of disruptive events.

Keywords: Supply Chain, Supply Chain Disruption, Business Continuity Management, Business Continuity Plan, COVID-19, Pandemic.

JEL Classification System: M10 – General Business Administration; Y40 – Dissertations

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GLOSSARY

APICS – Association for Operations Management

BCI – Business Continuity Institute

BCM – Business Continuity Management

BCMS – Business Continuity Management System

BIA – Business Impact Analysis

COVID-19 – Coronavirus disease 2019

CSCMP – Council of Supply Chain Management Professionals

ISM – Institute for Supply Management

IT – Information Technology

MTPD – Maximum Tolerable Period of Disruption

PDCA – Plan-Do-Check-Act Model

RTO – Recovery Time Objective

SC – Supply Chain

SCM – Supply Chain Management

SCOR – Supply Chain Operations Reference Model

SCR – Supply Chain Risk

SCRES – Supply Chain Resilience

SCRM – Supply Chain Risk Management

SCV – Supply Chain Visibility

CHAPTER 1 – INTRODUCTION

The present chapter aims at explaining the purpose and context of the investigation. In this regard, the segment starts by addressing the setting and framework fostering the study and acknowledging the theme's relevance at the academic and business levels. Subsequently, the problem and the objectives guiding the research are presented, followed by the research questions and the approach, ending with the overview of the document's structure.

1.1 Context and Relevance of the Theme

In December 2019, a new strain of coronavirus was identified in the capital city of Wuhan, located in east-central China. The coronaviruses are part of a more prominent family of viruses responsible for humans and animals respiratory illnesses. (Barshikar, 2020). The new strain was designated SARS-CoV-2 (an acronym that stands for “severe acute respiratory syndrome coronavirus 2”), by the World Health Organization (WHO) and is responsible for causing an infectious disease named Coronavirus disease 2019 (COVID-19). This disease escalated from a public health emergency, to a worldwide declared pandemic on March 11th, 2020 and quickly spread around the globe, transforming habits and routines, and forcing society to adapt to a new way of living that has been termed the “new normal” (Barshikar, 2020, p. 112).

According to McMaster *et al.* (2020, p. 2), “the severity of the virus differs between individuals”, with the typical symptoms ranging from fever and coughing to acute respiratory syndromes, in life-threatening cases. Considering both the infectious rate and the method of transmission of the disease (through air particles or saliva droplets) (WHO, 2020), multiple measures, such as social distancing and respiratory etiquette, were placed in practice. The highly infectious nature of the virus and its capacity to mutate, originating different stirps, contributed to the establishment of large restrictive measures that had considerable impacts on the economy and society worldwide. These measures – that include movement restrictions of both people and goods, closure of non-essential industries, logistical and border constraints and business slowdown – are responsible for the climate of global economic uncertainty and portray the disruptive potential of the Pandemic in the short and long-run (PwC Nigeria, 2020).

Worldwide, enterprises are reacting to an unprecedented crisis that has led to far-reaching consequences at the micro and macro levels (PwC Nigeria, 2020). Impacts ranging from global declines in trade and GDP, to particular job losses and income reductions. Additionally, the COVID-19 Pandemic continues to have considerable social and economic impacts, as people were forced into a confinement reality and businesses across several sectors were required to adapt and re-think their operational models. The widespread disruptions and their far-reaching consequences have led to an extensive debate on the topic, with consultants pointing out the particularities of the virus and its respective origin as underlying causes.

Over the last decade, China's role in global trade has grown significantly – “as a primary producer of high-value products and components, as a large customer of global commodities and industrial products, and as a very attractive consumer marketplace” – earning it the title of “world's factory” (Kilpatrick & Bater, 2020, p. 2). The emergence of the COVID-19 Pandemic in China, amid the Lunar New Year has deeply “affected the supply of finished and semi-finished products to countries around the world that depend on China for trade” (PwC Nigeria, 2020, p. 2). Impacts, not only due, to the extensive pandemic containment efforts, but also, the holiday's characteristic shutdowns, affected small to large enterprises, in particular, the manufacturing industry, dependent on China for inputs and organized around global supply chains (Dunn, 2021).

Global supply chains are particularly vulnerable to unexpected events occurring in major exporting countries (PwC Nigeria, 2020), due to their increasing complexity (Gurtu & Johnny, 2021; Wisner *et al.*, 2019). This vulnerability is linked with factors hindering the normal flow of goods and services, mainly logistical constraints, such as factory shutdowns and transportation restrictions. Moreover, it is essential to consider that even if businesses do not have direct suppliers in the affected countries, disruptions are still likely to occur, based on the pervasive ripple effect and the lack of visibility beyond Tier 1 suppliers (Kilpatrick & Barter, 2020).

As the COVID-19 spreads around the globe, governments continue to impose restrictive measures, as part of a global strategy, aiming at mitigating the impact of the disease, while trying to preserve human health. Nevertheless, these restrictions are associated with increasing supply chain disruptions, with companies reporting shortages due to imposed lockdowns (Dunn, 2021). For instance, 94% of the Fortune 1000 companies, which accounts for the biggest US companies organized by revenue,

reported COVID-19 driven supply chain disruptions, mainly due to factory shutdowns and demand fluctuations (McMaster *et al.*, 2020). Notwithstanding, specific industries and services were not allowed to simply shut down and had to quickly manage supply chain disruptions, to avoid significant impacts on performing essential services. Identifying these activities was one of the first steps taken by the governmental institutions of several countries, in particular, in the US and in Europe.

In Portugal, essential services were identified following Decree-Law Number 10-A/2020, of March 13th, Decree-Law Number 14-G/2020, of April 13th, and Decree Number 2-C/2020, of April 17th, in *Portaria* Number 97/2020, of April 19th, following the amendment of *Portaria* Number 82/2020, of March 29th, 2020. A list containing the designated services (Annex A) identifies several activities, ranging from the health services and the armed forces to specific governmental institutions. Also identified, under points 8, 9 and 10, are the Pharmaceutical Industry's related services, that continue to have a particularly active role in responding to the Pandemic.

The Pharmaceutical Industry has played a fundamental role in assisting governments addressing the COVID-19 Pandemic and has been experiencing significant progress, in research and development (R&D), with the production of the vaccines. Nonetheless, Pharmaceutical Companies “have also been burdened with the obligation to maintain supply chains for existing treatments and services” (Pharma Logistics IQ, 2020, p. 3). Considering the importance of these products for human welfare and the extensive regulatory requirements to which they are subjected (Argiyantari *et al.*, 2020), this created additional pressure and an increasing social responsibility. Additionally, this sector presents a greater vulnerability due to supply chain disruptions, which differentiates the Pharmaceutical Industry from others operating outside the health sector (Graves *et al.*, 2009).

The Pharmaceutical Supply Chain (PSC) is considerably complex, compared to the supply chains of other industries. It comprises the “suppliers, manufacturers, wholesalers, distributors, retailers, health service providers and medical practitioners across multiple markets” (Tripathi *et al.*, 2019, p. 518) and is directly constrained by information providers and regulatory authorities (Singh *et al.*, 2016), such as the Food and Drugs Administration (FDA) and the European Medicines Agency (EMA). These entities are responsible for approving the pharmaceutical products, upon quality, safety and cost evaluations, as well as any other changes being prompted by pharmaceutical

companies (Santos Bravo & Crespo de Carvalho, 2013). Once the products are tested and ready to be mass-produced, Pharmaceutical Manufacturing Companies contract approved active pharmaceutical ingredients' (APIs) suppliers, starting the production of finished products, adding excipient inert materials (Sousa *et al.*, 2011). The products are then distributed, following packaging and labelling, either directly or through a wholesaler, until they reach the final consumer, as portrayed in figure 1.1.

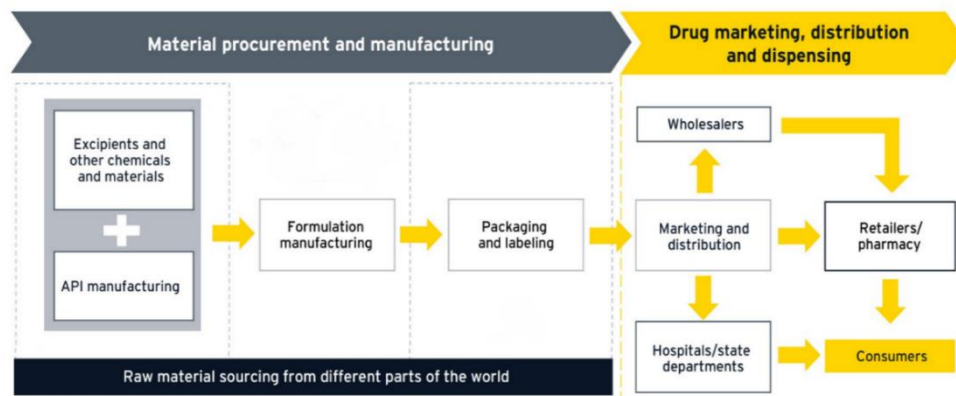


Figure 1.1 – Pharmaceutical Supply Chain. Source: Adapted from Jung (2020).

The APIs are fundamental components of the PSC, mainly produced in Asia and in countries like China or India. The impact of the COVID-19 Pandemic in this region, in particular, China, has led to significant PSC disruptions, “impeding manufacturing and supplies around the world” (Pharma Logistics IQ, 2020, p. 4), creating significant shortages. The complexity of the PSC, in terms of product characteristics and required permissions, makes any alteration dependent on approval, and therefore particularly time consuming, when compared with other industries. Given this, as there are no reliable substitutes for API supplies (Barshikar, 2020), the dependency on these countries poses a serious threat to human welfare, as agencies take shortcuts, prioritizing time over quality. Other problems in distribution and in tracking the products along the supply chain were also reported (Pharma Logistics IQ, 2020), portraying the vulnerabilities of the global PSC and leading to significant disruptions.

As stated by Graves *et al.* (2009, p. 1), “disruptions in pharmaceutical/healthcare contexts upset the continuity of providing for patient needs and can have particularly severe consequences”. The magnitude of the disruption increases as the time to recover lengthens (Kilpatrick & Barter, 2020), reflecting the importance of making the right decision, at the right moment in time and the relevance of assessments and planning in determining efficient responses to disruptive events (Moktadir *et al.*, 2018; Tripathi *et al.*, 2019). Nonetheless, not all companies have the same level of readiness to act upon

disruptions, with particular companies being better prepared than others to respond and mitigate the impact of the COVID-19 Pandemic. According to Kilpatrick & Barter (2020, p.4), these are the companies that “developed and implemented supply chain risk management and business continuity strategies”, implemented redundancy strategies, and established “strong relationships with key suppliers”, encouraged the extended supply chain’s visibility, “developed agility within their production and distribution networks” and “invested in supply chain planning”.

Special attention has been given to supply chain risk management and business continuity frameworks, particularly regarding essential services, such as the global PSC (Argiyantari *et al.*, 2020; Moktadir *et al.*, 2018; Tripathi *et al.*, 2019). In this respect, regulatory authorities, such as the FDA, proposed “requiring drug companies to conduct periodic risk assessments to identify and mitigate supply chain vulnerabilities” (Shanley, 2019). As a result, Pharmaceutical Companies have started to adopt holistic business continuity programmes to prepare for disruptive events. Nonetheless, the particularities of the COVID-19, in terms of dimension and length, confer a unique character to this event, with managers acknowledging the lack of preparation to manage the potential disruption.

The COVID-19 Pandemic will continue to have devastating impacts, as the virus spreads and governments worldwide impose further restrictive measures. Acknowledging the necessity of being prepared for uncertainty is particularly important for businesses, especially essential services, such as Pharmaceutical Companies. The growth in frequency of disruptive events, makes it likely that more disruptions will occur in the years to come, pressing the need for resilience practices and business continuity frameworks. Disruption preventive planning may differ between having extensive or reduced impacts and assuring or injuring human welfare. It is then, particularly crucial to assess the impact of the Pandemic in the supply chain structure of these companies and understand the relevance of these mechanisms, not only for academic validation, but also for informed planning in managing similar events.

1.2 Research Problem

The process of globalization that occurred throughout the late 80s and the 90s, associated with the development of technologies and communications, changed the business landscape, increasing supply chain complexity and exposing its vulnerabilities (Curkovic *et al.*, 2016; Fan & Stevenson, 2017; Kumar & Park, 2019; Wisner *et al.*, 2019; Gurtu & Johny, 2021). The fluctuations in risk profiles combined with the rising occurrence of disruptive events, led to a growing propensity for supply chain disruptions, while placing emphasis on proactive and reactive approaches, such as supply chain risk management, supply chain resilience and business continuity management (Blos *et al.*, 2012).

Over the last decade, companies have acknowledged the importance of planning for uncertainty, as the frequency of disruptive events increases (Kilpatrick & Barter, 2020). Nevertheless, many companies are still unprepared in the face of disruption, either by not having preventive mechanisms or because these mechanisms are not prepared for the scale of the impacts. In any case, disruptive events tend to have far-reaching consequences, injuring the normal flow of operations, affecting performance and, therefore, competitive advantage (Bode & Macdonald, 2016; Fiksel *et al.*, 2015). Moreover, disruptive events can even jeopardize human welfare if essential services are compromised.

Given this, researchers have been paying considerable attention to preventive and reactive mechanisms, with a particular focus on the former, especially in the aftermath of the 9/11 terrorist attacks (Deshpande *et al.*, 2017a). This event caused large scale disruptions and triggered the debate on supply chain risk management and its intrinsic importance for managing supply chain disruption. Throughout the years the literature moved from a preventive focus towards a deeper understanding of the phases that entail the prevention and materialisation of risk and therefore the disruption itself.

Business continuity as a broad holistic perspective has grown in importance, as a mechanism used by companies to prevent and react to disruptive events. Having a business continuity programme moved from being optional to being a requirement, in specific businesses (Shanley, 2019). Nevertheless, there is still a considerable gap in understanding business continuity, not only from a practical but also a theoretical point of view. The literature is rich in terms of general characterizations, historical evolutions,

and programme descriptions. However, when evaluating the benefits and the relevance of a business continuity programme in managing an actual disruptive event the number of studies is relatively low.

The COVID-19 Pandemic prompted this topic back on the table, as it caught businesses off guard and portrayed the scale and dimension that disruptive events may have in years to come. In addition to offer a unique analytical context from the literature point of view, its characteristics and the overall disruptive potential have led some researchers to characterize it as the most significant black swan event of modern history (Mishra, 2020). Therefore, as the potential for supply chain disruption increases, it is particularly imperative to analyse the impacts of these events and understand the role of these mechanisms. The overall importance of preparing for uncertainty, especially when it comes to essential services has forced businesses to continue operations even in the face of the greatest adversities.

Based on this, the research problem lies in the apparent lack of understanding of the importance of business continuity in mitigating the impacts of disruptive events in the supply chain. The COVID-19 Pandemic will provide the context for the investigation, and the pharmaceutical industry the base population to conduct the analysis.

1.3 Research Objectives

The purpose of this investigation is to analyse the impact of the COVID-19 Pandemic (as a disruptive event) on the supply chain of pharmaceutical manufacturing companies and, in turn, determine the level of readiness of the business continuity programme for effectively manage this disruptive event and its impacts. Additionally inferring on how these companies are planning for future disruptive events.

The research aims at contributing both in theory and in practice to the study of these problematics and to a more informed planning in managing similar events.

In order to achieve the objectives proposed above, a literature review was carried focused on the analysis of the state of the art, as a means to consolidate concepts and disclose the most relevant dimensions to be measured and analysed, being later complemented by an empirical study.

1.4 Research Questions

In order to achieve the research objectives described above and considering the context of the investigation, the following research questions were developed:

***RQ1** – What is the perception of the impact of the COVID-19 Pandemic on the Supply Chain of Pharmaceutical Manufacturing Companies?*

***RQ2** – What is the perception of the readiness of the Business Continuity Programme to address the COVID-19 Pandemic?*

***RQ3** – What are the key characteristics of a Business Continuity Programme in the Pharma sector?*

***RQ4** – How do Pharmaceutical Manufacturing Companies are planning for future disruptive events?*

1.5 Research Approach

The research investigation can be described as a sectoral analysis that aims to determine the perception of the impact of the COVID-19 Pandemic on the supply chain of pharmaceutical manufacturing companies. Also, to determine the readiness of the business continuity programme for effectively managing this disruptive event, while inferring on how these companies are planning for future disruptive events, by answering specific “what” and “how” research questions.

According to Yin’s (2014) seminal work, the research questions are the starting point of a logical process, aiming in designing and planning the research approach, culminating with the answers to these questions. Given this, the present investigation follows a sequential and logical process embedded in a solid and meticulous approach, as described in figure 1.2.

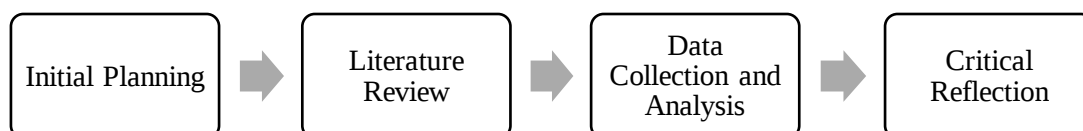


Figure 1.2 – Research Approach. Source: Own elaboration.

The first phase of the process is the initial planning, aiming at structuring the keys points based on the topic, namely the research problem, the theoretical constructs, the

research objectives, and the research questions to be answered and developed. Following, the literature review, an intricate phase, embedded in a sequential procedure, that begins with the research of reliable academic literature and the selection of relevant articles. This evolves into the review and analysis of selected articles, to develop a solid base of written thoughts, conceptualisations, and ideas. The third phase of the process, the data collection and analysis, is based on a dual approach, the first being essentially rooted in the selection of the target population and the second embedded in the development and application of a closed-ended questionnaire, sent by email to the identified population, followed by the characterization of the sample and the analysis of the data through specific data analysis instruments. The process ends with the critical reflection, which entails the analysis of the results, in close connection with the literature review, to retrieve practical and theoretical conclusions, identify limitations and propose recommendations for future research.

1.6 Document Structure

The document is structured in five chapters: Introduction, Literature Review, Methodology, Results and Discussion and Conclusions.

- Chapter 1: Introduction – The first chapter introduces the context and relevance of the theme, followed by the research problem, the research objectives, the research questions, and the research approach, culminating with the document structure.
- Chapter 2: Literature Review – The second chapter introduces the primary theoretical constructs that substantiate the analysis. The evolution and conceptualisation of the terms Supply Chain and Supply Chain Management, followed by the Supply Chain Operations Reference Model and the respective dimensions. A risk theorisation is then presented through the disclosure of Supply Chain Risk and Supply Chain Risk Management. Later, risk materialization is analysed based on Supply Chain Disruption and Supply Chain Resilience. The chapter concludes with a historical evolutionary perspective on Business Continuity Management, a description of a Business Continuity Programme, based on ISO 22301:2019 and a clarification on Pandemic planning.

- Chapter 3: Methodology – The third chapter presents and explains the research methodology guiding the investigation, in particular, the approach to the research questions, the data collection method, the process of construction of the questionnaire and the process of selection of the sample.
- Chapter 4: Results and Discussion – The fourth chapter introduces the main findings of the investigation, starting with the characterization of the sample and culminating with the presentation and discussion of the results to the specific research questions.
- Chapter 5: Conclusions – The final chapter presents the main conclusions and limitations of the investigation, the recommendations for future research, along with, empirical and practical implications.

CHAPTER 2 – LITERATURE REVIEW

The present chapter introduces the primary theoretical constructs that substantiate the investigation, starting with Supply Chain and Supply Chain Management. Subsequently, the SCOR Model is analysed, and the specific dimensions are identified, followed by the concepts of Supply Chain Risk and Supply Chain Risk Management. Later, a description of risk materialisation in terms of Supply Chain Disruption and Supply Chain Resilience is provided. The chapter is concluded with a historical perspective on Business Continuity Management, a standard description of a Business Continuity Programme and a clarification on Pandemic planning. The relationship between these concepts is shown in figure 2.1.

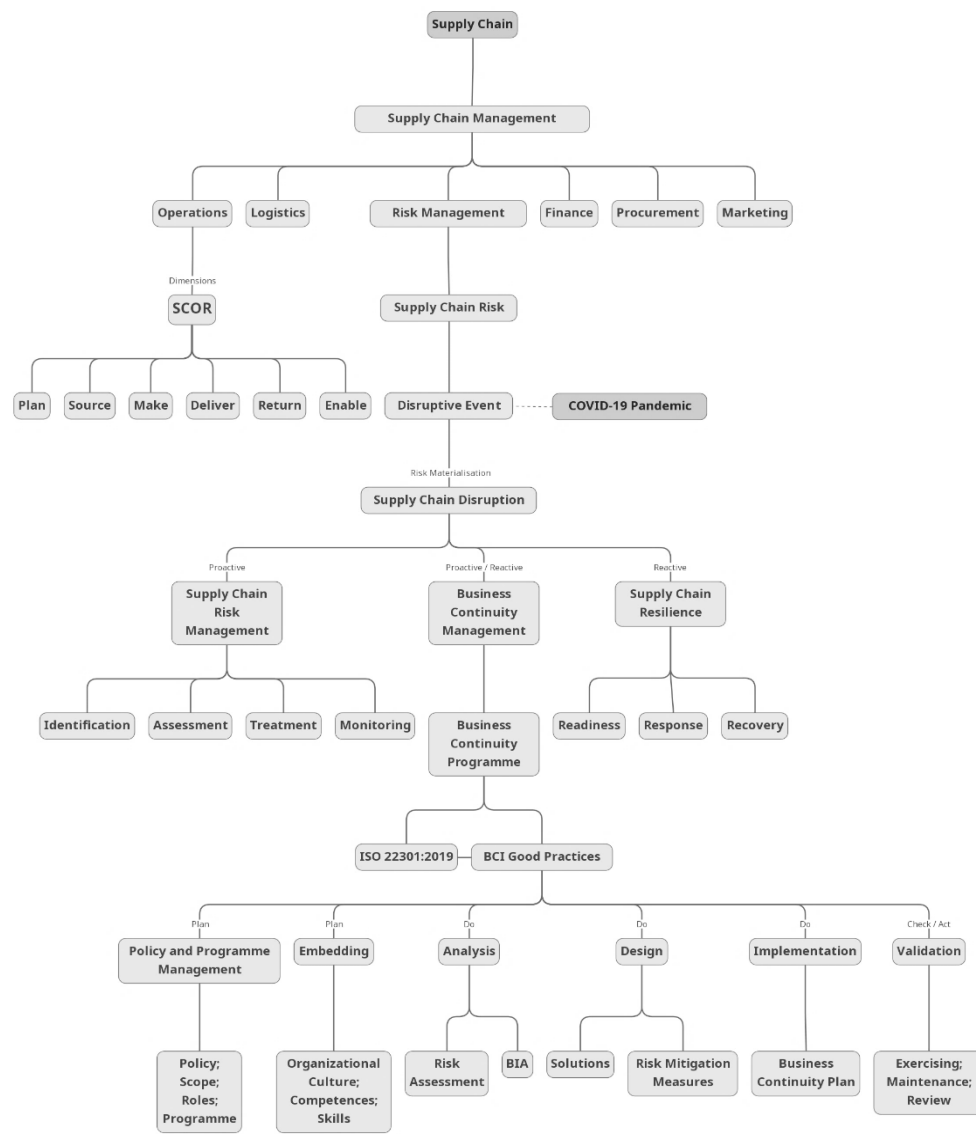


Figure 2.1 – Conceptual Mind Map. Source: Own elaboration.

2.1 Supply Chain

The term Supply Chain (SC) is traced back to the 80s, when scholars established an association with a new management field, adding the concept to the management lexicon (Christopher & Peck, 2004; Reis *et al.*, 2014). Throughout time, the term SC suffered a considerable evolution. According to Smart (2008, as cited in Reis *et al.*, 2014, p. 440), the SC evolved from an “operational activity” to a “strategic concept” that extends across functions and moves beyond the spectrum of one organization. Nevertheless, the theorization around the SC led to a fuzzy horizon, with scholars presenting different terms, ranging from organizational networks to supply networks or even supply webs (Reis *et al.*, 2014; Waters, 2003). Given this, the need to refine the theory and set the principles behind the concept emerged and many authors made efforts in this direction, for instance Carter *et al.* (2015).

In their preliminary effort, Carter *et al.* (2015), conceptualize SC according to six different premises.

The first premise is that the “supply chain is a network, consisting of nodes and links” (Carter *et al.*, 2015, p. 5). In this respect, nodes refer to agents or players that can make decisions and increase their performance, such as suppliers, manufacturers and distributors and links to the association between two nodes, which represents transactions, such as the flow of materials, information, and finance. This assumption is portrayed in the works of Sodhi & Tang (2012), Christopher (2016) and Swink *et al.* (2020), which define SC as a network, emphasizing the character of the relationship between players.

The second premise is that “the supply chain as a network operates as a complex adaptive system, where every agent duels with the tension between control and emergence” (Carter *et al.*, 2015, p. 6). Each node or agent in the SC has control over resources and is accountable to other nodes, providing agency while maximizing performance within its visible horizon. Beyond the visible horizon of the SC, the agent has no power, having to accept and adapt to the decisions made by other agents.

The third premise relates to the previous and states – “the supply chain is relative to a particular product and agent” (Carter *et al.*, 2015, p. 7) – resulting in that the SC may look completely different depending on the agent under analysis (focal agent). In terms of structure and considering the focal agent as the unit of analysis, the nodes that move

products inwards are called upstream the SC and are organized into tiers, while the ones that move products outwards are called downstream the SC (Waters, 2003).

The authors established a distinction within the SC, gathered in the fourth premise, moving beyond the introductory assumptions. Accordingly, “the supply chain consists of both a physical supply chain and a support supply chain” (Carter *et al.*, 2015, p. 9). The former is what scholars refer to as the traditional SC, consisting of nodes and links through which the product (that is relative to the agent) flows. The latter refers to the nodes through which the product does not flow, but instead, help support the physical SC, such as financial institutions. Carter *et al.* (2015), alert for the possibility of a support SC node serving as a physical SC node, considering their third premise underlining the relative nature of the SC.

The fifth premise assumes that “the supply chain is bounded by the visible horizon of the focal agent” (Carter *et al.*, 2015, p. 12), in the sense that is limited, based on the awareness the focal agent has of other nodes and links that affect the product. This assumption may explain the rising attention given to supply chain visibility (SCV) and its impact in overall performance (Wisner *et al.*, 2019).

The sixth and final premise is directly linked to the former, specifically, “the visible horizon of the focal agent is subject to attenuation, where distance depends on factors including physical distance, cultural distance, and closeness centrality” (Carter *et al.*, 2015, p. 13) portraying the importance of a co-operation approach, not only to improve visibility, but to support value creation.

In their preliminary attempt to produce a theory of SC, the holistic approach created by Carter *et al.* (2015) provides a delimitation and clarification of the term, following the literature and the specific behavioural context. Nevertheless, researchers have not reached a common ground when it comes to defining the term SC. Given this, the Council of Supply Chain Management Professionals (CSCMP) proposed some clarification by providing a deconstructed definition of SC: “1) starting with unprocessed raw materials and ending with the final customer using the finished goods, the supply chain links many companies together. 2) the material and informational interchanges in the logistical process stretching from acquisition of raw materials to delivery of finished products to the end-user. All vendors, service providers and customers are links in the supply chain” (Kate Vitasek, 2013, p. 183). This definition

portrays the SC as a complex and adaptative endeavour, bounded by specific agents, – producers, distributors, retailers, costumers, and service providers – that need to respond to market requirements in alignment with a particular strategy (Hugos, 2012).

In their quest for a clear conceptualization, scholars have also tried to define and adapt early definitions to match the nature and dynamism of the SC. Christopher (1992, as cited in Christopher & Peck, 2004, p.4), in an early work, defined SC as “the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer”. The author later revisited Aitken’s conceptualization, adapting its definition to “a network of connected and interdependent organisations mutually and co-operatively working together to control, manage and improve the flow of materials and information from suppliers to end users” (Christopher, 2016, p. 13). Recent definitions include what is known as reverse logistics or activities associated with warranty repairs, returns and the overall recycling of products (Wisner *et al.*, 2019). An example by Swink *et al.* (2020, p. 4) defines SC as “the global network of organizations and activities involved in (1) designing a set of goods and services and their related processes, (2) transforming inputs into goods and services, (3) consuming these goods and services, and (4) disposing of these goods and services”.

Overall, the theorisation around the term SC has been paving scholars’ agenda for years. Despite the lack of a common definition, scholars have seemed to agree that the SC (or network or web) connects a set of organizations or activities in a collaborative process to produce, control, manage and improve transaction flows (products, information, and finance) from upstream SC to downstream SC, while increasing performance. SCs are dynamic and complex and should report to the market, while following a specific business strategy.

2.2 Supply Chain Management

The term Supply Chain Management (SCM) appeared in the 80s (Carter *et al.*, 2015; Christopher, 2016; Christopher & Peck, 2004; Hugos, 2012; Mentzer *et al.*, 2001b; Reis *et al.*, 2014; Wisner *et al.*, 2019) to describe a new management field that aimed to respond to changes in business strategy (Christopher & Peck, 2004). It is associated

with the consultancy firm Booz, which in 1982, developed a white paper, discussing the need to move past the traditional arm's length relationship that characterized buyer/supplier association and establish a co-operation approach – SCM – based on trust (Christopher, 2016). Even though, the first conceptualizations can be traced back to four decades ago, the idea behind the concept is not new and revolves around perceptions that were maintained throughout the centuries (Hugos, 2012).

Back in the day, many large firms followed a vertical integration strategy, in which, they owned some of their suppliers and consumers. However, this strategy quickly became costly and challenging to manage. The process of globalization, associated with the development of technologies and communications, offered new strategies to firms, that could now focus on their core business capabilities, while trying to create alliances with other focal companies. This collaborative approach has become the foundation for success and is central in the SCM theorisation (Christopher, 2016; Wisner *et al.*, 2019). Due to all these changes, that happened, throughout the late 80s and the 90s, the term SCM came into widespread use, particularly, in this later decade (Hugos, 2012; Mentzer *et al.*, 2001b). According to Wisner *et al.* (2019, p. 12), “the practice of supply chain management rapidly increased in popularity as a source of competitive advantage”. Despite the development in theorisation, significant confusion regarding its meaning prevailed, with many considering SCM simply external logistics (Mentzer *et al.*, 2001b; Wisner *et al.*, 2019)

As referred in Hugos (2012), there are considerable differences between the concept of SCM and the concept of logistics. While SCM is related to coordinated action from a network of companies to deliver a product, the later comprises the activities that occur within one single organization from the point of origin to the point of consumption. SCM acknowledges logistics a critical element of its broader conceptualization (Wisner *et al.*, 2019). It encompasses the integration of traditional activities into cross-functional inter-organisational processes (Christopher & Peck, 2004). These activities, which range from logistics to finance, are fundamental for fulfilling costumer's requests and, therefore, for SCM (Hugos, 2012).

Notwithstanding the several attempts of clarification, that aimed to reach the maturity of the term, the lack of a common standard ground definition leads to different paths in theorisation. According to Mentzer *et al.* (2001b, p. 2), the concept of SCM has been defined in “operational terms”, as a “management philosophy” and as

“management process” in the specific literature. This ambiguity in defining SCM emphasizes the need to examine and deconstruct the term, process that some researchers have completed.

Mentzer *et al.* (2001) recognise that SCM comprises several firms, business activities and the coordination of the activities across the SC. Given this, they define SCM as “the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, to improve the long-term performance of the individual companies and the supply chain as a whole”. As mentioned in Wisner *et al.* (2019, p. 7), this systemic approach to SCM can also be found in the definitions of the CSCMP, – “the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers” – the Institute for Supply Management (ISM) – “the design and management of seamless, value-added processes across organizational boundaries to meet the real needs of the end customer” – and the Association for Operations Management (APICS) – “the design, planning, execution, control, and monitoring of supply chain activities to create net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand, and measuring performance globally”. The link between these definitions is the conceptualization around the coordination of business activities among SC participants to improve efficiency and customer service.

SCM's success depends on the collaboration of participants, which should find ways to work together and build relationships based on trust and shared information (Christopher, 2016; Wisner *et al.*, 2019). This was the foundation behind Christopher's definition, which some researchers accepted, such as Reis *et al.* (2014), and that is worth considering. The author defined SCM as “the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole” (Christopher, 2016, p. 13), portraying the beneficial potential of SCM for its members.

It appears that, despite the lack of consensus regarding a SCM definition, most of the theorisation and the definitions presented have intrinsically similar ideas. Given this, it is possible to infer that SCM sets on three aspects: the coordination or integration of

core business activities, the cooperation among participants and the advantages or benefits related to efficiency, value creation and customer satisfaction. The main differences in theorisation are related to the number of aspects considered, the lexicon and the selected approach. Nonetheless, there is an urge to find a standard definition, significantly when the SCM realm is growing in complexity (Wisner *et al.*, 2019). A standard definition would contribute to mature the topic, while building a cohesive discipline and helping researchers move beyond both in theory and practice.

2.3 Supply Chain Operations Reference Model (SCOR)

The Supply Chain Operations Reference Model (SCOR) is a widely accepted model for SC operations developed in 1996 by the founding firms of the Supply Chain Council (Hugos, 2012; Rotaru *et al.*, 2014; Wisner *et al.*, 2019). Following the merge with APICS, the SCOR model has become part of its body of knowledge and, the organization responsible for managing the framework, while also investing in education and growth opportunities (Christopher, 2016; Wisner *et al.*, 2019).

In holistic terms, the SCOR model is a cross-functional reference framework that provides methodology, diagnostic and benchmarking tools and assists organizations in managing SC operations and in monitoring performance (Rotaru *et al.*, 2014; Wisner *et al.*, 2019). As stated by Rotaru *et al.* (2014, p. 1247–1248) “it provides a unique framework that links business process, metrics, best practices and technology into a unified structure to support communication among supply chain partners and to improve the effectiveness of supply chain management and related supply chain improvement activities”. The structure lays around six primary processes, namely, Plan, Source, Make, Deliver, Return and Enable as described by APICS (2017) and characterised in figure 2.2:

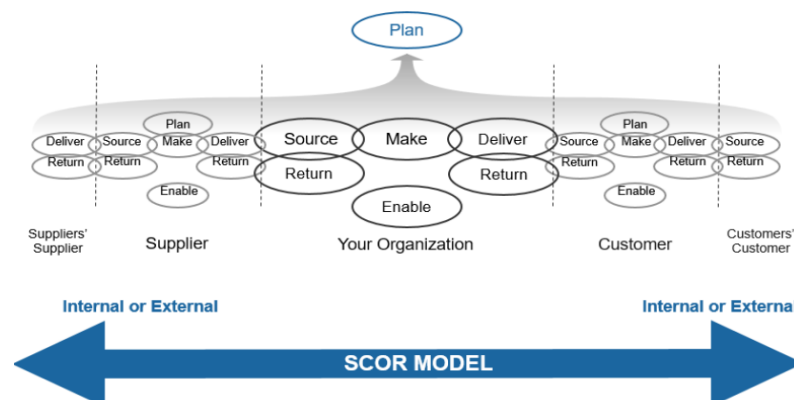


Figure 2.2 – SCOR Model. Source: APICS (2017)

- i. **Plan (sP):** The Plan processes refer to the activities associated with the planning and operating of the SC and that create the foundation for other SC processes. These include the collection of information on demand and the resources and requirements needed for the normal functioning of other processes and the overall plans for sourcing, production, delivery, and return. In terms of hierarchy the Plan processes include:
 - (sP1) Plan Supply Chain;
 - (sP2) Plan Source;
 - (sP3) Plan Make;
 - (sP4) Plan Deliver;
 - (sP5) Plan Return.
- ii. **Source (sS):** The Source processes comprise the activities related to ordering and delivering of goods and services. These include scheduling deliveries, purchasing orders and validation, and receiving and storage of goods. In terms of hierarchy, the Source processes include:
 - (sS1) Source Stocked Product;
 - (sS2) Source Make-to-Order Product;
 - (sS3) Source Engineer-to-Order Product.
- iii. **Make (sM):** The Make processes illustrate the activities associated with converting materials into products and creating substance for services. These comprise the scheduling of production activities and the assembly, testing, packaging, and release of the products. In terms of hierarchy, the Make processes include:
 - (sM1) Make-to-Stock;
 - (sM2) Make-to-Order;
 - (sM3) Engineer-to-Order.
- iv. **Deliver (sD):** The Deliver processes designate the activities involved in creating, preserving, and fulfilling customer's orders. These include the receipt, confirmation, and creation of customers' orders, scheduling of deliveries, picking, packing, and shipping, and lastly invoicing the customer. In terms of hierarchy the Deliver processes include:
 - (sD1) Deliver Stocked Product;
 - (sD2) Deliver Make-to-Order Product;
 - (sD3) Deliver Engineer-to-Order Product;

- (sD4) Deliver Retail Product.
- v. **Return (sR):** The Return processes refer to the activities associated with reverse logistics. These include the identification and disposition to return and the scheduling, shipment, and receipt of the returned goods. In terms of hierarchy the Return processes include:
 - (sSR1) Source Return Defective Product;
 - (sDR1) Deliver Return Defective Product;
 - (sSR2) Source Return MRO Product;
 - (sDR2) Deliver Return MRO Product;
 - (sSR3) Source Return Excess Products
 - (sDR3) Deliver Return Excess Product.
- vi. **Enable (sE):** The Enable processes comprise the activities involved in managing the SC, ranging from business rules to resource management, facilities management, data management, performance management, risk management, procurement, regulatory compliance, and contract management. In terms of hierarchy, the Enable processes include:
 - (sE1) Manage Supply Chain Business Rules;
 - (sE2) Manage Supply Chain Performance;
 - (sE3) Manage Data and Information;
 - (sE4) Manage Supply Chain Human Resources;
 - (sE5) Manage Supply Chain Assets;
 - (sE6) Manage Supply Chain Contracts;
 - (sE7) Manage Supply Chain Network;
 - (sE8) Manage Regulatory Compliance;
 - (sE9) Manage Supply Chain Risk;
 - (sE10) Manage Supply Chain Procurement;
 - (sE11) Manage Supply Chain Technology.

As portrayed in figure 2.3, the SCOR model performs a multi-level SC analysis. Nevertheless, to main its standardized approach, the framework focus is restricted to the top three process levels, that are neutral across organizations. Level 4 should, however, be implemented based on the organization's specific information (APICS, 2017). As a process reference model, SCOR's purpose is to enable communication, performance measurement and integration across the SC and between organizations, based on a

standardized perspective (APICS, 2017; Christopher, 2016; Wisner *et al.*, 2019). The framework consists of four major sections, according to APICS (2017): Performance (metrics to describe process performance and define goals), Processes (management processes and relationships), Practices (practices that produce better process performance) and People (skills required to perform SC processes). A fifth section is related with the special applications of the framework.

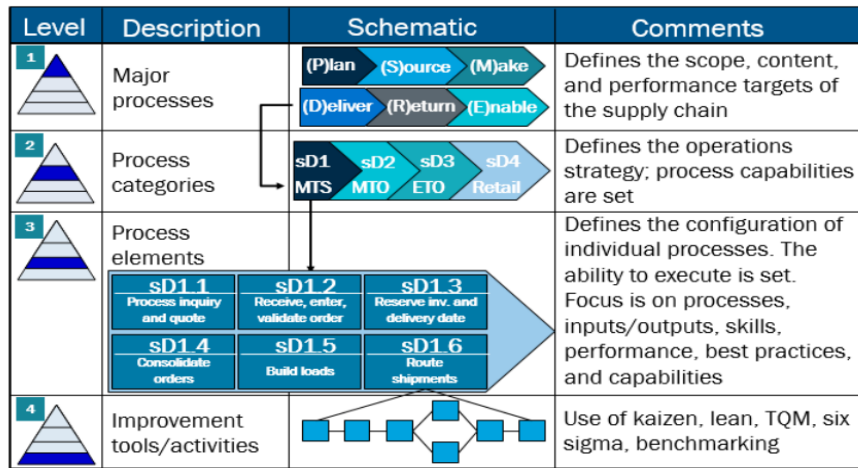


Figure 2.3 - SCOR Process Hierarchy. Source: APICS (2017)

Implementing the SCOR framework requires a considerable investment, not only in terms of resources, but also in terms of time, considering the need to establish an open communication type of relationship with the SC partners. Nevertheless, process reference models can be extremely useful from a SCM perspective, leading to improvements in terms of performance and competitive advantage (Wisner *et al.*, 2019).

In this investigation, the SCOR model will be used as a foundational tool, by providing the dimensions and the metrics necessary to measure the supply chain and construct the first part of the analysis.

2.4 Supply Chain Risk Management

The process of globalization that occurred throughout the late 80s and the 90s, associated with the development of technologies and communications, changed the business landscape and improved the complexity of SCs, increasing its vulnerability and the associated risks (Albastroiu & Felea, 2013; Bandaly *et al.*, 2012; Christopher, 2016; Christopher & Peck, 2004; Curkovic *et al.*, 2015; Fan & Stevenson, 2018; Gurtu & Johny, 2021; Kumar & Park, 2018; Wisner *et al.*, 2019).

According to Wozniak & Wereda (2019, as cited in Kabus *et al.*, 2020, p. 469), “risk is an ambiguous and heterogenous category”, difficult to define and subject to different interpretations (Christopher & Peck, 2004; Cook, 2018; Deshpande *et al.*, 2017a). Nevertheless, some scholars attempted at conceptualizing the term, that in turn may be defined as “the probability of emergence of unwanted situations, of negative consequences of an event” (Rowe, 2007, as cited in Kabus *et al.*, 2020, p. 469) or “the set of specific factors, activities and/or actions that cause material damage or loss” (Kaczmarek, 2008, as cited in Kabus *et al.*, 2020, p. 469). The term was also associated with uncertainty and the probability of losing or gaining something of value (Cook, 2018; Gurtu & Johny, 2021). Even though most definitions imply a negative connotation, risk can also have a positive significance (Deshpande *et al.*, 2017b), considering its relative nature, dependent on the subjects’ perception (Bak, 2018; Cook, 2018).

In association with SC, risk has been conceptualized in supply chain risk (SCR), although there is no consensus regarding a definition (Deshpande *et al.*, 2017b; Ho *et al.*, 2015). Wisner *et al.* (2019, p. 522) define SCR as “the likelihood of an internal or external event that disrupts supply chain operations, causing potential reductions in service levels, product quality, and sales, along with an increase in costs”. A similar perspective was proposed by Ho *et al.* (2015, p. 5), whereas Zsidisin (2003, as cited in Kabus *et al.*, 2020, p. 470) and (Swink *et al.*, 2020), conceptualize SCR as the “probability” of an event, occurring in a specific stage of the SC, threaten the capacity of the organization to satisfy its customers. Deshpande *et al.* (2017b, p. 184) acknowledge that the most common definition in the literature is “based on the magnitude of potential losses incurred by the firms in the supply chain due to undesirable deviations from the expected supply chain performance measures or outcomes caused by triggering of disruptive events”. Despite these variations, researchers have reached an agreement on the pressing need to manage SCR, considering the growing complexity and interdependence of the SC and the overall risks’ disruptive potential (Revilla & Saenz, 2017). The interest was also reinforced by the SC disruptions experienced in the aftermath of the 9/11 terrorist attacks that served as a triggering point in the supply chain risk management (SCRM) theorization (Christopher & Peck, 2004; Deshpande *et al.*, 2017b; Sodhi & Tang, 2012).

According to Sodhi & Tang (2012), SCRM is a multi-disciplinary field, considering the links with SCM, enterprise risk management, crisis management and business continuity. Nevertheless, it is crucial to recognise that each discipline has its purpose and that, even though, an overlap may exist, there is a clear difference between them (Sodhi & Tang, 2012). Considering that the major theorisation around SCRM only started in the aftermath of 9/11, the field is still relatively new (Albastroiu & Felea, 2013), which may explain the lack of consensus regarding a definition (Deshpande *et al.*, 2017b).

Several researchers provided definitions for SCRM, regarding its collaborative nature (Deshpande *et al.*, 2017b) and differing in terms of the elements, methods and objectives considered (Ho *et al.*, 2015). The importance of collaboration is stressed in the definition adopted by Revilla & Saenz (2017), in which SCRM is “the identification of potential sources of risk and implementation of appropriate strategies through a coordinated approach among supply chain members, to reduce supply chain vulnerability” (Juttner *et al.*, 2003, as cited in Revilla & Saenz, 2017, p. 560).

Ho *et al.* (2015) identified the gaps in theorisation based on a literature review approach, defining SCRM as “an interorganizational collaborative endeavour utilizing quantitative and qualitative risk management methodologies to identify, evaluate, mitigate, and monitor unexpected macro and micro level events or conditions, which might adversely impact any part of a supply chain”. Later, Fan & Stevenson (2018) acknowledged that this definition, in accordance with others, emphasizes the stages of SCRM, while dismissing its pathway and primary objectives. The authors moved beyond, as to propose a comprehensive definition that “ticks” all the aspects, defining SCRM as “the identification, assessment, treatment, and monitoring of supply chain risks, with the aid of the internal implementation of tools, techniques and strategies and of external coordination and collaboration with supply chain members to reduce vulnerability and ensure continuity coupled with profitability, leading to competitive advantage” (Fan & Stevenson, 2018, p. 210).

The conceptualization of SCRM, revolves around the objectives, the process, and the pathway towards implementation (Fan & Stevenson, 2018; Ho *et al.*, 2015). The SCRM process is associated with four main stages: risk identification, risk assessment, risk treatment and risk monitoring (Ho *et al.*, 2015; Vakharia & Yenipazarli, 2009), related with ISO 31000 (2009), – released by the International Organization for

Standardization (ISO) – an alternative approach on risk management (Fan & Stevenson, 2018). In terms of literature, there are considerable differences in terminology when comparing one author to the other, which has been attributed to the “lack of a common vocabulary” when it comes to risk (Deshpande *et al.*, 2017b, p. 183). Nonetheless, even though scholars attribute different terms to the stages presented, the process is inherently identical.

Risk identification is the first (Ho *et al.*, 2015) and most critical step in SCRM (Fan & Stevenson, 2018), involving a structured identification and categorization of SCRs (Deshpande *et al.*, 2017b; Ho *et al.*, 2015) that contributes to the deployment of strategies (Chopra & Sodhi, 2004). The lack of a common vocabulary has contributed to the development of several terminologies in identifying risk sources (Deshpande *et al.*, 2017b) or risk types (Ho *et al.*, 2015), that range from internal and external risks (Albastroiu & Felea, 2013; Christopher & Peck, 2004) and micro and macro risks (Ho *et al.*, 2015) to supplier-related, process-related, demand-related and corporate-level risks (Sodhi & Tang, 2012). These are dependent on the subject and organization under consideration (Deshpande *et al.*, 2017b).

Risk assessment entails a cost-efficient approach to SCRs, considering that SCRM endeavours can be costly, and a careful deployment of resources is imperative for its effectiveness (Fan & Stevenson, 2018). Risk prioritization is fundamental in this stage, to identify the pressing risks and organize the resources accordingly (Bandaly *et al.*, 2012). As stated by Sodhi & Tang (2012, p. 35), companies usually assess risk based on a “risk mapping” exercise, where for each identified risk source/type, a quantification in terms of likelihood (probability of occurrence) x impact (consequence) is made. The highest scores constitute the pressing risks, that that have either a high likelihood or a high impact, or a combination of both and require special attention. Moreover, it is essential to consider that SCRs are often interconnected (Chopra & Sodhi, 2004) and that “a risk event is rarely an isolated incident” (Fan & Stevenson, 2018, p.215).

Risk treatment consists of the deployment of strategies, in order to mitigate specific SCRs. There are several risk treatment strategies in the literature of SCRM, notwithstanding, there are five generic ones: risk acceptance, risk avoidance, risk transfer, risk sharing, and risk mitigation (Fan & Stevenson, 2018). As the name specifies, risk acceptance, refers to the risk that an organization is willing to accept, and it is intrinsically related to the impossibility of mitigating every risk. Nonetheless,

willingness to accept a risk is not the same as ignoring the risk, which should still be traced and controlled. Risk avoidance is essentially preventive and intends to eliminate unwanted events (Fan & Stevenson, 2018; Sodhi & Tang, 2012). Risk transfer and risk sharing are similar, in the way, that there are other parties involved. The former consists on the transference of responsibilities to other parties, while the latter is related to shared responsibilities (Fan & Stevenson, 2018). Risk mitigation entails efforts to reduce the likelihood or the impact of a risk source/type, or a combination of both, (Sodhi & Tang, 2012) until it reaches an acceptable level (Fan & Stevenson, 2018). These strategies dependent on a vast number of factors, ranging from the organization's circumstances to the resources available for SCRM (Bandaly *et al.*, 2012) and should be continuously monitored.

Risk monitoring is linked to the dynamic nature of risk and the need to continuously monitor and trace risk, to make the necessary adjustments to the strategies deployed. This procedure should rely, not only, on judgemental assessments, but also formally recognized measures (Fan & Stevenson, 2018). It involves monitoring the strategies and the plans designed to treat SCRs, while also taking preventive actions (Deshpande *et al.*, 2017b).

The objectives of SCRM arise mainly from financial and business continuity perspectives. In terms of finance, SCRM aims at improving performance and profitability. It does so proactively, ensuring the normal flow of operations and business continuity (Fan & Stevenson, 2018). Even though some researchers consider that SCRM can also portray a reactive nature by responding to SC disruptions, it is important to consider that its objective is essentially proactive, leaving the response to other fields, such as business continuity and crisis management (Sodhi & Tang, 2012). Lastly, the pathway towards SCRM is related to the strategies deployed to treat SCRs internally and the external collaboration between SC partners. Creating a SCRM culture within the organisation, aligned with the business strategy (Bandaly *et al.*, 2012; Curkovic *et al.*, 2015) is extremely important to ensure effectiveness. Once a company understands and acts upon its vulnerabilities, identifying, assessing, treating, and monitoring SCRs will be best prepared to deal with uncertainty while enhancing operational resilience, fostering performance, and preventing SC disruptions (Christopher, 2016).

2.5 Supply Chain Disruption

Ensuring the normal flow of operations is extremely important for any business that aims to maintain or improve its performance and competitive advantage. The evolution of SCs as a result of changes in business strategy, altered the risk profile of most organizations and its propensity for SC disruptions (Bode & Macdonald, 2016; Fiksel *et al.*, 2015; Gurtu & Johny, 2021; Sodhi & Tang, 2012; Vakharia & Yenipazarli, 2009).

In the SCRM literature, a disruption is defined as “an unplanned, unintended, and exceptional situation that disrupts the normal flow of goods and materials within a supply chain” (Revilla & Saenz, 2017, p. 2). Other contribution described disruption as “unplanned and unanticipated events that disrupt the normal flow of goods and materials within a supply chain and, as a consequence, expose firms within the supply chain to operational and financial risks.” (Craighead *et al.*, 2007, as cited in Bode & Macdonald, 2016, p. 838). A similar view was proposed by Bode & Macdonald (2016, p. 838), defining SC disruption as “the combination of an unintended and unexpected triggering event that occurs somewhere in the upstream supply chain (the supply network), the inbound logistics network, or the purchasing (sourcing) environment, and a consequential situation, which presents a serious threat to the normal course of business operations of the focal firm”. Despite the differences in terminology, it is possible to infer that, SC disruptions are the merge of unanticipated disruptive events, injuring the normal flow of operations within a SC, and the direct consequences, affecting the organization’s overall performance. Examples of disruptive events abound in the literature, ranging from the 9/11 terrorist attacks to the COVID-19 Pandemic (Pournader *et al.*, 2020).

SC disruptions have far-reaching consequences (Chopra & Sodhi, 2014; Fiksel *et al.*, 2015; Mandal, 2014) that “may affect performance through lost sales, stockouts, production shutdowns, premium freight charges, and product substitutions” (Bode & Macdonald, 2016, p. 837). “The Business Continuity Institute in its recent supply chain resilience report identified loss of productivity, customer complaints, increased cost of working, loss of revenue and impaired service outcomes as the top five consequences of supply chain disruption” as stated in Datta (2017, p.1378). A SC disruption occurs when the SCR is materialized in the verge of a disruptive event. While SCR is related to the likelihood of a SC disruption, the latter is linked with an unforeseen disruptive event

and its direct consequences. SCR exists without SC disruption, but SC disruption doesn't exist without SCR (Gurtu & Johny, 2021). After a SC disruption occurs, there is a need to restore the normal flow of operations by ensuring supply chain resilience. While SCRM follows a proactive approach by identifying, assessing, treating, and monitoring SCRs, supply chain resilience follows a reactive approach, ensuring the normal flow of operations and managing SC disruptions (Mandal, 2014). This process is represented in figure 2.4, following an adaptation from Messina *et al.* (2020) and the theorization of (Mandal, 2014), where SCRM is portrayed as a predecessor of supply chain resilience.

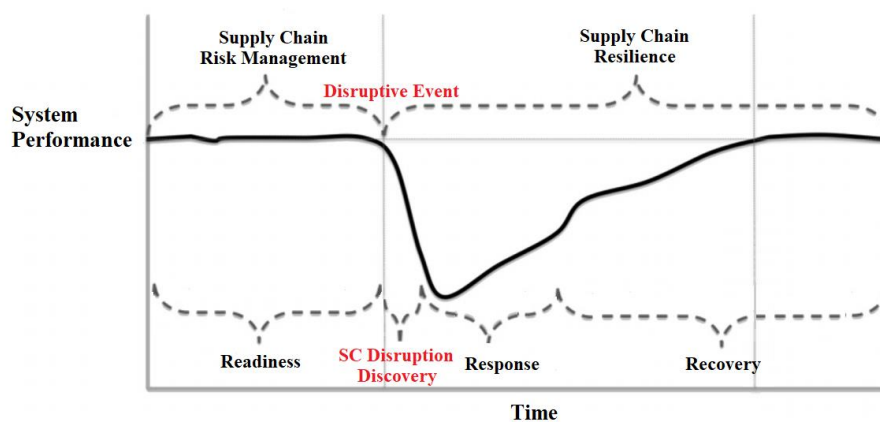


Figure 2.4 - Supply Chain Risk Process. Source: Own elaboration based on (Mandal, 2014). Adapted from (Messina *et al.*, 2020).

2.6 Supply Chain Resilience

Supply chain resilience (SCRES) has become the focus of many scholars in recent years, considering its importance in managing SC disruptions and its pertinence in terms of SCM (Chowdhury & Quaddus, 2016; Hohenstein *et al.*, 2015).

The term can be traced back to the 70s, when Holling first described it as a “measure of the persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables” (Holling, 1973, as cited in Blos *et al.*, 2012). Related to SC, resilience is defined as the “capability of a supply chain to minimize the impact of a disruption and to recover after a disruption” (Swink *et al.*, 2020). In a more comprehensive basis, as “a dynamic process of steering the actions so that the organisation always stays out of danger zone, and if the disruptive/uncertain event occurs, resilience implies initiating a very rapid and efficient response to minimise the consequences and maintaining or

regaining a dynamically stable state, which allows it to adapt operations to the requirements of the changed environment before the competitors and succeed in the long run” (Datta, 2017). Despite the existing conceptualizations “the most widely cited definition is given by Christopher and Peck” (Chowdhury & Quaddus, 2016, p. 709).

According to the authors, resilience is “the ability of a system to return to its original state or move to a new, more desirable state after being disturbed” (Christopher & Peck, 2004, p. 4). This conceptualization served as the basis for many theorisations, such as Blos *et al.* (2012), Hohenstein *et al.* (2015) and Mandal (2012). Even though, the conceptualization of Christopher & Peck (2004) provided some clarification over the definition of SCRES, its antecedents and the specific measurement criteria remain fuzzy in the vast horizon of practitioners and perspectives (Chowdhury & Quaddus, 2016; Hohenstein *et al.*, 2015).

Supply chain design/re-engineering, supply chain agility, supply chain collaboration and supply chain risk management are identified as antecedents of SCRES (Christopher, 2016; Christopher & Peck, 2004; Datta, 2017; Mandal, 2012). The first, SC design/re-engineering, is related to the systemic nature of risk, which is linked to how SC is engineered (Christopher, 2016). Organizations need to design SCs, based on a cost reduction approach and based on a resilience perspective by having a clear understanding of the network (Christopher, 2016; Christopher & Peck, 2004). The second antecedent, SC agility, is the “the ability to respond rapidly to unpredictable changes in demand or supply” (Christopher & Peck, 2004, p. 18). In the verge of a SC disruption, the response time is extremely important, considering that it could be the deciding factor between having a smooth or a major impact in terms of performance. It should be decoupled in terms of visibility (see things sooner) and velocity (time to respond to the event). In turn, SC collaboration, is associated with the benefits that can be retrieved from establishing a collaborative perspective across the SC. Moving past the traditional arm’s-length relationship can have significant advantages, considering that information sharing and greater visibility, play a significant role in reducing uncertainty and, therefore, mitigating risks (Blos *et al.*, 2012; Christopher, 2016; Christopher & Peck, 2004). Lastly, building a SCRM culture is extremely important in SCRES, considering that awareness and monitorization are focal in managing SC disruptions (Christopher & Peck, 2004; Mandal, 2012).

In terms of the process, SCRES has been divided into proactive and reactive processes, more specifically readiness, response and recovery (Chowdhury & Quaddus, 2016; Datta, 2017; Hohenstein *et al.*, 2015), as portrayed in figure 2.4. In recent years, scholars have contributed to the conceptualization by adding other measures, such as business growth (Hohenstein *et al.*, 2015) and redesign (Messina *et al.*, 2020). Chowdhury & Quaddus, (2016), acknowledge that “supply chains shall have required level of readiness during the pre-disruption phase to reduce the likelihood of disruptive events”. This process is associated with the proactive phase of SCRES, which occurs before the SC disruption takes place. Given this, readiness is essentially identified with the antecedents of SCRES, as the outcome of a self-assessment and preparation process (Bode & Macdonald, 2016). Human resource management, contingency plans and redundancy perspectives have also been associated with readiness (Hohenstein *et al.*, 2015).

After a SC disruption occurs, reactive measures are necessary “to reduce the impact and bounce back from the post-disruption state” (Chowdhury & Quaddus, 2016, p. 710). Response ensures that appropriate strategies are put in place to move to recovery as soon as possible. It is directly linked with time, considering that a fast response can reduce the overall disruptive impact in performance (Hohenstein *et al.*, 2015). Similarly, the recovery phase is associated with the response, where once again, time is a valuable asset. A significant competitive advantage is gained from recovering faster than competitors, not only in terms of performance but also in market shares and customer service. It is essential to consider that these processes are interdependent, and that readiness plays a crucial role in managing SC disruption, given that a solid preparation leads to a quicker response and to a fast recovery (Bode & Macdonald, 2016; Chowdhury & Quaddus, 2016).

As Christopher & Peck (2004) stated in their widely cited definition, not always organizations return to their original state after a disruption, but to new desired ones. This can be explained by the recent propensity in SCRES to use SC disruption to create a significant competitive advantage (Datta, 2017; Mandal, 2014). This is the idea behind recent conceptualisations, considering that business growth (Hohenstein *et al.*, 2015) and redesign (Messina *et al.*, 2020) are also part of SCRES. On this note, Datta (2017, p.1405), considered that “after a disruption, often supply chain is reorganized in such a manner that a new and improved business opportunity arises resulting in business

growth”. Given this, if managed correctly, SC disruptions, can also generate considerable advantages for the organization. Nevertheless, it is important to consider that only through a broad SCRES approach is possible to reach this outcome, combining both antecedents and processes.

SCRES, is then, associated with the preparation for SC disruption, through readiness, and the response and recovery processes, to ensure the normal flow of operations. The antecedents of SCRES are fundamental for managing and reaching specific outcomes. These are bound to collaborative and introspective practices, aiming at assessing the organization’s SC and establishing reliant relationships, based on transparency and flexibility (Christopher & Peck, 2004). Moreover, it is essential to acknowledge that establishing SCRES practices can be costly. However, doing nothing is sometimes more costly (Chopra & Sodhi, 2014), significantly when SC disruptions are increasing in frequency (Bode & Macdonald, 2016; Gurtu & Johny, 2021). Finding an optimal point between available resources and practices is fundamental, not only to manage SC disruptions, but also to ensure long-term performance.

2.7 Business Continuity Management

In the last two decades, the growing propensity for SC disruptions, placed an emphasis on SCRM, SCRES, and business continuity (Blos *et al.*, 2012). Many organizations faced with new regulatory requirements highlighted the need for business continuity management (BCM) and for the establishment of specific programmes (Kildow, 2011). BCM is the outcome of an evolutionary process rooted in the 70s – in association with disaster recovery – that later evolved into a broad holistic perspective (Barnes, 2001; Drewitt, 2013; Gallagher, 2003; Herbane, 2010; Hiles, 2007; Kildow, 2011).

The technological revolution triggered by the introduction of business computer systems in the 70s, led many companies to recognize the importance of protecting data and maintaining operations (Drewitt, 2013; Herbane, 2010). Strategies and plans were then developed, focusing on protecting information technology (IT) systems, an approach known as disaster recovery. This approach continued to expand throughout the late 70s, with the escalation in the development of computerized systems and automated processes (Kildow, 2011). The 80s marked the beginning of the theorisation of SC and SCM that, despite benefiting from computerized systems, also introduced

significant risks (Kildow, 2011). Nonetheless, the focus within disaster recovery remained only on IT, what transcended into the early 90s (Gallagher, 2003; Herbane, 2010).

It was only in the mid-90s, that disaster recovery witnessed considerable changes (Kildow, 2011). Familiarisation with points of failure led to an additional preventive approach, and disaster recovery evolved into including recovery of business operations as part of the disaster recovery planning. Moreover, the preparation for the “year 2000 problem” (Y2K), originated considerable concerns within firms, that, for the first time, considered external threats in the disaster recovery approach (Barnes, 2001; Kildow, 2011). The creation of the Business Continuity Institute (BCI) in 1994 was also an important milestone, considering that, it not only provided standards, but also attracted scholars’ attention to the ongoing changes (Herbane, 2010).

The emergence of a new millennium brought old and new disruptions and a growing awareness of the need to manage risks proactively. Business operations became more demanding, specifically, in terms of acceptable downtime (Kildow, 2011). Managers realised that the real need was to ensure the normal flow of operations and not recover them, propelling the quest for business continuity planning instead of disaster recovery planning (Herbane, 2010; Kildow, 2011). The 9/11 terrorist attacks contributed to the growth and recognition of the field, considering the importance of business continuity planning in managing disruption (Gallagher, 2003; Herbane, 2010). Business continuity planning later matured into BCM, a continuous programme that has evolved to meet the demands of rapidly changing environments (Kildow, 2011).

In the literature, BCM is often associated with SCRM and SCRES. However, it is vital to acknowledge the differences and similarities between these fields. SCRM is limited to the activities that direct an organization in terms of risk, while BCM goes beyond as to incorporate mitigation strategies and recovery plans (Azadegan *et al.*, 2020b). Similarly, the main processes identified with SCRES, namely, readiness, response and recovery are part of the larger scope of BCM (Azadegan *et al.*, 2020b). Therefore, BCM tangles both fields, while presenting a broader holistic approach.

Considering its evolution, BCM is still a recent field (Kildow, 2011). This can be defined as “a holistic management process that identifies potential threats to an organization and the impacts to business operations that those threats—if realized—

might cause, and which provides a framework for building organizational resilience with the capability for an effective response that safeguards the interests of its key stakeholders, reputation, brand, and value-creating activities” (Bird, 2011, p.10). This definition is also supported by the BCI, the ISO and the British Standards Institution (BSI), the central regulatory bodies in BCM standardization.

According to Watters (2014, p. 17), “standards have been devised to help organizations perform important activities in a consistent and high-quality way” by providing a set of specific guidelines. It is possible to identify both national and international standards and two major phases of development: Pre-9/11 and Post 9/11 terrorist attacks (Herbane, 2010; Hiles, 2007). Before the 9/11 terrorist attacks there were around 20 standards and best practices related to business continuity planning. Nevertheless, after the attacks on World Trade Centre, the development of standards and best practices proliferated (Hiles, 2007). The most cited include: BSI/BCI Standard, Pas 56 (UK); BSI BS25999 Business Continuity Standards (UK); ISO 22301:2012 and BCI Good Practice Guidelines. Recognising which standard to follow is not always an easy decision, which led many authors to perform comparative assessments, to identify both differences and similarities.

The BSI/BCI Standard Pas 56 (UK) was published in the 90s and attempted a methodical approach to business continuity. It was superseded by BS 25999 Business Continuity Standards (UK), in 2007 (Drewitt, 2013). In comparison, the two standards have significant differences, with BS 25999 outstanding the former in the approach used to systematise operational resilience (Drewitt, 2013). BS 25999 was the most widely adopted standard until the publication of ISO 22301, in 2012, that withdrew its utilisation (Wallace & Webber, 2017). The differences between BS 25999 and ISO 22301 are less significant, revolving around adaptations to meet the required formats and terminology (Drewitt, 2013; Estall, 2012). For instance, ISO 22301 does not refer directly to the BCM lifecycle, introduced by the BS 25999, but explaining the Plan-Do-Check-Act (PDCA) Cycle refers to its specific components (Estall, 2012). The standard is constructed based on a generalised approach to streamline its application internationally and across different industries (Watters, 2014). It is organized around ten key clauses, the first three introducing and explaining terms and the other seven presenting the requirements (Wallace & Webber, 2017).

The BCI Good Practice Guidelines is the leading global guidance for business continuity professionals (Business Continuity Institute, 2017). It provides a base for conceptualization, while promoting good practices around the globe. This standard is used by the official European institutions (Parliament, Commission and Council) in association with other standards (Hiles, 2007). It is significantly different from other standards, considering its focus on individuals instead of organizations. The BCI Good Practice Guidelines builds on the requirements of ISO 22301:2012 by focusing on individual knowledge and specific requirements professionals need to successfully develop, implement and maintain a business continuity programme (Business Continuity Institute, 2017).

The continuous establishment and renewal of standards and best practices contributes to the recognition of BCM as a distinct management process (Folkers, 2017). Even though, professional certification can be costly, “the financial benefit of BCM must be viewed from a long-term perspective” (Engemann & Henderson, 2012). Regardless of the standard the organization chooses to follow and get certified from, it is important to consider that BCM standards have similar requirements and that the processes will not differ substantially, if implemented following a different standard. Also, it is important to consider that BCM as an ongoing programme requires a broad level of commitment, not only from a certified body, but from the entire organization (Blos *et al.*, 2012).

2.8 Business Continuity Programme

The transition from business continuity planning into BCM, helped solidify the management component in business continuity, while clarifying its embedded natured as an ongoing programme, that requires constant monitoring and generalised commitment, instead of a project that eventually reaches completion (Kildow, 2011). Given this, when organizations raise the need to establish a business continuity plan, usually they are not referring to this stage alone, but to the broad holistic approach, through the deployment of the programme. A BCM programme includes several steps, ranging from initial assessments, onto response and recovery plans and institutional practices, aiming at assuring its effectiveness (Azadegan *et al.*, 2020b).

According to BS ISO 22301:2012 (British Standards Institution, 2012) and the BCI Good Practice Guidelines (Business Continuity Institute 2017, p. 10), a business continuity programme can be defined as “the ongoing management and governance process supported by top management and appropriately resourced to implement and maintain business continuity management”. In 2012, when it was first introduced, ISO 22301, provided some cohesion, by bringing together concepts displayed in the national standards and setting an international benchmark for BCM. It quickly became the standard guiding organizations all around the world, considering its adaptability in association with other standards and across industries (Folkers, 2017; Watters, 2014). It follows a management system rationale similar to the programme management introduced by BS 25999 (Drewitt, 2013), essential for developing and enhancing organizational resilience (Business Continuity Institute, 2017).

A clarification of the business continuity programme will be provided based on ISO 22301:2019, the successor of ISO 22301:2012, following its revision and consequent withdrawn. ISO 22301:2019 “specifies the structure and requirements for implementing and maintaining a business continuity management system (BCMS)” (ISO, 2019). A BCMS includes a policy, people with defined responsibilities, a management process or programme and documented information. ISO 22301:2019 infers on these components, based on a structure organised around clauses and in accordance with the PDCA Cycle, portrayed in figure 2.5.

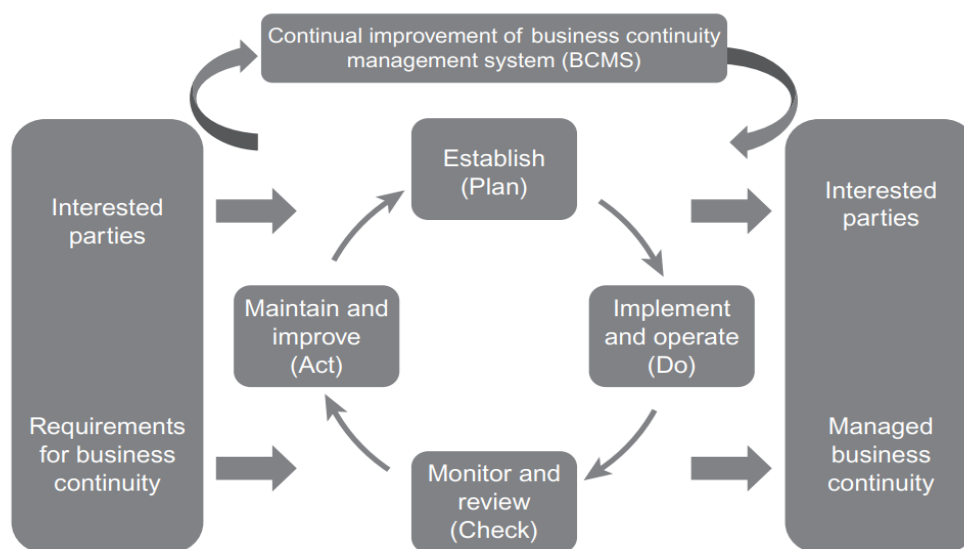


Figure 2.5 - PDCA Cycle applied to BCMS. Source: BS ISO 22301:2012 (British Standards Institution, 2012)

The PDCA Cycle is associated with the implementation, maintenance, and continuous improvement of the BCMS and follows an approach shared by other ISO standards. It is established throughout the clauses organizing the standard. Clauses 1 to 3 introduce, respectively, the scope, the normative references and the terms and definitions¹. Clauses 4 to 10 refer to the main requirements needed for the business continuity programme and the overall BCMS (ISO, 2019), consisting, therefore, on the focus of analysis:

- Clause 4: Context of the Organization – It is important to understand the context of the organization and the desired outcomes of the interested parties, when implementing a BCMS. Similarly, an overview of the requirements and the legal constraints is necessary, in order, to determine and establish the scope and the boundaries of the programme. This information should be documented, continuously maintained, and improved, in accordance to changes and the referred requirements;
- Clause 5: Leadership – A commitment regarding the BCMS should be demonstrated by the top management by embedding this process in the culture of the organization. The establishment of a business continuity policy, its application and the attribution of roles and responsibilities is also required as part of the leadership role;
- Clause 6: Planning – The risks and opportunities of establishing a BCMS should be considered, to prevent undesired effects. The business continuity objectives should be determined and established according to different functions and levels;
- Clause 7: Support – The organization should determine and provide the necessary resources for the implementation and maintenance of the BCMS. It also should strive for competence, awareness, communication, while documenting the required information;
- Clause 8: Operation – The organization should plan, implement, and maintain the necessary processes to establish the BCMS, particularly:
 - Business Impact Analysis (BIA) – The BIA tries to assess the vulnerabilities of the business process, by determining the importance of

¹ For more information on Clauses 1 to 3, refer to ISO 22301:2019. Available at: [ISO 22301:2019\(en\), Security and resilience — Business continuity management systems — Requirements](#) (22.03.2021).

the organization's activities and assessing its impact, over time, if interrupted (Barnes, 2001; Engemann & Henderson, 2012; Folkers, 2017). For each critical operation, the BIA, establishes: a maximum tolerable period of disruption (MTPD), a prospective point in time when not resuming operations compromises the ability of the organization to achieve its objectives and a recovery time objective (RTO), a prioritized time frame within the MTPD, for resuming activities at a minimum acceptable capacity;

- Risk Assessment: A risk assessment process should be established by identifying the risks of disruption of the critical activities, analyzing, and evaluating the risks based on a likelihood x impact calculation and treating the prioritized risks, in an approach similar to SCRM or ISO 31000 on Risk Management;
- Business Continuity Strategies and Solutions: The organization should develop business continuity strategies and solutions, based on the outputs of the BIA and the Risk Assessment, and consider options for before, during and after the disruption. The resource requirements should be determined, and the strategies deployed, to streamline its activation, when needed, based on a cost-benefit analysis;
- Business Continuity Plan: The business continuity plan is the central plan that documents the procedures during and after a crisis and assists organizations with response and recovery (Engemann & Henderson, 2012). It must be supported by the top management and committed across the organization. Effective plans are coordinated, comprehensive and adaptable and ensure that all parties are aware of their responsibilities. Each plan includes: “a) the purpose, scope and objectives; b) the roles and responsibilities of the team that will implement the plan; c) actions to implement the solutions; d) supporting information needed to activate (including activation criteria), operate, coordinate and communicate the team's actions; e) internal and external interdependencies; f) the resource requirements; g) the reporting requirements; h) a process for standing down” (ISO 22301:2019, clause 8.4.4.3);

- Exercise programme: The implementation and maintenance of a programme to exercise the strategies and solutions is fundamental, in order to preserve an up-to-date business continuity plan and implement changes and modifications, if necessary;
 - Evaluation of business continuity documentation and capabilities: The business continuity plan and other procedures, such as the BIA and Risk Assessment should be evaluated through reviews, exercises, simulation, and tests, in order to assure its effectiveness and make the necessary arrangements when significant changes occur.
- Clause 9: Performance Evaluation – The organization should evaluate, monitor, and measure the BCMS performance and effectiveness, through internal audits and top management reviews, in order to ensure its suitability and adequacy;
 - Clause 10: Improvement – The organization should focus on opportunities for improvement and implement the required actions to achieve the necessary outcomes of the BCMS. The BCMS should be continuously maintained through careful evaluations that serve as the base for improvement.

The model and requirements presented in ISO:22301 are similar to the conceptualizations presented by Barnes (2001), Blos *et al.* (2012), Drewitt (2013), Engemann & Henderson, (2012), Estall (2012), Gallagher (2003), Kildow (2011), Wallace & Webber (2017), Watters (2014) on BCM. Unlike other standards, that embrace self-declare compliance, ISO 22301, requires certification by an approved auditor (Wallace & Webber, 2017). Even if the organization is not certified, a comparative analysis and a revision of the programme from the standards point of view is crucial to identify areas of improvement and appraise the best practices. Nevertheless, it is essential to understand that succeeding on paper and succeeding in real life is entirely different and, ultimately, a BCMS will only succeed if, the business continuity culture is incorporated into the organization's policies and operations (Blos *et al.*, 2012; Gallagher, 2003; Kildow, 2011).

In sum, the way through which “organizations recover from supply chain disruptions depends on their response orientation to such events” (Azadegan *et al.*, 2020a, p. 64). A BCMS is fundamental in managing the impact of disruptions, considering that it provides a roadmap that supports the organization and its strategy. Moreover, deploying an effective BCMS, is essential in limiting reputational damage,

preserving operational capabilities, ensuring performance, and assuring competitive advantage in the verge of a disruptive event (Azadegan *et al.*, 2020b; Drewitt, 2013).

2.9 Pandemic Planning

A pandemic is a widespread infectious disease that affects a large portion of the population, usually during a long period (Wallace & Webber, 2017). Even though each pandemic is unique in terms of its specific characteristics, the disease spreads through contact with people, which portrays its highly disruptive potential.

As mentioned by Wallace & Webber (2017, p.175), “a pandemic affects more than people”, considering that the containment efforts impact, not only the society but also businesses in direct and indirect ways. As acknowledged in previous events, the infectious nature is usually combined with a tendency for mutation, with the capacity to originate different stirps that may lead to large restrictive measures and force businesses to adapt and re-think their operational models. Given this, planning for a pandemic is different from planning for other disruptive events, as the disease's length and severity may constantly change. The expected impacts include absenteeism, fluctuations in demand, and others depending on the scale and the restrictive measures imposed. However, a pandemic does not involve loss of physical property, as it typically happens with disruptive events (Engemann & Henderson, 2012).

Traditionally business continuity programmes focus on material liabilities and hazards that may jeopardize equipment and infrastructures (Wallace & Webber, 2017). Nonetheless, a pandemic, as a large-scale disease impacts first and foremost the people. In this view, a pandemic requires specific measures as it “fits under business continuity planning as a disruption of the flow of business” (Wallace & Webber, 2017, p.175). Given this, it is important to consider the different plans that need to be established in the larger business continuity programme and ensure that the scenarios of failure are identified and have a clear response.

During a pandemic, “it is not unreasonable to expect a 30 per cent to 40 per cent, and perhaps even as high as 50 per cent, absenteeism rate” (Kildow, 2011, p.208), among employees, suppliers and other partners during an undetermined period. These circumstances, if materialized may substantiate employee failures, supplier failures and even production line failures or process failures, as the normal functioning of operations

may be compromised due to high absenteeism. Similarly, if the number of cases rises considerably or there is an outbreak, the measures imposed can be more restrictive and may even escalate into shutdowns. Work-at-home capabilities are significant in these situations and should be made available, if possible (Kildow, 2011). Given this, it is important to contemplate the scenarios of failure when planning for a pandemic and consider others that may not be as straightforward, such as storage failures, equipment failures and infrastructure failures, that may arise depending on the severity of the restrictions imposed (Engemann & Henderson, 2012).

As the backbone of these scenarios, specific plans should be developed to identify specific measures as to deal with these impacts. As a pandemic is mainly a disruptive humanitarian event, a succession plan is essential considering that casualties are likely to occur (Kildow, 2011). Similarly, and considering that this phenomenon disrupts the flow of business, a plan containing the critical areas is fundamental to ensure and secure the mainstream processes, as well as a contingency plan accompanied with the mainstream's information system and infrastructure and equipment plans.

Understanding the potential threat caused by a pandemic is extremely important and the various scenarios that may occur. "Unlike the sharp point in time during which a disaster occurs, a pandemic is like an ocean wave", gradually appearing, devastating the population and then progressively receding (Wallace & Webber, 2017, p.194). A concise business continuity programme is fundamental on this situation, considering that it provides companies with guidelines to deal with potential impacts (Azadegan *et al.*, 2020b). In this view, identifying the possible scenarios of failure through the BIA and the risk assessments is a fundamental step to develop appropriate measures to manage disruption, ensure performance, and competitive advantage.

CHAPTER 3 – METHODOLOGY

The present chapter introduces the methodology guiding the investigation. In this respect, the segment starts by addressing the approach to the research questions, aiming at justifying its pertinence. Subsequently, the data collection method is presented and characterized, followed by the construction of the questionnaire in close connection with the research questions. The chapter is concluded with a description of the process of selection of the sample.

3.1 Approach to the Research Questions

The research questions are fundamental tools for the research process, as they provide researchers with a guide to conduct the investigation, while narrowing its focus. According to Bryman (2012, p.90), the research questions must present a set of particular characteristics, including a theoretical foundation, making it essential to justify the pertinence of the questions developed. Based on this, the research questions are presented below, followed by the respective reasonings.

RQ1 – What is the perception of the impact of the COVID-19 Pandemic on the Supply Chain of Pharmaceutical Manufacturing Companies?

The COVID-19 Pandemic exemplifies the scale and dimension that disruptive events may have in years to come and the urgency of preparing for uncertainty. Pandemics, not only have highly disruptive potential, considering its dimension and length, but also exhibit a unique character, when triggering a “disruption of the flow of business” (Wallace & Webber, 2017, p.194) leading to diversified and lasting impacts. Preparation is vital when managing a disruptive event, considering that the magnitude of the impact increases as the time to recover lengthens (Kilpatrick & Barter, 2020). Nonetheless, not all companies have the same level of readiness to act upon disruptions, with particular companies being better prepared than others to respond and mitigate the impact of a disruptive event. Although it is impossible to predict when and how a disruptive event will occur, and there is no manual for dealing with disruption, analysing the impacts of these events is crucial in order to contribute to an informed planning in managing similar events.

RQ2 – What is the perception of the readiness of the Business Continuity Programme to address the COVID-19 Pandemic?

Business continuity programmes are described as fundamental tools in managing disruptive events, considering that they provide companies with a roadmap to deal with disruption, identify potential threats and build organizational resilience (Azadegan *et al.*, 2020b). Business continuity as a broad holistic perspective has grown in importance, as a mechanism companies use to prevent and react to disruptive events. As the frequency of disruptive events increases, the need for establishing efficient responses to these events increases (Kilpatrick & Barter, 2020), portraying the importance of resilience practices when preparing for disruption. Considering that a solid preparation leads to a quicker response and a fast recovery (Bode & Macdonald, 2016; Chowdhury & Quaddus, 2016), it is crucial to understand the readiness of preventive mechanisms when managing a disruptive event.

RQ3 – What are the key characteristics of a Business Continuity Programme in the Pharma sector?

As a holistic mechanism, the business continuity programme has an intricate development process, including several steps and characteristics that aim to improve its effectiveness (Azadegan *et al.*, 2020b). Given this, when developing and implementing a business continuity programme, it is crucial to consider these steps and the overall processes in order to ensure that the end result is compelling. The standards on business continuity were created with this purpose, describing in detail the phases and the requirements needed, and guiding professionals in their own ventures. Every detail is important in business continuity, considering that programmes can fail due to small details. Given this, it is imperative to analyse the business continuity programme, in terms of its specific characteristics, especially when it comes to essential services that have a greater responsibility when faced with disruptions.

RQ4 – How do Pharmaceutical Manufacturing Companies are planning for future disruptive events?

The essential character of the Pharmaceutical Manufacturing Companies doesn't allow these companies to simply shut down in the verge of a disruptive event, forcing them to maintain operations, in order to guarantee human welfare (Pharma Logistics IQ, 2020). These characteristics, not only contribute to differentiate the Pharmaceutical

Manufacturing Companies from others performing non-essential services, but also to increase social responsibility and vulnerability, in managing disruptive events (Graves *et al.*, 2009). Given this, is it particular important to understand how these companies are planning for future disruptive events, considering their obligation to maintain resilience practices.

3.2 Data Collection Method

The methodological approach to this investigation began with the review of existing literature. This allowed for the identification of gaps and revealed underexplored research areas, while reinforcing the relevance of the theme. The literature review also worked as the backbone of the data collection method, identifying necessary tools that served as the base for its development. In this regard, the chosen strategy to conduct the investigation was the survey design, based on a qualitative approach to research.

According to Check & Schutt (2012), the survey design can be defined as “the collection of information from a sample of individuals through their responses to questions”. It may use different data collection methods, “with the most common being questionnaires and interviews” (Ponto, 2015). Depending on the method employed, this strategy may assume a quantitative or qualitative approach to research. Bryman (2012, p. 79) describes qualitative research as a strategy that “emphasizes an inductive approach to the relationship between theory and research”. In other words, it focuses on interpreting a phenomenon, rather than quantifying and patterning its meaning, as such for this research, a qualitative approach is followed.

In this investigation, the survey design was employed based on the development and application of a questionnaire – a research instrument, widely used by scholars and researchers due to its convenience, in terms of cost and administration (Bryman, 2012; Marshall, 2005). The questionnaire was applied through LimeSurvey, an online survey application software, chosen primarily due to its advanced logic resources and due the possibility of tracking down the target population by creating a unique link for each company.

Before applying the questionnaire to the population, this was validated by APIFARMA, the Portuguese Association of the Pharmaceutical Industry, to obtain technical validation and test its adequacy and relevance, being later substantiated by its

technical director. The validation was highly relevant and led to adjustments in the questions based on the inputs received.

As presented in Annex B (Portuguese) and Annex C (English), the final questionnaire was sent to the population via email on the 20th of August of 2021, followed by four reminders and two phone follow-ups, for the companies who had not responded. The respondents were informed of the particular goals and the scope of the investigation before starting the questionnaire and assured of the confidentiality of the answers provided. The questionnaire was closed in mid-late October 2021.

3.3 Questionnaire

The questionnaire was developed from scratch based on the literature review described in Chapter 2 and following the research problem and the specific research questions. Given this, it is important to acknowledge the rationale that guided the construction process, not only as a base for justifying the pertinence of the questions, but also as a way to create a common thread that links the research questions, the data collection method and later establishes the structure for presenting the results.

In terms of structure, the questionnaire contained four different sections:

Section 1 – General Characterization of the Company and the Respondents;

Section 2 – The Impact on the Supply Chain;

Section 3 – The Business Continuity Programme;

Section 4 – The Recovery.

As the title may suggest, the first section aims to perform a general description of the company and the respondents, in order to create the respective profiles. The segment starts with an optional open-ended question to identify the company, substantiating the questionnaire's only optional or open-ended questions. Then, a single choice question is asked on the role performed by the respondent, considering that the level of knowledge and the access to knowledge is often influenced by the role performed in the company. Afterwards, a single choice question is asked on the annual turnover of the company, and a multiple-choice question is asked, regarding INFARMED's categories of activity, in order to characterize the company, not only in terms of its size, but also in terms of the nature of authorizations they have. Section 1 culminates with a single-choice

question, in particular a slider question, aiming at characterizing the company's business model.

The second section aims to analyse the perception of the impact of the COVID-19 Pandemic on the supply chain of the pharmaceutical manufacturing companies, thus answering research question 1. The segment starts with a single choice question, in particular a Likert 5-point scale, on the respondent's perception of the impact of this disruptive event on the company's supply chain. Moreover, as it is important to analyse the impact based on the processes that construct the supply chain, not only to have a more specific assessment, but also considering that the respondent's perception often changes. This clarity can be obtained by performing a micro-analysis of the events. The remaining four questions were based on the processes that construct the supply chain. These dimensions are identified based on SCOR, the Supply Chain Operations Reference Model, following an intricate literature review. The questions analyse the impact in the Plan, Source, Make and Deliver processes, considering that these are the dimensions that substantiate the SC and are structured in a Likert scale format, grouping together the dimensions embedded in the same process. The Return and Enable processes were not considered for the analysis, considering that the former is related with the reverse supply chain, that is not considered in the context of this disruptive event and the latter has a holistic foundation revolving around the management practices that are also not relevant when evaluating the operational processes.

The third section aims to determine the perception of the relevance of the business continuity programme for effectively managing the COVID-19 Pandemic, while analyzing the characteristics of the programme that support similar scenarios to this disruptive event, and therefore answering research questions 2 and 3. The section begins with a conditional single choice question, to analyse if the companies had a business continuity programme prior to the pandemic, considering that to answer to the respective questions, having a programme is a necessary pre-condition. If the respondents answered Yes, they would move on to the questions in section 3, if not they would move directly into the last section of the questionnaire.

In the first scenario, the respondents would find a section structured around twelve questions, the first concerned with standardization, to understand if the programme followed any particular referential, considering the relevance of these mechanisms for the development of these frameworks. The following questions focused on the

programme development process, based on ISO 22301:2019, the most used standard in business continuity, as portrayed in the literature review. Four Likert scale questions were organized measuring the procedures introduced by ISO 22301:2019, in particular the incorporation and management, the analysis, the design and implementation and the validation of the business continuity programme. Later an in-depth analysis of the plan is made, starting with a multiple-choice question on the plans established, a multiple-choice question on the scenarios of failure identified, followed by a single choice question on the existence of responses to the specific scenarios and finally a Likert scale question assessing the effectiveness of these responses. This analysis is fundamental considering that the plan, identifies, not only several scenarios of failure, but also the respective responses that should be effective, for the overall effectiveness of the plan. In the final part of the section, the COVID-19 Pandemic is evaluated in more detail. A single choice question is asked in order to understand if the plan considered a disruptive event similar to this Pandemic, followed by a Likert scale question assessing the programme throughout this disruptive event. The section culminates with a Likert 5-point scale question, on the respondent's perception of the relevance of the business continuity programme for effectively managing this disruptive event.

The final section aims to perform an introspective thoughtful analysis moving forward from this disruptive event, on how pharmaceutical manufacturing companies plan for disruptive events, and therefore answering to research question 4. For the companies that skipped section 3 by answering *No* or *I have no knowledge* on having a business continuity programme prior to the COVID-19 Pandemic, section four, starts with a single choice question on the intention of developing one and culminates with a single choice slider question on the likelihood of establishing particular strategies, based on the impacts of this disruptive event.

As portrayed above, the process of constructing the questionnaire was heavily dependent on the literature review, which allowed for the identification of specific tools, particularly the SCOR Model and the ISO 22301:2019 on business continuity, that contributed with specific dimensions in order to perform the analysis. Similarly, the rationale behind the construction of the questionnaire was also closely related with the research questions, with the sections being explicitly structured for this purpose, except for section 1 which had a more general-purpose, making it possible to establish a relationship between the two, as portrayed in figure 3.1.

The process of constructing the questionnaire and the pertinence of the questions is presented in more detail in Annex D, based on an exploratory table that presents all the questions and sub-questions developed, divided by the respective sections. In addition to this information, it describes the question type, the response options, and the particular link with the literature review. In order to facilitate the understanding, the questions in Annex D are presented in English, although the official questionnaire and the respective questions are written in Portuguese.



*Figure 3.1 - Relationship between the Research Questions and the Questionnaire Questions.
Source: own elaboration.*

3.4 Population

The essential character of the Pharmaceutical Industry, combined with their prominent role throughout the COVID-19 Pandemic, prompted this sector of activity to be the focus of this investigation. In Portugal, this sector is represented on the online licensing portal of INFARMED, the Portuguese National Authority for Medicines and Health

Products, considering that the companies are licensed in order to perform their activities.

As portrayed in Table 3.1, as of May 10th, 2021, the number of registrations in the different activity categories amounted to a total of 4106. Nonetheless, it is crucial to consider that this value refers to the total number of registrations and not the total number of companies, as many are registered under more than one activity category.

Table 3.1 - Pharmaceutical Industry's Activity Categories. Source: Online licensing portal of INFARMED (Information retrieved on May 10th, 2021).

Contagem de Atividade	
Atividade	Total
	9
Aquisição Direta - Deliberação n.º 97/CD/2014 - Substâncias Controladas	4
Aquisição Direta - Entidades Privadas	858
Aquisição Direta - Entidades Privadas - Substâncias Controladas	299
Aquisição Direta - Entidades Privadas - Unidades de Diagnóstico por imagem	12
Aquisição Direta - Entidades Públicas	142
Aquisição Direta - Entidades Públicas - Substâncias Controladas	84
Comércio por Grosso de preparações e substâncias à base da planta da canábis	2
Cultivo de Substâncias Controladas / Canábis	11
Distribuidor de Substâncias Ativas	36
Distribuidor por Grosso de Dispositivos Médicos	1280
Distribuidor por Grosso de Medicamentos de Uso Humano	398
Distribuidor por Grosso de Substâncias Controladas	197
Exportação de preparações e substâncias à base da planta da canábis	1
Exportador Substâncias Controladas	130
Fabricante de Dispositivos Médicos	283
Fabricante de Substâncias Ativas	8
Fabrico de Substâncias Controladas	19
Fornecimento para Fins Específicos (n.º 1, alínea a), do artigo 21.º DR n.º 61/94, 12 de outubro)	5
Importação de preparações e substâncias à base da planta da canábis	1
Importador de Substâncias Ativas	28
Importador Substâncias Controladas	117
Intermediação de Medicamentos	52
Titular de AIM - Distribuição por Grosso de Medicamentos	102
Trânsito Substâncias Controladas	28
Total Geral	4106

For this particular investigation, and after assessing these categories, the production emerges as the most relevant one, considering that the supply chain is more visible, as it involves physical products. In contrast, the others are more procedural. Notwithstanding, the categories of activity presented in table 3.2, are not straightforward, urging the need to filter the entries. Given this, an individual search of the entities was carried out, to identify the pharmaceutical manufacturing companies, which were then aggregated into a draft list, as represented in Annex E, that was, in turn, forwarded to APIFARMA, for further clarification.

This process allowed for the identification of inaccuracies, related with the underlined. Companies 2 and 5 refer to medical device manufacturers, while entries 15,

31, 79, 83, 85, 97, 103, 106, 109, 111, 126, 128 and 131 maintain only distribution and commercialization activities. Similarly, it was also possible to identify relationships and acquisitions that went unnoticed, particularly: Pfizer acquired Parke Davis in the later 1970s, Fresenius Medical Care acquired Labesfal in 2005, Teva acquired Ratiopharm in 2010, Bristol Myers Squibb acquired Celgene in 2019, AstraZeneca acquired Alexion Pharmaceuticals in 2021, Viivhiv Healthcare is the result of a partnership between GlaxoSmithKline and Pfizer, Sofarimex is part of Azevedos Group and lastly, Farmalabor, Genéricos Portugueses and Medinfar Sorológico are part of Group Medinfar. As a result, these companies will not be considered multiple independent entries, but, instead, the different groups will be analysed, with an implied representation of their branches.

Subsequently, after the adjustments mentioned above, the list was approved by one of APIFARMA's technical directors. Moreover, as the population identified was relatively small, accounting for 109 companies, instead of choosing a sample, the questionnaire was applied to the entire population. The term *population* refers to the collection of entities intended to conclude a specific research topic (Salkind, 2021). Because of this, it is defined as the population of this empirical research the pharmaceutical manufacturing companies represented in Portugal.

The population was then contacted via phone, in order to collect the email addresses required for the submission of the questionnaire. In some cases, it was possible to obtain direct emails from representatives, while in others, only the general email was provided due to confidentiality clauses. The list containing the final population, as approved by APIFARMA, and the respective emails addresses of the representatives is presented in Annex F.

CHAPTER 4 – RESULTS AND DISCUSSION

The present chapter introduces the main findings of the questionnaire, while discussing the results of the investigation. In this respect, the segment starts by characterizing the sample and profiling the respondent. Subsequently, the results to the specific research questions are presented and discussed, serving as the basis for the main theoretical conclusions.

4.1 Characterization of the Sample

This section aims at characterizing the sample and profiling the respondents. In order to perform this analysis, it is essential to understand the results of the data collection method. Given this, the questionnaire had 49 respondents, for a population of 109 companies invited. After filtering the responses and eliminating incomplete submissions, the final sample size is 26 respondents ($n=26$). At a confidence level of 95%, for this particular population and given the sample size ($n=26$), the margin of error or confidence interval is 17%. Considering these results, the sample can be characterised as follows:

Following figure 4.1, which describes the distribution of the respondents regarding their company's annual turnover (in millions of euros), it is possible to conclude that 54% of the companies, and therefore the majority, report to the second tier, *Between 1-25*, 15% to the third tier, *Between 26-50*, 15% to the fourth tier, *Over than 50* and 12% to the first tier, *Less than 1*. Additionally, 4% of the respondent's report having no knowledge on their companies' annual turnover.

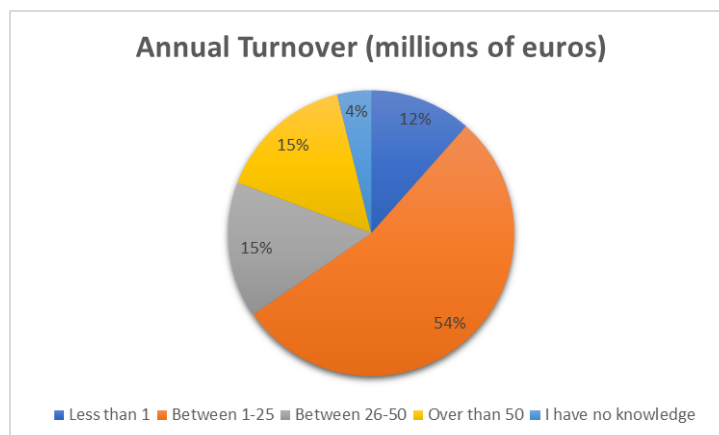


Figure 4.1 - Annual Turnover (millions of euros).

Source: Own elaboration based on Excel outputs.

Based on this, it is possible to conclude that sample comprises mostly, small to medium-sized enterprises (SME's), in accordance with the European Commission's Regulation (EU) 2016/867 and the Commission Recommendation 2003/361/EC².

Having characterized the sample in terms of its size, it is important to frame it according to INFARMED's categories to understand the nature of the licenses they possess. In this view, figure 4.2, describes the distribution of the respondents regarding their companies' categories of activity. It is essential to consider that the companies can be licensed in more than one category. Accordingly, 62% of the companies report being licensed on category A5, 50% report being licensed on category A1, 19% of the companies on category A4, 12% of the companies on category A2 and 8% of the companies on category A3. These results corroborate the production activity of these companies, considering that the majority of the companies are licensed in category A5, *Titular de AIM – Distribuição por Grosso de Medicamentos*, that accounts for companies that hold drug registration licenses, being mainly manufacturers. Similarly, 50% of the companies are licensed on category A1, *Distribuidor por Grosso de Medicamentos de Uso Humano*, which is based on a license for the movement of the physical product, also in most cases, held by producers.

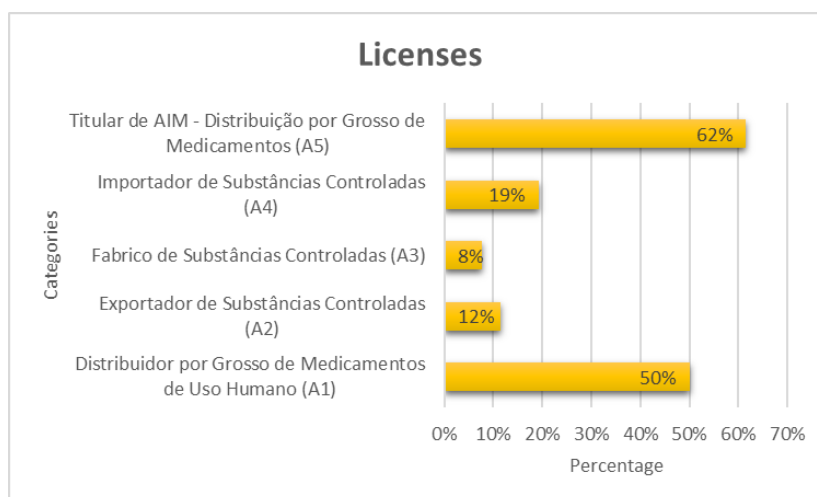


Figure 4.2 – INFARMED's Categories of Activity. Source: Own elaboration based on Excel outputs.

Lastly, figure 4.3, describes the distribution of the respondents regarding their companies' business model. The average of the percentages indicated by the

² For more information refer to [Enterprise size and Commission Recommendation 2003/361/EC \(europa.eu\)](https://eur-lex.europa.eu/legal-content/pt/TXT/?uri=CELEX:32003R0361).

respondents was approximately 42%, with the minimum value indicated by the respondents being 0% and the maximum value indicated by the respondents being 100%. The standard deviation for this data distribution is 42,33, which demonstrates a high dispersion of responses. Considering that the average of owned production is 42%, it is possible to conclude that the companies depend heavily on subsidiaries for this process, which may influence the perceived impacts.

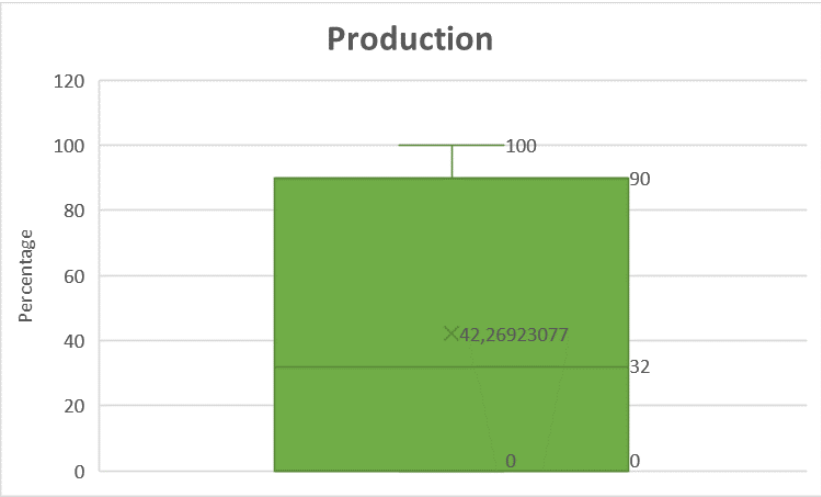


Figure 4.3 – Distribution of the responses regarding the Business Model. Source: Own elaboration based on Excel outputs.

Having characterised the sample, it is also important to profile the respondents. Following figure 4.4, that describes the distribution of the respondents regarding the area that best describes the role they perform in the company, it is possible to conclude that 27% of the respondents, and therefore the majority, report having Logistics or Supply Chain related functions, 23% report having Commercial related functions, 15% report having Administration related functions, 12% report having HR or SHSW related functions and 4% of the respondents report having Production or Operations related functions. Additionally, 19% of the respondents report having other functions, which not correspond to any of the areas mentioned above. None of the respondents reported having functions related to Information Systems, Quality Management or Environment, Risk Management or Business Continuity.

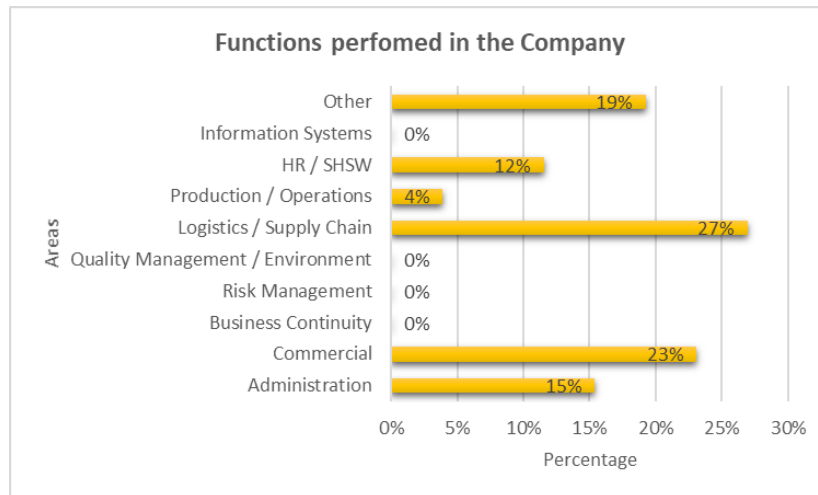


Figure 4.4 – Areas of Function Performed in the Company. Source:
Own elaboration based on Excel outputs.

4.2 Results to Research Question 1

This section intends to present and discuss the results to research question 1. Based on this, it is important to consider that the first research question aims to analyse the perception of the impact of the COVID-19 Pandemic on the supply chain of pharmaceutical manufacturing companies.

RQ1 – *What is the perception of the impact of the COVID-19 Pandemic on the Supply Chain of Pharmaceutical Manufacturing Companies?*

In accordance with figure 4.5, when asked directly if the COVID-19 Pandemic impacted the company's supply chain, 35% of the respondents *Agree* that this disruptive event has impacted the supply chain, 19% of the respondents *Strongly Disagree* that an impact has occurred, 19% of the respondents present a *Neutral* opinion, neither agreeing or disagreeing that this event has had an impact on the supply chain, 15% of the respondents *Disagree* that an impact occurred and lastly, 12% of the respondents *Strongly Agree* that the COVID-19 has impacted the supply chain. Based on this, it is possible to conclude, that when asked directly, 47% of the respondents (4+5) report impacts on the supply chain, while 34% of the respondents (1+2) report not having impacts.

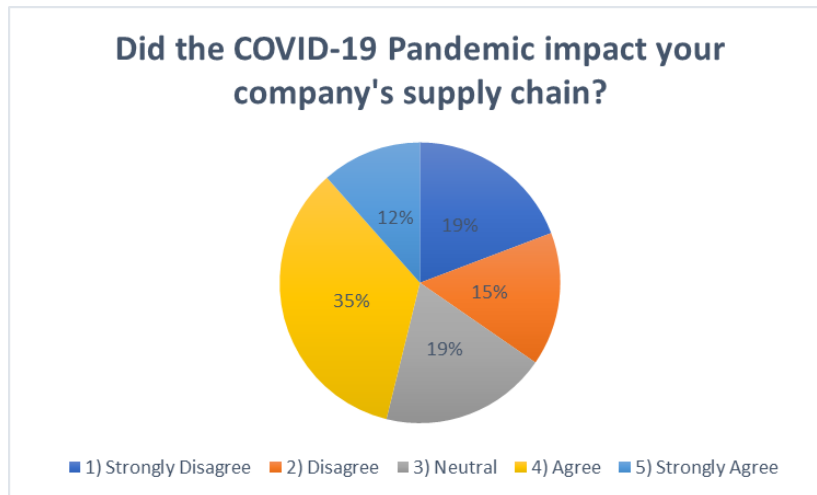


Figure 4.5 – Distribution of the responses on question 6. Source: Own elaboration based on Excel outputs.

Moving from this general picture, it is essential to analyse the perception of impact on the specific dimensions that structure the SC, in particular the Plan (sP), Source (sS), Make (sM) and Deliver (sD). Considering that for this investigation the focus is on the dimensions as a whole, that combined allow to perform a characterization of the SC, the results are going to be presented based on the average of the responses given to the questions on each dimension. These questions work as metrics in order to evaluate the perception of impact on the overall dimension. Nonetheless, as the questions have academic relevance, the results are presented in more detail in Annex G. Additionally, considering that the aim is to analyse the impact, the 5-point Likert scale used to assess each dimension was converted into a 5-point impact scale, in order to facilitate the analysis and simplify the understanding, as described in table 4.1.

Table 4.1 - Conversion of the Likert Scale into the Impact Scale. Source: Own elaboration.

5-Point Likert Scale	5- Point Impact Scale
1) Strongly Disagree	1) Very low
2) Disagree	2) Low
3) Neutral	3) Moderate
4) Agree	4) High
5) Strongly Agree	5) Very High

In terms of the Plan (sP) and following with figure 4.6, which represents the distribution of the respondents on the impact of the COVID-19 Pandemic on this

dimension, it is possible to acknowledge that on average, 30% of the respondents consider that this event had a *low* impact on this dimension, 25% of the respondents consider that it had a *high* impact, 24% of the respondents consider that it had a *very low* impact, 19% of the respondents consider that it had a *moderate* impact and only 2% of the respondents consider that it had a *very high* impact. Given this, it is possible to conclude that on average the impact perceived in the Plan (sP) dimension was low, considering that 54% of the respondents (1+2) reported a *low* or *very low impact*, representing the majority of the sample.

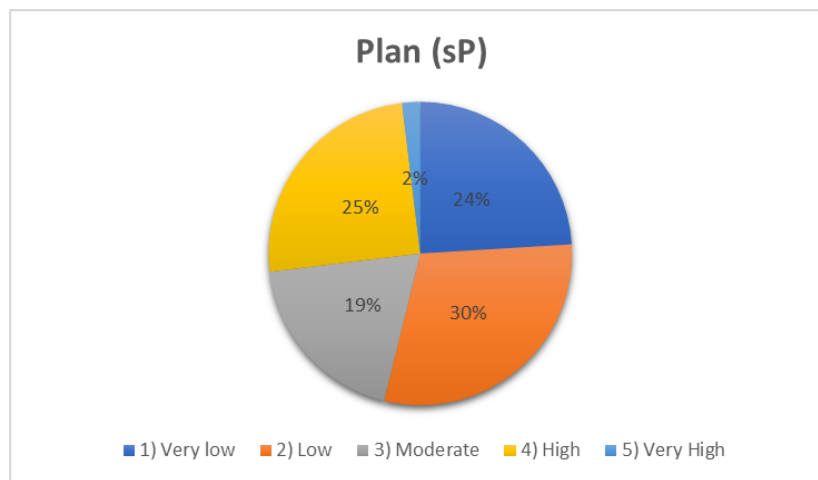


Figure 4.6 – The perceived Impact of the COVID-19 on the Plan (sP). Source: Own elaboration based on Excel outputs.

In terms of the Source (sP) and following figure 4.7, which represents the distribution of the respondents on the impact of the COVID-19 Pandemic on this dimension, it is possible to acknowledge that on average, 35% of the respondents consider that this event had a *high* impact on this dimension, 24% of the respondents consider that it had a *low* impact, 18% of the respondents consider that it had a *moderate* impact, 15% of the respondents consider that it had a *very low* impact and only 8% of the respondents consider that it had a *very high* impact. Given this, it is possible to conclude that on average the impact perceived in the Source (sS) dimension was high, considering that 43% of the respondents (4+5) reported a *high* or *very high* impact. Nonetheless, it is important to consider that 39% of the respondents (1+2) reported a *low* or *very low* impact, which portrays the dispersion of the answers.

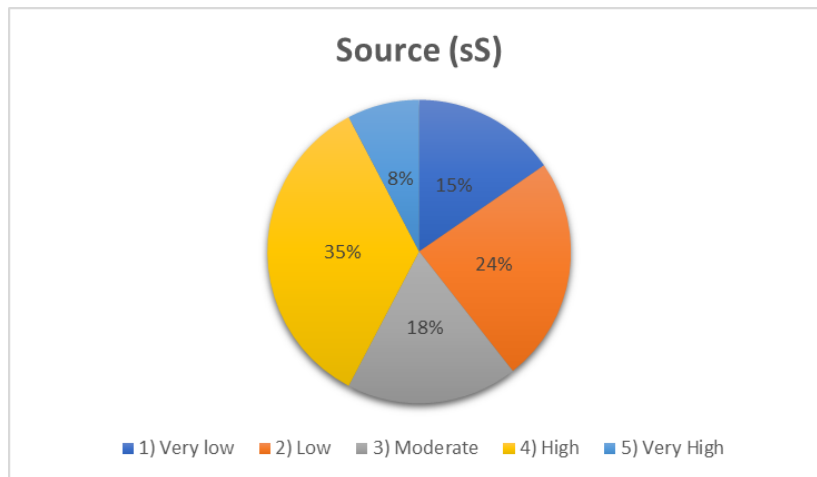


Figure 4.7 – The perceived Impact of the COVID-19 on the Source (sS). Source: Own elaboration based on Excel outputs.

In terms of the Make (sM) and following figure 4.8, which represents the distribution of the respondents on the impact of the COVID-19 Pandemic on this dimension, it is possible to acknowledge that on average, 32% of the respondents consider that this event had a *high* impact on this dimension, 27% of the respondents consider that it had a *low* impact, 25% of the respondents consider that it had a *moderate* impact, 9% of the respondents consider that it had a *very high* impact and only 7% of the respondents consider that it had a *very low* impact. Given this, it is possible to conclude that on average the impact perceived in the Make (sM) dimension was high, considering that 41% of the respondents (4+5) reported a *high* or *very high* impact, while 34% of the respondents (1+2) reported a *low* or *very low* impact.

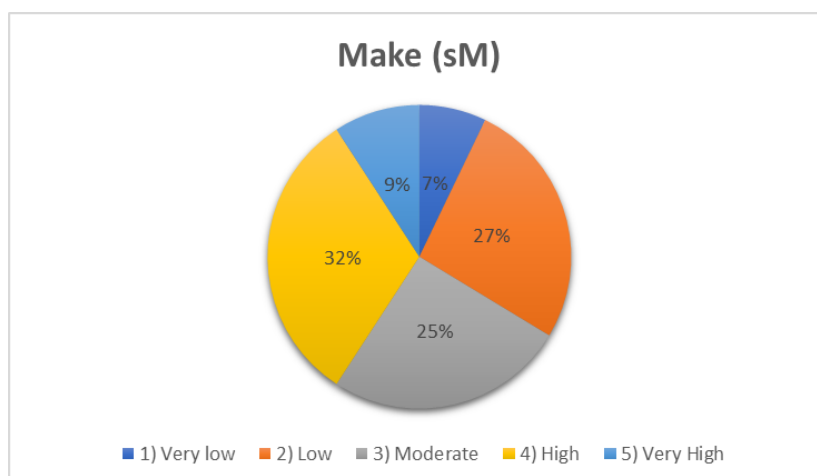


Figure 4.8 – The perceived Impact of the COVID-19 on the Make (sM). Source: own elaboration based on Excel outputs.

Lastly, in terms of the Deliver (sD), and in accordance with figure 4.9, that represents the distribution of the respondents on the impact of the COVID-19 Pandemic on this dimension, it is possible to acknowledge that on average, 37% of the respondents consider that this event had a *low* impact on this dimension, 26% of the respondents consider that it had a *high* impact, 13% of the respondents consider that it had a *moderate* impact, 13% of the respondents consider that it had a *very low* impact and only 11% of the respondents consider that it had a *very high* impact. Given this, it is possible to conclude that on average the impact perceived in the Deliver (sD) dimension was low, considering that 50% of the respondents (1+2) reported a *low* or *very low* impact, representing, therefore, the majority of the sample.

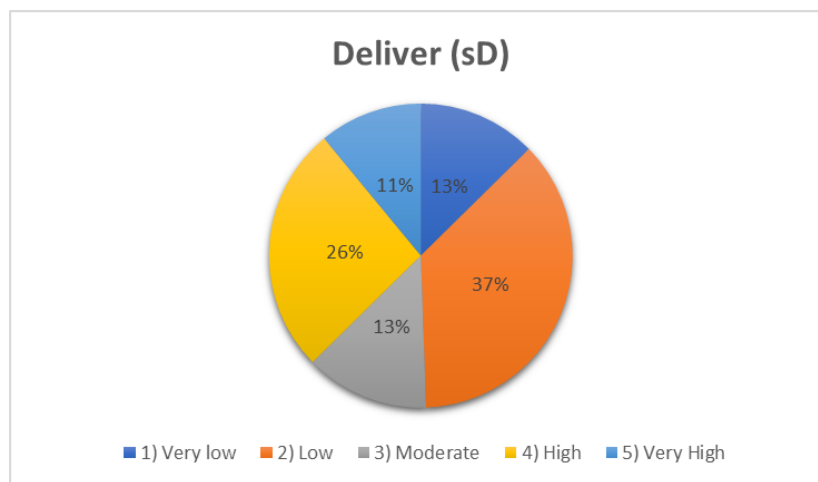


Figure 4.9 – The perceived Impact of the COVID-19 on the Deliver (sD). Source: own elaboration based on Excel outputs.

Having characterized the perceived impact of the COVID-19 Pandemic on the specific dimensions that substantiate the SC, it is now time, to analyse the impact on the SC as a whole, by grouping together the different dimensions. Accordingly, figure 4.10, describes the distribution of the respondents on the impact of the COVID-19 Pandemic on the SC, based on an average of the specific dimensions. It is possible to conclude that on average, 30% of the respondents consider that this event had a *low* impact on the SC, 28% of the respondents consider that this event had a *high* impact on the SC, 18% of the respondents consider that this event had a *moderate* impact on the SC, 16% of the respondents consider that this event had a *very low* impact on the SC and 8% of the respondents consider that this disruptive event had a *very high* impact on the SC.

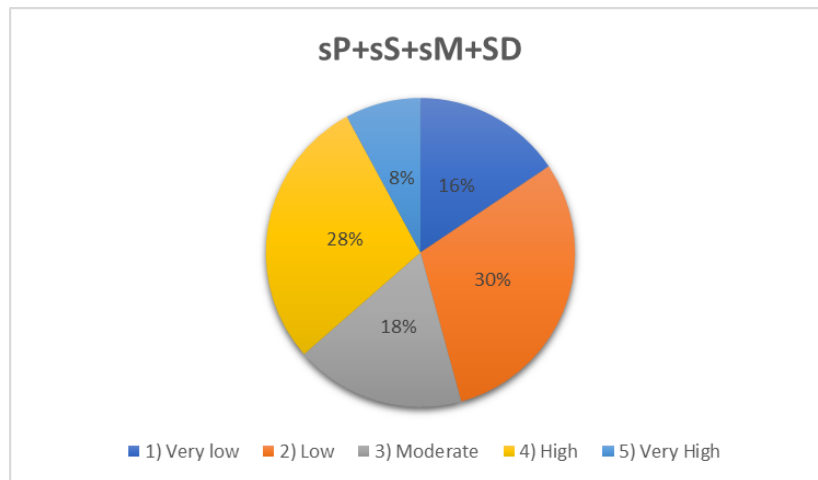


Figure 4.10 – The perceived Impact of the COVID-19 on the Supply Chain based on the dimensions. Source: Own elaboration based on Excel outputs.

Considering the results described above, it is possible to assume that the perception of the impact changes, when the respondent is asked directly versus when using the dimensions to conduct the analysis. This happens because the respondent is forced to change the level of analysis, from a macro to a micro point of view, thus altering the general perception. This fact can be observed when comparing figures 4.5. and 4.10. For instance, when asked directly (figure 4.5), 47% of the respondents (4+5) agree and 34% of the respondents (1+2) disagree that this disruptive event impacted the SC, whereas, when basing the analysis on the dimensions (figure 4.10), on average, 36% of the respondents (4+5) report a high impact and 46% of the respondents report a low impact on the SC.

Based on this it is possible to conclude that at a macro level of analysis, the perceived impact of the COVID-19 on the SC is relevant, whereas at a micro level of analysis is relatively lower. Nonetheless, for the investigation the micro level is more relevant, considering that is not only based on a perception, but a perception of the impact. In terms of the dimensions, when comparing the results, it is possible to infer that the Source (sS) was the most impacted dimension, with a combined average of 43% of the respondents (4+5) reporting high impacts, and the Deliver (sD) was the least impacted, with a combined average of 50% of the respondents (1+2) reporting low impacts. These results are in agreement with the literature on this topic, for example, the work of Ayati *et al.* (2020) and can be explained based on the characteristics of Pandemic in close relation with the particularities of the companies. Given this, the results may be related with the emergence of the COVID-19 Pandemic in China and

later in India, the main API suppliers (Pharma Logistics IQ, 2020). Similarly, the essential character of these companies may have allowed them to maintain distribution settings and avoid movement constraints as reported in other industries.

4.3 Results to Research Question 2

This section intends to present and discuss the results to research question 2. Based on this, it is important to consider that the second research question aims to analyse the perception of readiness of the business continuity programme to address the COVID-19 Pandemic.

RQ2 – *What is the perception of the readiness of the Business Continuity Programme to address the COVID-19 Pandemic.*

Before moving into the results and considering that having a business continuity programme is a necessary pre-condition for answering both RQ2 and RQ3, it is important to analyse the level of implementation of these mechanisms prior to the Pandemic. Following figure 4.11, which describes the distribution of the respondents in terms of having a business continuity programme, 58% of the respondents report *Having no knowledge* if their company had this mechanism prior to the Pandemic, 31% of the respondents answered *Yes* on having this mechanism and 11% of the respondents answered *No* on having this mechanism. Based on this, for the analysis of the results to RQ2 and RQ3, the total sample size considered will be 31% of the respondents (n=8), considering that having a programme is fundamental in analysing both questions.

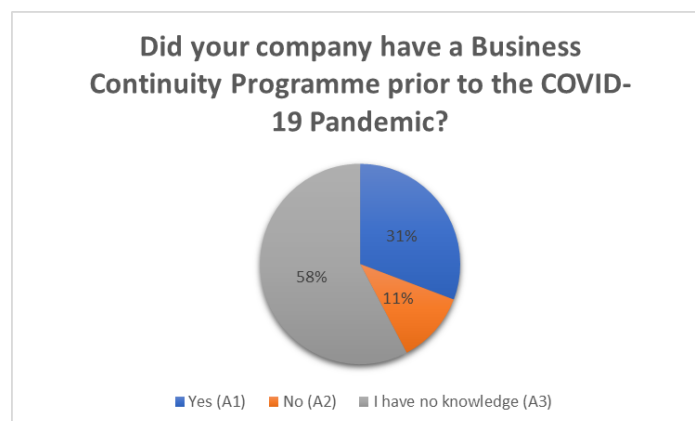


Figure 4.11 – *Implementation of a Business Continuity Programme, prior to the Pandemic. Source: Own elaboration based on Excel outputs.*

Having characterised the sample, it is also important to consider the concept of *readiness*, before going into the analysis. A business continuity programme is “ready” if it has a response for the particular disruptive event. Based on this it is important to consider the plans established, the scenarios of failure, the responses to the scenarios of failure and the particular programme during the disruptive event.

Following figure 4.12, which describes the distribution of the respondents considering the plans established on the business continuity programme, it is possible to conclude that the plans considered in a Pandemic scenario had a high implementation, with 75% of the respondents report having, respectively, a Succession, a Contingency and a Critical Business Areas Plans, 63% of the respondents report having an Information Systems Plan, 50% of the respondents report having an Infrastructure and Equipment Plan and 13% of the respondents report having no knowledge on the plans established in the business continuity programme.

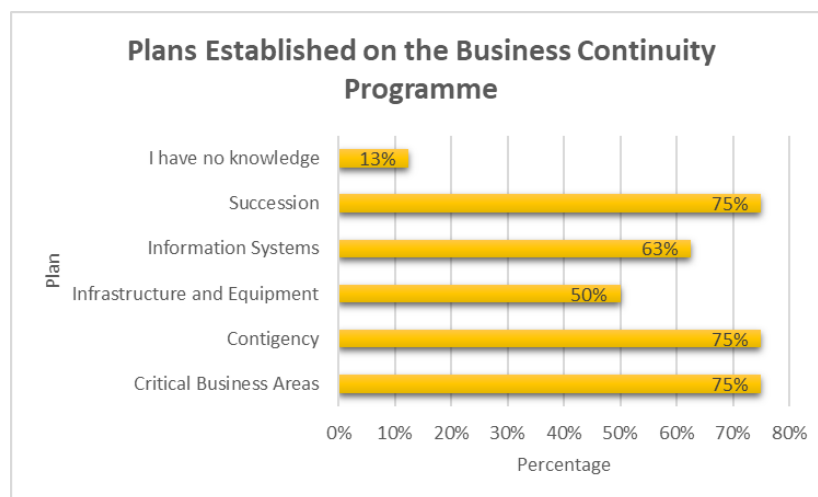


Figure 4.12 – Plans established on the Business Continuity Programme. Source: Own elaboration based on Excel outputs.

Having identified the plans established on the business continuity programme, it is important to analyse the scenarios of failure established in the overall business continuity plan. Following figure 4.13, which describes the distribution of the respondents considering the scenarios of failure identified in the plan, it is possible to conclude that the scenarios of failure related to a pandemic are identified in the majority of the companies. In particular, 75% of the respondents report having identified, Storage, Supplier, Equipment and Employee failures, 63% of the respondents report

having identified Infrastructure failure, 50% of the respondents report having identified both Process and Production Line failures and 25% of the respondents report having no knowledge on the scenarios of failure identified in the overall business continuity plan.

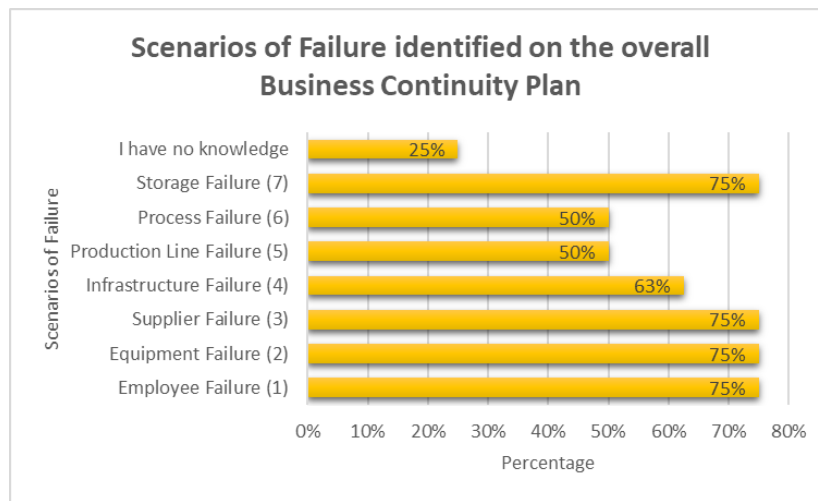


Figure 4.13 – Scenarios of Failure identified on the Business Continuity Plan. Source: Own elaboration based on Excel outputs.

Having identified the scenarios of failure comprised in the business continuity plan, it is important to analyse if these scenarios had answers. Following figure 4.14, which describes the distribution of the respondents in terms of having answers to the scenarios of failure, it is possible to conclude that the majority of the respondents report having answers to the specific scenarios. These scenarios are identified based on numbers ranging from 1 to 7, in accordance with the labels presented in figure 4.13. Based on this, 88% of the respondents report having answers to Employee Failure (1) and Storage Failure (7), 75% of the respondents report having answers to Equipment Failure (2), Supplier Failure (3) and Process Failure (6) and 50% of the respondents report having answers to Infrastructure Failure (4) and Production Line Failure (5). On average, 72% of the respondents answers *Yes* to having answers for the scenarios of failure described above, while 9% of the respondents answers *No* to having answers for these specific scenarios and 19% of the respondents answers *I have no knowledge* to having answers for these specific scenarios of failure.

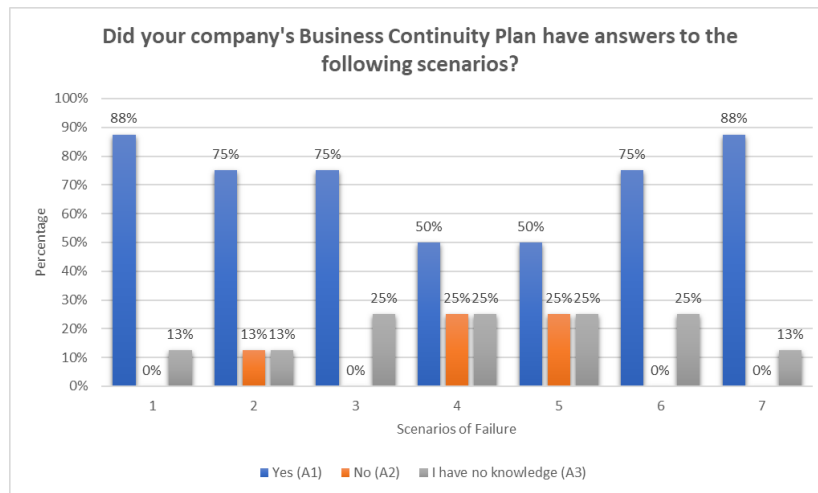


Figure 4.14 – Distribution of the respondents to having answers to the Scenarios of Failure. Source: Own elaboration based on Excel outputs.

The last step in analysing the scenarios of failure is concerned with the effectiveness of the responses identified in the plan. Figure 4.15 describes the average distribution of the respondents on the perceived effectiveness of the answers established for the scenarios of failure. Given this, it is possible to conclude that on average, 53% of the respondents *Agree* that the answers to the scenarios of failure were effective, 27% of the respondents report a *Neutral* position not agreeing or disagreeing with the effectiveness of the answers and 14% of the respondents *Strongly Agree* that the answers were effective. Additionally, on average, 4% of the respondents *Disagree* with the effectiveness of the answers and 2% of the respondents *Strongly Disagree* with the effectiveness of the answers. In general, it is possible to infer that an average of 67% of the respondents (4+5) considers that the answers contained in the business continuity plan were effective for the identified scenarios of failure.

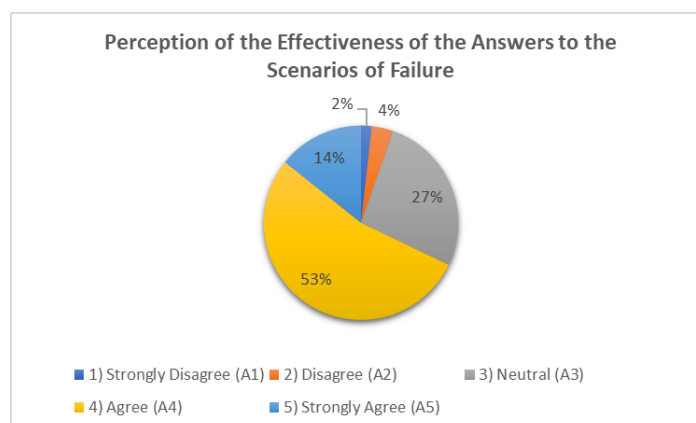


Figure 4.15 – Average perception of the effectiveness of the answers to the scenarios of failure. Source: Own elaboration based on Excel outputs.

Moving forward from this specific characterisation, it is essential to perform a macro analysis on the business continuity programme regarding the specific disruptive event. Based on this, figure 4.16, describes the distribution of the respondents in terms of the business continuity programme including a similar scenario to the COVID-19 Pandemic. Given this, 50% of the respondents reported that the programme did not include a similar event to the Pandemic, 25% of the respondents reported that the programme included a scenario similar to this and the other 25% reported having no knowledge on this specific matter.

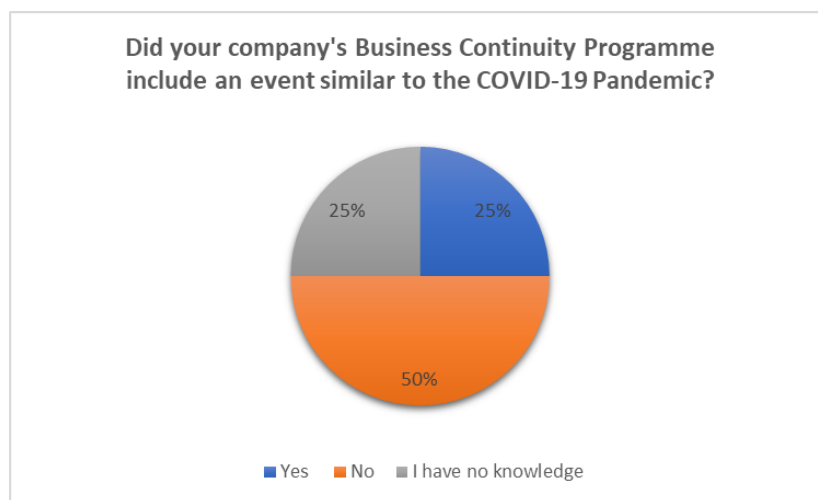


Figure 4. 16 – Distribution of the Respondents on having a similar scenario to the COVID-19 on the Programme. Source: Own elaboration based on Excel outputs.

Following figure 4.17, which describes the average distribution of the respondents on the effectiveness of the programme during the COVID-19 Pandemic, it is important to consider that this dimension was analysed based on five Likert scale questions. Nonetheless, even though these questions have academic relevance on their own, as presented in Annex G, in the investigation they were used as metrics. Given this, the particular results are not going to be considered, but instead the average of responses of the respondents, to analyse effectiveness a whole. On average, 55% of the respondents agreed to its effectiveness, 25% of the respondents strongly agreed and 20% of the respondents reported a neutral opinion, not agreeing or disagreeing with its effectiveness. In general, it is possible to infer that the business continuity programme was effective during the COVID-19 Pandemic, considering that, on average 90% of the respondents agreed to its effectiveness.

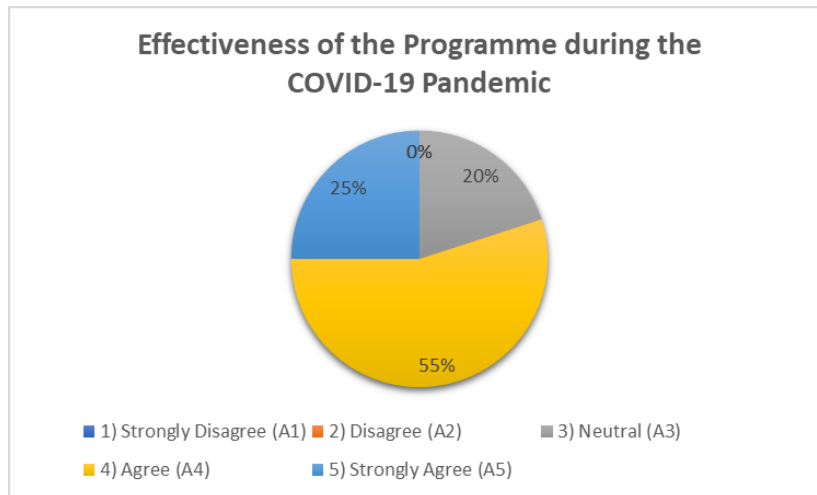


Figure 4.17 – Average on the Effectiveness of the Business Continuity Programme during the COVID-19 Pandemic. Source: Own elaboration based on Excel outputs

Lastly, to evaluate the *readiness*, it is also important to consider the perception of the relevance of the business continuity programme, in managing the disruptive event. Following figure 4.18, which describes the distribution of the respondents on the relevance of the business continuity programme for managing the COVID-19 Pandemic, it is possible to conclude that 63% of the respondents *Agree* that the programme helped in managing the disruptive event, 25% of the respondents *Strongly Agree* that the programme helped in managing the disruptive event and 12% of the respondents *Disagree* that the programme helped in managing the COVID-19 Pandemic. Given this, it is possible to conclude that 88% of the respondents (4+5), *Agree* that the programme helped in managing the disruptive event. Considering this, it is also possible to infer that the programme proved to be relevant.

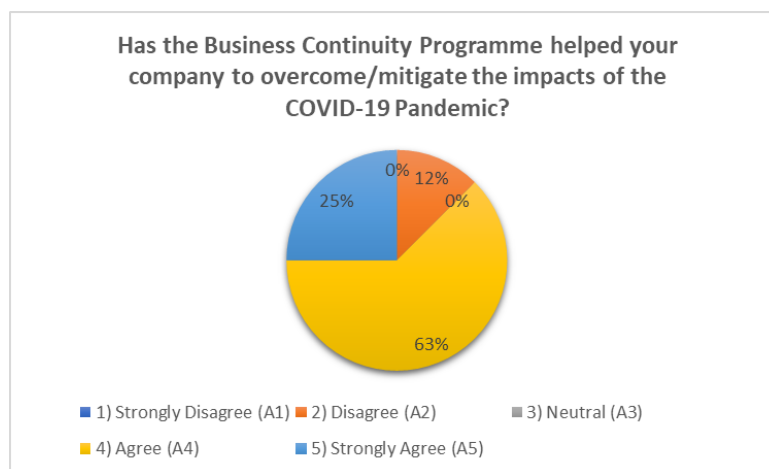


Figure 4.18 – Relevance of the Business Continuity Programme for Managing the COVID-19 Pandemic. Source: Own elaboration based on Excel outputs.

Based on the results described above, it is possible to conclude that the main plans were established, the scenarios of failure for this event were identified by the large majority of the companies, the answers were established for the specific scenarios of failure and were perceived as effective, and the overall programme was effective during the event. Event though, only 25% of the respondents reported including a similar scenario to the COVID-19 in the business continuity programme, as the main impacts were assured by the central plans, this result is not as relevant. Furthermore, the programme was perceived as relevant by 88% of the respondents that considered that it helped in managing the Pandemic.

Based on this, the business continuity programme of the pharmaceutical manufacturing companies proved to be relevant and efficient in addressing this disruptive event, demonstrating a high perception of readiness for managing the COVID-19 Pandemic.

4.4 Results to Research Question 3

This section intends to present and discuss the results to research question 3. Based on this, it is important to consider that the third research question aims to identify the key characteristics of the business continuity programme in the pharma sector.

RQ3 – What are the key characteristics of a Business Continuity Programme in the Pharma Sector?

Before entering the analysis of the specific characteristics that substantiate the development process, it is essential to consider if the business continuity programme followed any specific standard, considering that it gives a perception on its structure. Based on figure 4.19, which describes the distribution of the respondents on the business continuity programme following a referential standard, 62% of the respondents answered *Yes* on following a specific referential standard, while 13% of the respondents answered *No* on following a referential standard and 25% of the respondents reported *Having no knowledge* on this particular subject. Given this, the majority of the companies follows a referential standard in business continuity, and therefore a process similar or identical to the one identified by ISO 22301:2019, in chapter 2.

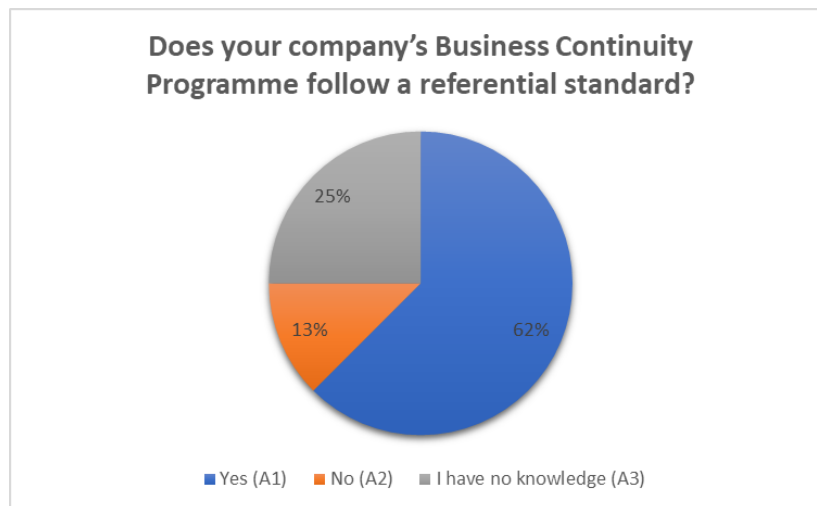


Figure 4.19 – Distribution of the Respondents on following a Business Continuity referential standard. Source: Own elaboration based on Excel outputs.

Based on this, the characteristics of the business continuity programme are going to be identified based on ISO 22301:2019, starting with the process of Incorporation and Management. To facilitate the understanding, the statements analysed (question 13) are presented as follows:

- 1) The Business Continuity Programme is suited to the company's objectives;
- 2) The Administration is committed to the success of the Business Continuity Programme;
- 3) The Business Continuity Policy was established and communicated;
- 4) Business Continuity is an integral part of the company's culture;
- 5) The roles and responsibilities associated with the Business Continuity Programme were established and communicated;
- 6) The Business Continuity Programme is properly documented.

Based on these statements, and following figure 4.20, which describes the distribution of the respondents considering the Incorporation and Management of the business continuity programme, it is essential to first consider that none of the respondents *Disagreed* or *Strongly Disagreed* with any of the statements analysed. On average, 13% of the respondents report a *Neutral* position not agreeing or disagreeing with any of the statements, 42% of the respondents *Agree* with the statements proposed and 45% of the respondents *Strongly Agree* with statements proposed. By coupling these last two categories, it is possible to conclude that, on average 87% of the respondents validates the statements mentioned above in regards to Incorporation and

Management of the business continuity programme. Given this, in regards to the first process, the respondents validate all the characteristics presented above.

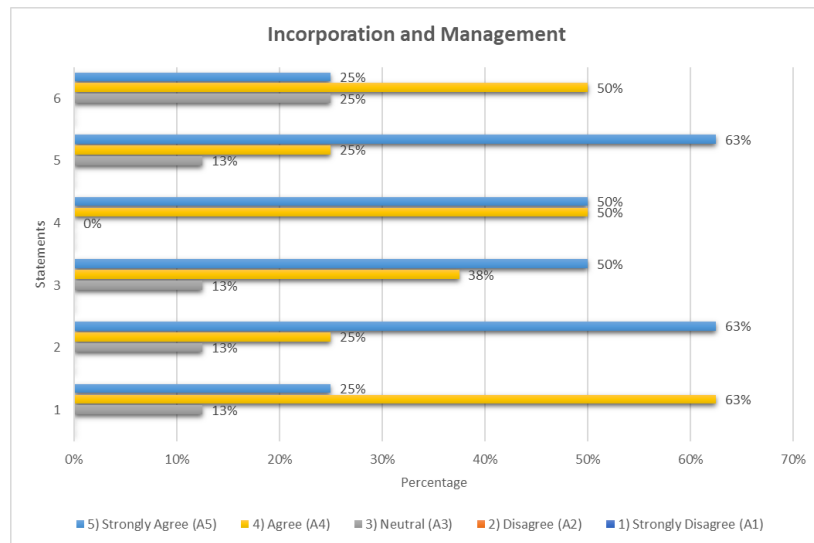


Figure 4.20 – Distribution of the respondents perception on the Incorporation and Management of the Business Continuity Programme. Source: Own elaboration based on Excel outputs.

The second process to be evaluated is the Analysis of the business continuity programme. To facilitate the understanding, the statements (question 14) are presented as follows:

- 1) Critical processes were identified through a Business Impact Analysis (BIA);
- 2) The recovery time objective (RTO) was established for each critical process;
- 3) The maximum tolerable period of disruption (MTPD) was established for each critical process;
- 4) The risks associated with the disruption of critical processes were identified through a Risk Assessment;
- 5) The risks associated with the disruption of critical processes were evaluated;
- 6) The scenarios of failure were identified and prioritised.

Based on the statements, and following figure 4.21, which describes the distribution of the respondents considering the Analysis of the business continuity programme, it is essential to consider that none of the respondents *Disagreed* or *Strongly Disagreed* with any of the statements analysed, in close similarity with the results obtained for the first process. On average, 21% of the respondents report a *Neutral* position not agreeing or disagreeing with any of the statements, 61% of the respondents *Agree* with the

statements proposed and 18% of the respondents *Strongly Agree* with statements proposed. By coupling these last two categories, it is possible to conclude that, on average 79% of the respondents validates the statements mentioned above in regards to the Analysis of the business continuity programme. Given this, in regards to the second process, the respondents validate the characteristics presented above. Nonetheless, it is important to consider that the level of agreement is not as much strong, as in the first process.

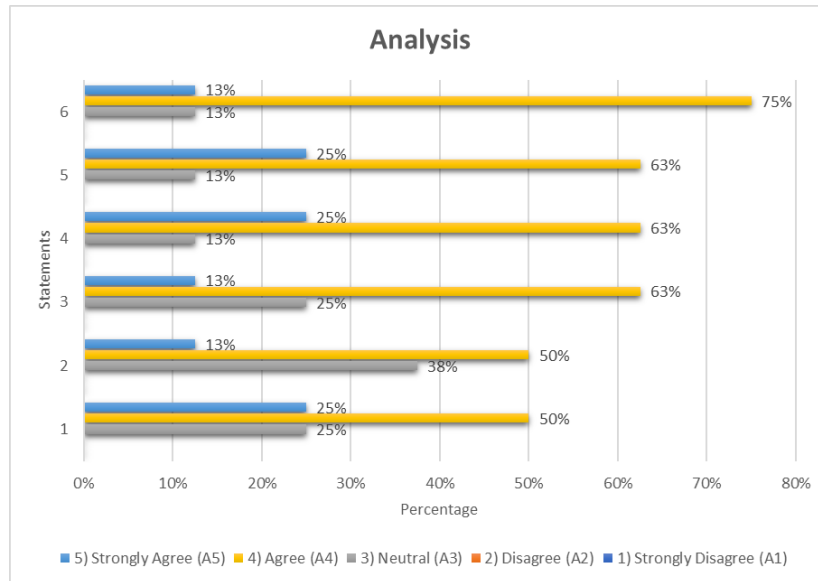


Figure 4.21 – Distribution of the respondents perception on the Analysis of the Business Continuity Programme. Source: Own elaboration based on Excel outputs.

The third process to be evaluated is the Design and Implementation of the business continuity programme. To facilitate the understanding the statements (question 15) are presented as follows:

- 1) Risk mitigation strategies were established;
- 2) Solutions were established for each scenario of failure, taking into account the response and recovery times;
- 3) The solutions were analysed taking into account their effectiveness and cost;
- 4) The necessary requirements for exercising the solutions were identified and approved;
- 5) The Business Continuity Plan documents the processes during and after the disruption;

- 6) The Business Continuity Plan includes a response framework for activation, escalation, and control;
- 7) The Business Continuity Plan was communicated to all the interested parties.

Based on the statements, and following figure 4.22, which describes the distribution of the respondents considering the Design and Implementation of the business continuity programme, it is essential to consider that none of the respondents *Disagreed* or *Strongly Disagreed* with any of the statements analysed, in close similarity with the results obtained for the first and second processes. On average, 23% of the respondents report a *Neutral* position not agreeing or disagreeing with any of the statements, 64% of the respondents *Agree* with the statements proposed and 13% of the respondents *Strongly Agree* with statements proposed. By coupling these last two categories, it is possible to conclude that, on average 77% of the respondents validates the statements mentioned above in regards to the Design and Implementation of the business continuity programme. Given this, in regards to the third process, the respondents validate the characteristics presented above. Nonetheless, it is important to consider that the level of agreement is not as much strong, as in the first or second processes.

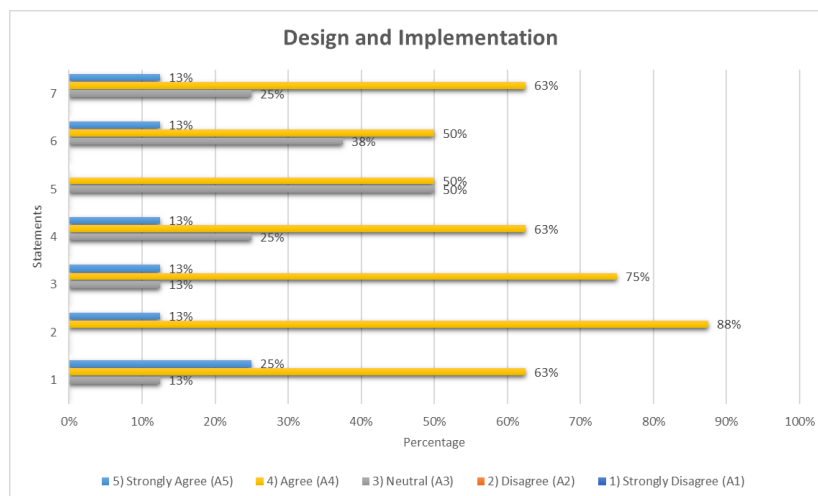


Figure 4.22 – Distribution of the respondents perception on the Analysis of the Business Continuity Programme. Source: Own elaboration based on Excel outputs.

The fourth process to be evaluated is the Validation of the business continuity programme. To facilitate the understanding, the statements (question 16) are presented as follows:

- 1) The Business Continuity Programme is revised according to an established time interval or after a change;

- 2) The Business Continuity Programme is reviewed regularly (at least once a year);
- 3) The Business Continuity Plan is tested after each review;
- 4) The results of the exercises, tests and reviews are communicated to High Administration.

Based on the statements, and following figure 4.23, which describes the distribution of the respondents considering the Validation of the business continuity programme, it is essential to consider that none of the respondents *Disagreed* or *Strongly Disagreed* with any of the statements analysed, in close similarity with the results obtained in other processes. On average, 25% of the respondents report a *Neutral* position not agreeing or disagreeing with any of the statements, 56% of the respondents *Agree* with the statements proposed and 19% of the respondents *Strongly Agree* with statements proposed. By coupling these last two categories, it is possible to conclude that, on average 75% of the respondents validates the statements mentioned above in regards to the Validation of the business continuity programme. Given this, in regards to the fourth process, the respondents validate the characteristics presented above. Nonetheless, it is important to consider that the level of agreement is not as much strong, as in the other processes.

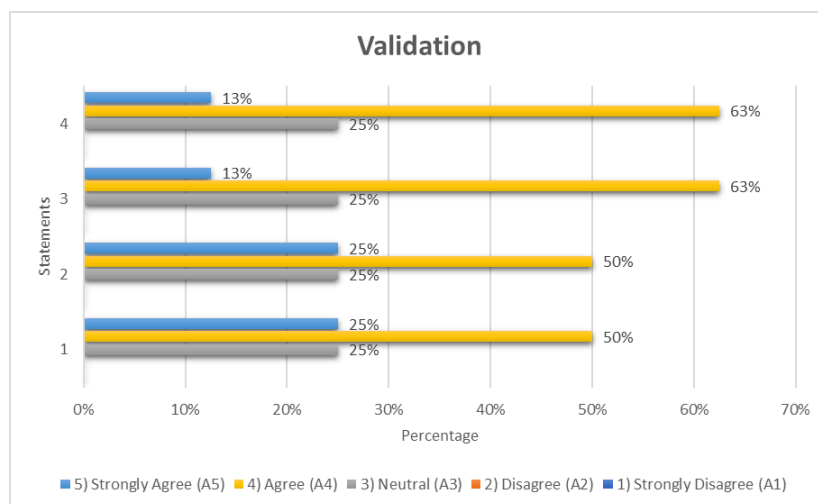


Figure 4.23 - Distribution of the respondents perception on the Validation of the Business Continuity Programme. Source: Own elaboration based on Excel outputs.

Having analysed the processes that substantiate the business continuity programme, based on ISO 22301:2019, it is possible to conclude that the majority of the companies strictly follows the referential standards on business continuity, considering the patterns identified in the results. In this respect, none of the respondents answered *Disagree* or

Strongly Disagree regarding the 23 statements analysed in the processes, what portrays a high level of agreement and a close framing with the standards. Similarly, when asked directly if the programme followed a referential standard, 62% of the respondents answered *Yes*, representing the majority of the respondents. These results seem to be in line with Shanley (2019) assumption, that pharmaceutical companies are betting more on preventive mechanisms in order to avoid disruptions. Similarly, these results may also be corroborated based on the requirements imposed by the regulatory entities, in the way that pharma companies need to be prepared to mitigate supply chain vulnerabilities.

Based on this, it is possible to conclude that a business continuity programme in the Pharma sector, is highly standardised containing the characteristics inherent to these processes, as described above.

4.5 Results to Research Question 4

This section intends to present and discuss the results to research question 4. Based on this, it is important to consider that the fourth research question aims to analyse how pharmaceutical manufacturing companies are planning for disruptive events.

RQ4 – *How do Pharmaceutical Manufacturing Companies are planning for future disruptive events?*

Based on this, the analysis starts with an overview of the respondents that said *No* or *I have no knowledge* on having a business continuity programme prior to the COVID-19 Pandemic, and that account for 69% of the respondents (n=18), comprising the total sample size for this question. The analysis is based on the intention of developing a business continuity programme, as portrayed in figure 4.24. Given this, 72% of the respondents reported *Having no knowledge* on the intentions of developing a business continuity programme, 11% of the respondents answered *No* on the intention of developing this programme, 6% of the respondents answered *Yes* on the intention of developing this programme and 11% of the respondents answered *Yes*, stating that the process is already underway. Considering this, it is possible to infer that 17% of the respondents answered *Yes* on the intention of developing a business continuity programme.

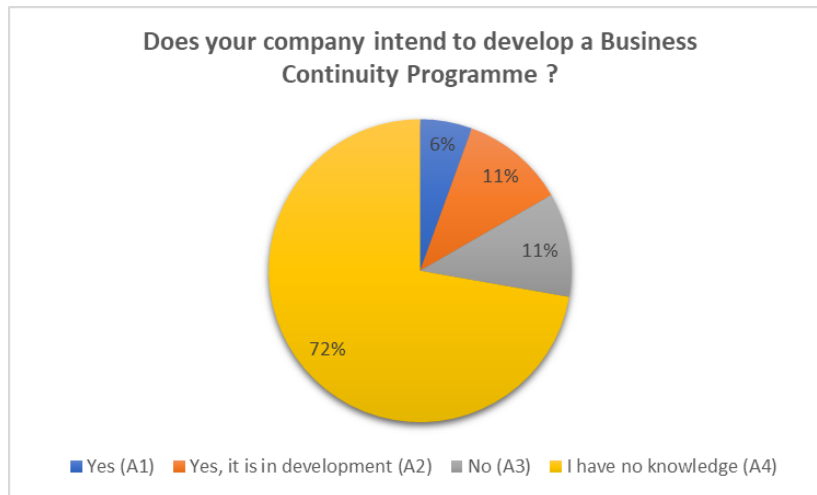


Figure 4.24 – Intention of developing a Business Continuity Programme. Source: Own elaboration based on Excel outputs.

The second part of the analysis concerns the likelihood of implementation of specific strategies, considering the impact of the COVID-19 Pandemic and the planning for future disruptions. Given this, figure 4.25, describes the respondents perception on the likelihood on implementing five different strategies. The first, *Diversify the supplier network*, has an average of implementation of 45,92%, and therefore the highest probability of being implemented. The second, *Reallocate part of the production*, has an average of implementation of 15,31% and therefore the lowest probability of being implemented. The third, *Invest in the digitalisation of the SC*, has an average implementation of 32,08% and therefore a moderate probability of being implemented. The fourth, *Map the supply chain*, has an average of implementation of 32,62% and therefore a moderate probability of being implemented. The fifth, *Increase due diligence on suppliers*, has an average of implementation of 45,62 and, therefore, a high probability of implementation. The standard deviation of this dataset is 29,05, which demonstrates the deviation in the results presented.

The strategies that have the highest likelihood of being implemented are both related with the suppliers, which is not surprising considering that the Source (sS) was the most heavily impacted supply chain dimension. Similarly, the strategy that has the lowest likelihood of being implemented is related in the production and may be constrained by the company's business model.

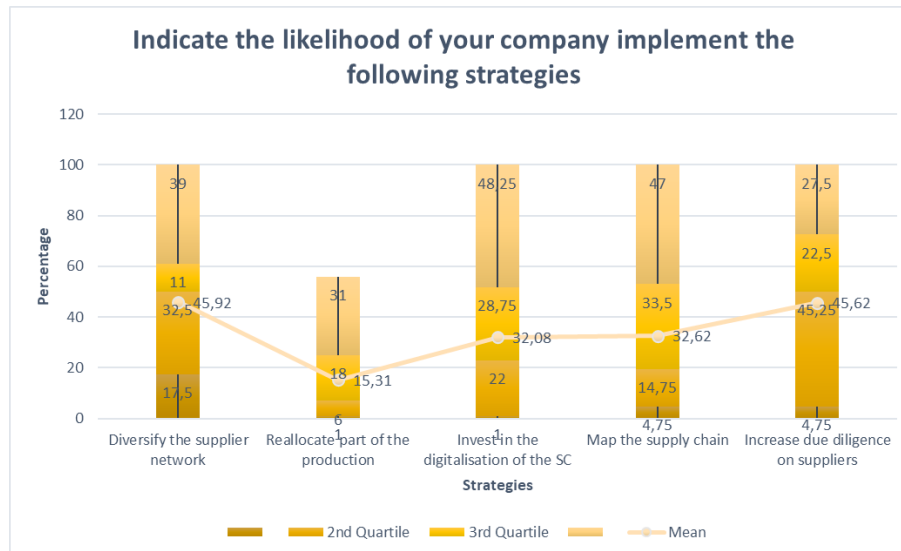


Figure 4.25 – Likelihood of Implementing Recovery Strategies. Source: Own elaboration based on Excel outputs.

Based on this, the pharmaceutical manufacturing companies are planning for disruptive events based on the implementation of preventive mechanisms and specific recovery strategies that aim to strengthen the most impacted areas. For instance, 17% of the pharmaceutical manufacturing companies that did not have a business continuity programme prior to the pandemic (n=18) are planning for future disruptive events, through the development and implementation of this preventive mechanism, 11% of which stating that the process is already underway. Similarly, as mentioned above, Source (sS) related strategies account for the strategies that have the highest likelihood of implementation, portraying that companies intend to recover from the impacts experienced with the COVID-19 Pandemic and learn from this disruptive event.

CHAPTER 5 – CONCLUSIONS

The present chapter introduces the final considerations of the investigation. In this respect, the segment starts by establishing the general conclusion to the research problem. Subsequently, the empirical and practical implications are established, and the limitations identified. The chapter is concluded with recommendations for future research.

5.1 Conclusion

The aim of this investigation was to analyse the perception of the impact of the COVID-19 Pandemic on the supply chain of pharmaceutical manufacturing companies and, in turn, determine the level of readiness of the business continuity programme for effectively manage this disruptive event.

In this respect, the perception of the impact of the COVID-19 Pandemic on the supply chain differs based on the level of analysis considered. At the macro level, where no dimensions are taken into consideration, pharmaceutical manufacturing companies report having a relevant impact, with 47% of the respondents acknowledging these effects. At the micro level and taking into consideration the processes that substantiate the supply chain, in particular the SCOR dimensions, the perception of the impact is relatively lower, with an average of 36% of the respondents report having a high impact and an average of 46% of the respondents report having a low impact on the SC. Considering that the micro level is based on specific metrics that analyse the overall dimensions, it is more relevant for the investigation as it is not based on a “raw” perception, but instead the on a sum of several perceptions on specific impacts. Given this, it is particularly crucial to understand the reasoning behind these results.

According to Kilpatrick & Barter (2020), the companies that were better prepared to respond and mitigate the impact of the COVID-19 Pandemic, were the ones that had preventive mechanisms and resilience practices. Even though, only 31% of respondents said *Yes* to having a business continuity programme prior to the pandemic, this number should not be analysed so rigidly considering that 58% of the respondents reported having no knowledge on this subject, which does not prevent companies from still having a programme.

In this respect, from the analysis of the business continuity programme, it was possible to infer that the main plans were established, and the scenarios of failure were identified by the large majority of the companies, the answers were established and were perceived as effective, and the overall programme was effective during the event. Furthermore, the business continuity programme of the pharmaceutical manufacturing companies proved to be relevant and efficient in addressing this disruptive event, demonstrating, therefore, a high perception of readiness for managing the COVID-19 Pandemic. Similarly, the business continuity programme of these companies also follows referential standards, having identified the general characteristics of ISO 22301:2019 in the majority of the companies.

Business continuity programmes are described as fundamental tools in managing the impact of disruptions, as they provide companies with a roadmap to deal with disruptive events (Azadegan, *et al.*, 2020a). Given this, these results help in understanding the reasoning behind the impact perceived.

Considering that 31% of the companies or more had holistic business continuity programmes, with a high perception of readiness for managing the COVID-19 Pandemic and highly standardised characteristics, it would be expected the perceived impact to be low, with some deviations based on the other companies' flexibility, as portrayed, in the micro analysis of the perception of the impact. Based on this, the results, not only corroborate the perception of the impact of the COVID-19 Pandemic on the supply chain, but also the relevance of business continuity in managing and mitigating the impacts of a disruptive event.

Having a business continuity programme helped pharmaceutical manufacturing companies in managing the impacts of the COVID-19 Pandemic, considering, not only the level of the perceived impacts, but also the overall relevance of these mechanisms in responding to these disruptive events. Nonetheless, it is important to consider that the programmes were standardised and included directly or indirectly responses to mitigate the impacts. Given this, for a business continuity programme to be effective, when managing a disruptive event, the scenario needs to be established or has to be adapted based on other identified scenarios. Business continuity programmes function has manuals, identifying the impacts and the particular strategies for dealing with disruption.

5.2 Implications

This investigation contributed both in theory and in practice to the literature gap identified in the literature review, by giving an understanding of the importance of business continuity in mitigating the impacts of an actual disruptive event in the supply chain. It also contributes to a more informed planning in managing similar events and to the theorisation on the COVID-19 Pandemic, considering its topicality and overall importance in years to come.

5.3 Limitations

The main limitation of this investigation is the high margin of error in the results of the survey, based on the low sample size of the questionnaire. In this sense, it is important to mention other related limitations, such as the difficulty in identifying the population, given that many companies are characterized as producers, but do not have a production activity in Portugal and the difficulty in identifying the respondent, considering the level of knowledge required to answer some questions in the questionnaire. Similarly, the phase of data collection also coincided with the relief of pandemic restrictions, which may have influenced the process.

5.4 Recommendations for Future Research

This investigation led to several conclusions on the importance of business continuity for managing supply chain disruption. Nonetheless, throughout the investigation, other topics were tangled that could be used in future investigations.

In this respect, it would be relevant to extend the analysis to other players in the pharmaceutical industry, and perform a comparative analysis, for instance between producers and distributors, to understand the perception of impact in other players across the supply chain and the relevance of these mechanisms.

Additionally, this study could also be expanded to other industries, to assess the relevance of business continuity in other sectors and to other countries in order to understand the relative position of Portugal in regards to BMS.

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ANNEXES

Annex A – List of Essential Services in Portaria Number 97/2020, of April 19th, following the amendment of Portaria Number 82/2020, of March 29th, 2020



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ANEXO

[a que se refere a alínea b) do n.º 1 do artigo 2.º]

I — Serviços na área da saúde [para além dos profissionais de saúde referidos na alínea a) do n.º 1 do artigo 2.º]

1 — Serviços de manutenção de hospitais, serviços de emergência médica, centros de saúde, unidades autónomas de gaseificação, clínicas de hemodiálise, outras estruturas de prestação de cuidados de saúde e demais estruturas associadas, nomeadamente relativas a atividades de medicina transfusional, de transplantação, vigilância epidemiológica, cuidados continuados, cuidados paliativos e cuidados domiciliários.

2 — Serviço de helicópteros de emergência médica.

3 — Serviços de telecomunicações, informática e desenvolvimento e operação dos sistemas de informação necessários ao suporte das atividades clínicas e administrativas de combate à pandemia.

4 — Serviços de manutenção de infraestruturas críticas de saúde.

5 — Serviços de formação dos profissionais de saúde em formato *online*.

6 — Serviços de gestão e manutenção de infraestruturas tecnológicas e de todos os sistemas de informação do Serviço Nacional de Saúde, incluindo SNS24 e demais sistemas conexos.

7 — Serviços de manutenção dos serviços e organismos do Ministério da Saúde.

8 — Serviços de importação e aquisição de matérias-primas destinadas ao fabrico de substâncias ativas, medicamentos, incluindo os medicamentos contendo substâncias controladas, dispositivos médicos e outros produtos de saúde, biocidas e equipamentos de proteção individual.

9 — Serviços de fabrico, comercialização, distribuição por grosso, importação, exportação e dispensa de medicamentos, de especialidades farmacêuticas, dispositivos médicos e outros produtos de saúde, biocidas e equipamentos de proteção individual.

10 — Serviços de fornecimento de medicamentos a farmácias de oficina.

11 — Serviços de fornecimento de gases medicinais ao domicílio.

12 — Serviços de transporte de produtos biológicos destinados à avaliação laboratorial e transplante, em viaturas de unidades hospitalares e para transporte de equipas cirúrgicas para colheita de órgãos e tecidos, entre instituições de saúde.

13 — Serviços de tratamento de resíduos hospitalares.

14 — Serviços de tratamento de roupa e de fornecimento de alimentação às unidades prestadoras de cuidados de saúde.

15 — Serviços de fornecimento de material radioativo para fins clínicos ou médicos.



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ANEXO

(a que se refere o artigo 3.º)

«ANEXO

[...]

I — [...]

8 — [...]

9 — Serviços de fabrico, comercialização, distribuição por grosso, importação, exportação e dispensa de medicamentos, de especialidades farmacêuticas, dispositivos médicos e outros produtos de saúde, biocidas e equipamentos de proteção individual, bem como serviços de suporte a estas atividades, designadamente de embalagem para a indústria farmacêutica, incluindo o embalagem secundário.

10 — [...]

11 — [...]

12 — [...]

Annex B – The Final Questionnaire (Portuguese Version)

COVID-19: O Impacto na Cadeia de Abastecimento e o Programa de Continuidade de Negócio

O presente estudo foi desenvolvido no âmbito de uma dissertação de Mestrado em Gestão Internacional da ISCTE Business School e tem como objetivos:

- 1) Analisar o impacto da Pandemia do COVID-19 na Cadeia de Abastecimento das Empresas Produtoras Farmacêuticas;
- 2) Aferir a relevância da existência de um Programa de Continuidade de Negócio para a gestão eficaz do impacto da Pandemia.

Todas as respostas são anónimas e confidenciais. Deve responder às questões selecionando a opção que melhor caracteriza a sua empresa. O tempo médio previsto para responder ao questionário é de aproximadamente 10 minutos. Em caso de dúvidas, envie um email para migrf@iscte-iul.pt.

Obrigada pela sua colaboração.

Secção 1: Caracterização Geral da Empresa e Respondentes

1. Caso pretenda, indique o nome da sua empresa.

2. Qual das seguintes áreas melhor descreve a função que desempenha?

- ☐ Administração
- ☐ Comercial
- ☐ Continuidade de Negócio
- ☐ Gestão do Risco
- ☐ Gestão da Qualidade / Ambiente
- ☐ Logística / Cadeia de Abastecimento
- ☐ Produção / Operações
- ☐ RH / SHST
- ☐ Sistemas de Informação
- ☐ Outro

3. Qual o volume de negócios anual (aproximado) da sua empresa, em milhões de euros?

- ☐ Inferior a 1
- ☐ Entre 1-25
- ☐ Entre 26-50
- ☐ Superior a 50
- ☐ Não tenho conhecimento

4. Selecione a(s) categoria(s) de atividade em que se insere a sua empresa.

- ☐ Distribuidor por Grosso de Medicamentos de Uso Humano
- ☐ Exportador de Substâncias Controladas
- ☐ Fabrico de Substâncias Controladas
- ☐ Importador de Substâncias Controladas
- ☐ Titular de AIM - Distribuição por Grosso de Medicamentos

5. Characterise o modelo de negócio da sua empresa, indicando a percentagem de negócio de Produção

Própria:

Secção 2: O Impacto na Cadeia de Abastecimento

6. A Pandemia do COVID-19 impactou a Cadeia de Abastecimento da sua empresa? Considere a escala apresentada em que 1 representa o "Discordo Totalmente" e 5 representa o "Concordo Totalmente".

1 ○ 2 ○ 3 ○ 4 ○ 5 ○

7. Classifique as seguintes afirmações tendo em conta o impacto da Pandemia do COVID-19 (contexto) na Cadeia de Abastecimento, no que diz respeito à dimensão do Planeamento.

	1) Discordo Totalmente	2) Discordo	3) Não concordo, nem discordo	4) Concordo	5) Concordo Totalmente
Este contexto obrigou a alterações na rede de fornecedores.	○	○	○	○	○
Este contexto obrigou ao estabelecimento de novas parcerias.	○	○	○	○	○
Este contexto desencadeou problemas de sucessão de colaboradores.	○	○	○	○	○
Este contexto evidenciou a falta de modelos de previsão de procura ("demand forecasting").	○	○	○	○	○

8. Classifique as seguintes afirmações tendo em conta o impacto da Pandemia do COVID-19 (contexto) na Cadeia de Abastecimento, no que diz respeito à dimensão do Fornecimento.

	1) Discordo Totalmente	2) Discordo	3) Não concordo, nem discordo	4) Concordo	5) Concordo Totalmente
Este contexto impactou a comunicação com os fornecedores.	○	○	○	○	○

Este contexto levou ao encerramento dos fornecedores.	☐	☐	☐	☐	☐
Este contexto dificultou o acesso a inputs (ex.: princípios ativos, excipientes, embalagens, etc.)	☐	☐	☐	☐	☐
Este contexto resultou num aumento dos preços dos inputs.	☐	☐	☐	☐	☐

9. Classifique as seguintes afirmações tendo em conta o impacto da Pandemia do COVID-19 (contexto) na Cadeia de Abastecimento, no que diz respeito à dimensão da Produção.

	1) Discordo Totalmente	2) Discordo	3) Não concordo, nem discordo	4) Concordo	5) Concordo Totalmente
Este contexto obrigou à suspensão da produção.	☐	☐	☐	☐	☐
Este contexto obrigou ao abrandamento da produção.	☐	☐	☐	☐	☐
Este contexto desencadeou adaptações nas tecnologias e nos processos envolvidos na produção.	☐	☐	☐	☐	☐
Este contexto resultou num aumento do stock do produto final.	☐	☐	☐	☐	☐

10. Classifique as seguintes afirmações tendo em conta o impacto da Pandemia do COVID-19 (contexto) na Cadeia de Abastecimento, no que diz respeito à dimensão da Distribuição.

	1) Discordo Totalmente	2) Discordo	3) Não concordo, nem discordo	4) Concordo	5) Concordo Totalmente
Este contexto impactou a capacidade de armazenamento do produto final.	☐	☐	☐	☐	☐
Este contexto impactou a comunicação com as empresas de distribuição.	☐	☐	☐	☐	☐
Este contexto resultou em restrições no escoamento do produto final.	☐	☐	☐	☐	☐

Este contexto resultou num atraso das entregas do produto final.	☐	☐	☐	☐	☐
Este contexto resultou numa mudança dos canais de distribuição.	☐	☐	☐	☐	☐
Este contexto resultou no aumento das tarifas de distribuição.	☐	☐	☐	☐	☐
Este contexto resultou numa diminuição da procura.	☐	☐	☐	☐	☐

Secção 3: O Programa de Continuidade de Negócio

11. A sua empresa tinha um Programa de Continuidade de Negócio, anteriormente à Pandemia do COVID-19?

- ☐ Sim
- ☐ Não
- ☐ Não tenho conhecimento

12. O Programa de Continuidade de Negócio da sua empresa segue um referencial (ex: ISO 22301, BCI)?

- ☐ Sim
- ☐ Não
- ☐ Não tenho conhecimento

13. Classifique as seguintes afirmações tendo em conta a Incorporação e Gestão do Programa de Continuidade de Negócio da sua empresa.

	1) Discordo Totalmente	2) Discordo	3) Não concordo, nem discordo	4) Concordo	5) Concordo Totalmente
O Programa de Continuidade de Negócio é adequado aos objetivos da empresa.	☐	☐	☐	☐	☐
A Administração está comprometida com o sucesso do Programa de Continuidade de Negócio.	☐	☐	☐	☐	☐
A Política de Continuidade de Negócio foi estabelecida e comunicada.	☐	☐	☐	☐	☐
A Continuidade de Negócio é parte integrante da cultura da empresa.	☐	☐	☐	☐	☐

As funções e responsabilidades associadas ao Programa de Continuidade de Negócio foram estabelecidas e comunicadas.	☐	☐	☐	☐	☐
O Programa de Continuidade de Negócio está devidamente documentado.	☐	☐	☐	☐	☐

14. Classifique as seguintes afirmações tendo em conta o processo de Análise do Programa de Continuidade de Negócio da sua empresa.

	1) Discordo Totalmente	2) Discordo	3) Não concordo, nem discordo	4) Concordo	5) Concordo Totalmente
Os processos críticos foram identificadas através de uma Análise de Impacto de Negócio (BIA).	☐	☐	☐	☐	☐
O objetivo de tempo de recuperação (RTO) foi estabelecido para cada processo crítico.	☐	☐	☐	☐	☐
O período máximo tolerável de interrupção (MTPD) foi estabelecido para cada processo crítico.	☐	☐	☐	☐	☐
Os riscos associados à disrupção dos processos críticos foram identificados através de uma Análise de Risco.	☐	☐	☐	☐	☐
Os riscos associados à disrupção dos processos críticos foram avaliados.	☐	☐	☐	☐	☐
Os cenários de falha foram identificados e priorizados.	☐	☐	☐	☐	☐

15. Classifique as seguintes afirmações tendo em conta o Design e Implementação do Programa de Continuidade de Negócio da sua empresa.

	1) Discordo Totalmente	2) Discordo	3) Não concordo, nem discordo	4) Concordo	5) Concordo Totalmente
Foram estabelecidas estratégias de mitigação do risco.	☐	☐	☐	☐	☐

Foram estabelecidas soluções para cada cenário de falha, tendo em conta os momentos de resposta e recuperação.	☐	☐	☐	☐	☐
As soluções foram analisadas tendo em conta a sua eficácia e custo.	☐	☐	☐	☐	☐
Os requisitos necessários para o exercício das soluções foram identificados e aprovados.	☐	☐	☐	☐	☐
O Plano de Continuidade de Negócio documenta os processos durante e após a disrupção.	☐	☐	☐	☐	☐
O Plano de Continuidade de Negócio inclui uma estrutura de resposta para ativação, escalonamento e controlo.	☐	☐	☐	☐	☐
O Plano de Continuidade de Negócio foi comunicado a todas as partes interessadas.	☐	☐	☐	☐	☐

16. Classifique as seguintes afirmações tendo em conta a Validação do Programa de Continuidade de Negócio da sua empresa.

	1) Discordo Totalmente	2) Discordo	3) Não concordo, nem discordo	4) Concordo	5) Concordo Totalmente
O Programa de Continuidade de Negócio é revisto de acordo com um intervalo de tempo estabelecido ou após uma alteração.	☐	☐	☐	☐	☐
O Programa de Continuidade de Negócio é revisto regularmente (pelo menos uma vez por ano).	☐	☐	☐	☐	☐
O Plano de Continuidade de Negócio é testado após cada revisão.	☐	☐	☐	☐	☐
Os resultados dos exercícios, testes e revisões são comunicados à Alta Administração.	☐	☐	☐	☐	☐

17. Selecione o(s) Plano(s) estabelecido(s) no Programa de Continuidade de Negócio da sua empresa.

- ☐ Plano de Áreas Críticas de Negócio
- ☐ Plano de Contingência
- ☐ Plano de Infraestruturas e Equipamentos
- ☐ Plano de Sistemas de Informação
- ☐ Plano de Sucessão
- ☐ Não tenho conhecimento

18. Selecione o(s) cenário(s) de falha identificado(s) no Plano de Continuidade de Negócio da sua empresa.

- ☐ Falha de Colaboradores
- ☐ Falha de Equipamentos
- ☐ Falha de Fornecedores
- ☐ Falha de Infraestruturas
- ☐ Falha de Linha de Produção
- ☐ Falha de Processos
- ☐ Falha de Armazenamento
- ☐ Não tenho conhecimento

19. O Plano de Continuidade de Negócio da sua empresa tinha respostas para os cenários de falha seguintes?

	Falha de Colaboradores	Falha de Equipamentos	Falha de Fornecedores	Falha de Infraestruturas	Falha de Linha de Produção	Falha de Processos	Falha de Armazenamento
Sim	☐	☐	☐	☐	☐	☐	☐
Não	☐	☐	☐	☐	☐	☐	☐
Não tenho conhecimento	☐	☐	☐	☐	☐	☐	☐

20. As respostas contidas no Plano de Continuidade de Negócio foram eficazes para os cenários de falha seguintes?

	1) Discordo Totalmente	2) Discordo	3) Não concordo, nem discordo	4) Concordo	5) Concordo Totalmente
Falha de Colaboradores	☐	☐	☐	☐	☐
Falha de Equipamentos	☐	☐	☐	☐	☐
Falha de Fornecedores	☐	☐	☐	☐	☐
Falha de Infraestruturas	☐	☐	☐	☐	☐
Falha de Linha de Produção	☐	☐	☐	☐	☐
Falha de Processos	☐	☐	☐	☐	☐
Falha de Armazenamento	☐	☐	☐	☐	☐

21. O Programa de Continuidade de Negócio da sua empresa incluía um evento semelhante à Pandemia do COVID-19?

- ☐ Sim
- ☐ Não
- ☐ Não tenho conhecimento

22. Classifique as seguintes afirmações tendo em conta o Programa de Continuidade de Negócio da sua empresa durante a Pandemia do COVID-19.

	1) Discordo Totalmente	2) Discordo	3) Não concordo, nem discordo	4) Concordo	5) Concordo Totalmente
O processo de ativação do plano decorreu sem incidentes.	☐	☐	☐	☐	☐
Os colaboradores conheciam as suas funções e responsabilidades.	☐	☐	☐	☐	☐
As equipas comunicaram bem entre si.	☐	☐	☐	☐	☐
As equipas mantiveram-se em contacto com as autoridades de saúde locais.	☐	☐	☐	☐	☐
O processo de escalonamento do plano acompanhou o desenvolvimento da Pandemia.	☐	☐	☐	☐	☐

23. O Programa de Continuidade de Negócio ajudou a sua empresa a superar/mitigar os impactos da Pandemia do COVID-19? Considere a escala apresentada em que 1 representa o "Discordo Totalmente" e 5 representa o "Concordo Totalmente".

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Secção 4: A Recuperação

24. A sua empresa pretende desenvolver um Programa de Continuidade de Negócio, para endereçar riscos semelhantes à Pandemia do COVID-19?

- ☐ Sim
- ☐ Sim, está em desenvolvimento
- ☐ Não
- ☐ Não tenho conhecimento

25. Indique a probabilidade da sua empresa implementar as seguintes estratégias, considerando o impacto da Pandemia do COVID-19.

Diversificar a rede de fornecedores



Estratégia	Probabilidade (%)
Diversificar a rede de fornecedores	10
Realocar parte da produção	10
Investir na digitalização da cadeia de abastecimento	10
Mapear a cadeia de abastecimento	10
Aumentar a diligência prévia ("due diligence") nos fornecedores	10

Realocar parte da produção



Investir na digitalização da cadeia de abastecimento



Mapear a cadeia de abastecimento



Aumentar a diligência prévia ("due diligence") nos fornecedores



Por "diligência prévia" ou "due diligence", entenda-se as ações que uma empresa toma para conhecer os seus parceiros.

Annex C - The Final Questionnaire (English Version)

COVID-19: The Impact on the Supply Chain and the Business Continuity Programme

This study was developed within the scope of a master's thesis in International Management at ISCTE Business School and aims to:

- 1) Analyze the impact of the COVID-19 Pandemic on the Supply Chain of Pharmaceutical Manufacturing Companies;
- 2) Assess the relevance of a Business Continuity Programme for the effective management of the impact of the Pandemic.

All the responses are anonymous and confidential. You must answer the questions by selecting the option that best characterizes your company. The expected average time to answer the questionnaire is approximately 10 minutes. In case of doubts, send an email to migrf@iscte-iul.pt.

Thank you for your collaboration.

Section 1: General Characterization of the Company and the Respondents

1. If you wish, please indicate your company's name.

2. Which of the following areas best describes your role?

- ☐ Administration
- ☐ Commercial
- ☐ Business Continuity
- ☐ Risk Management
- ☐ Quality Management / Environment
- ☐ Logistics / Supply Chain
- ☐ Production / Operations
- ☐ HR / ISHR
- ☐ Information Systems
- ☐ Other

3. What is the (approximate) annual turnover of your company, in millions of euros?

- ☐ Less than 1
- ☐ Between 1-25
- ☐ Between 26-50
- ☐ Over than 50
- ☐ I have no knowledge

4. Select the category(ies) of activity your company belongs to.*

- ☐ Distribuidor por Grosso de Medicamentos de Uso Humano
- ☐ Exportador de Substâncias Controladas
- ☐ Fabrico de Substâncias Controladas
- ☐ Importador de Substâncias Controladas
- ☐ Titular de AIM - Distribuição por Grosso de Medicamentos

5. Characterize your company's business model, by indicating the percentage of business that refers to own production.

Section 2: The Impact on the Supply Chain

6. Did the COVID-19 Pandemic impact your company's supply chain? Consider the scale presented where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree".

1 ○ 2 ○ 3 ○ 4 ○ 5 ○

7. Rate the following statements taking into account the impact of the COVID-19 Pandemic (context) on the Supply Chain Structure, regarding the Planning dimension.

	1) Strongly Disagree	2) Disagree	3) Neutral	4) Agree	5) Strongly Agree
This context forced changes in the supplier network.	○	○	○	○	○
This context forced the establishment of new partnerships.	○	○	○	○	○
This context triggered employee succession problems.	○	○	○	○	○
This context highlighted the lack of demand forecasting models.	○	○	○	○	○

8. Rate the following statements taking into account the impact of the COVID-19 Pandemic (context) on the Supply Chain Structure, regarding the Sourcing dimension.

	1) Strongly Disagree	2) Disagree	3) Neutral	4) Agree	5) Strongly Agree
This context impacted the communication with the suppliers.	○	○	○	○	○
This context led to the closure of suppliers.	○	○	○	○	○

This context made it difficult to access inputs (ex. active ingredients, excipients, packaging, etc.)	☐	☐	☐	☐	☐
This context resulted in an increase in input prices.	☐	☐	☐	☐	☐

9. Rate the following statements taking into account the impact of the COVID-19 Pandemic (context) on the Supply Chain Structure, regarding the Making dimension.

	1) Strongly Disagree	2) Disagree	3) Neutral	4) Agree	5) Strongly Agree
This context forced the suspension of the production.	☐	☐	☐	☐	☐
This context forced a slowdown in production.	☐	☐	☐	☐	☐
This context triggered adaptations in the technologies and the processes involved in the production.	☐	☐	☐	☐	☐
This context resulted in an increase in the stock of the final product.	☐	☐	☐	☐	☐

10. Rate the following statements taking into account the impact of the COVID-19 Pandemic (context) on the Supply Chain Structure, regarding the Distribution dimension.

	1) Strongly Disagree	2) Disagree	3) Neutral	4) Agree	5) Strongly Agree
This context impacted the storage capacity of the final product.	☐	☐	☐	☐	☐
This context impacted the communication with the distribution companies.	☐	☐	☐	☐	☐
This context resulted in restrictions on the flow of the final product.	☐	☐	☐	☐	☐
This context resulted in a delay in the deliveries of the final product.	☐	☐	☐	☐	☐
This context resulted in a change in distribution channels.	☐	☐	☐	☐	☐

This context resulted in an increase of the distribution tariffs.	☐	☐	☐	☐	☐
This context resulted in a decrease in demand.	☐	☐	☐	☐	☐

Section 3: The Business Continuity Programme

11. Did your company have a Business Continuity Programme prior to the COVID-19 Pandemic?

- ☐ Yes
- ☐ No
- ☐ I don't have knowledge

12. Does your company's Business Continuity Programme follow a referential standard (ex: ISO 22301, BCI, etc.)?

- ☐ Yes
- ☐ No
- ☐ I don't have knowledge

13. Rate the following statements taking into account the Incorporation and Management of your company's Business Continuity Programme.

	1) Strongly Disagree	2) Disagree	3) Neutral	4) Agree	5) Strongly Agree
The Business Continuity Programme is suited to the company's objectives.	☐	☐	☐	☐	☐
The Administration is committed to the success of the Business Continuity Programme.	☐	☐	☐	☐	☐
The Business Continuity Policy was established and communicated.	☐	☐	☐	☐	☐
Business Continuity is an integral part of the company's culture.	☐	☐	☐	☐	☐
The roles and responsibilities associated with the Business Continuity Programme were established and communicated.	☐	☐	☐	☐	☐

The Business Continuity Programme is properly documented.	☐	☐	☐	☐	☐

14. Rate the following statements taking into account the process of Analysis of your company's Business Continuity Programme.

	1) Strongly Disagree	2) Disagree	3) Neutral	4) Agree	5) Strongly Agree
Critical processes were identified through a Business Impact Analysis (BIA).	☐	☐	☐	☐	☐
The recovery time objective (RTO) was established for each critical process.	☐	☐	☐	☐	☐
The maximum tolerable period of disruption (MTPD) was established for each critical process.	☐	☐	☐	☐	☐
The risks associated with the disruption of critical processes were identified through a Risk Assessment.	☐	☐	☐	☐	☐
The risks associated with the disruption of critical processes were evaluated.	☐	☐	☐	☐	☐
The scenarios of failure were identified and prioritized.	☐	☐	☐	☐	☐

15. Rate the following statements taking into account the Design and Implementation of your company's Business Continuity Programme.

	1) Strongly Disagree	2) Disagree	3) Neutral	4) Agree	5) Strongly Agree
Risk mitigation strategies were established.	☐	☐	☐	☐	☐

Solutions were established for each scenario of failure, taking into account the response and recovery times.	☐	☐	☐	☐	☐
The solutions were analyzed taking into account their effectiveness and cost.	☐	☐	☐	☐	☐
The necessary requirements for exercising the solutions were identified and approved.	☐	☐	☐	☐	☐
The Business Continuity Plan documents the processes during and after the disruption.	☐	☐	☐	☐	☐
The Business Continuity Plan includes a response framework for activation, escalation, and control.	☐	☐	☐	☐	☐
The Business Continuity Plan was communicated to all the interested parties.	☐	☐	☐	☐	☐

16. Rate the following statements taking into account the Validation of your company's Business Continuity Programme.

	1) Strongly Disagree	2) Disagree	3) Neutral	4) Agree	5) Strongly Agree
The Business Continuity Programme is revised according to an established time interval or after a change.	☐	☐	☐	☐	☐
The Business Continuity Programme is reviewed regularly (at least once a year).	☐	☐	☐	☐	☐
The Business Continuity Plan is tested after each review.	☐	☐	☐	☐	☐

The results of the exercises, tests and reviews are communicated to High Administration.

☐	☐	☐	☐	☐
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17. Select the Plan(s) established in your company's Business Continuity Programme.

- ☐ Critical Business Areas Plan
- ☐ Contingency Plan
- ☐ Infrastructure and Equipment Plan
- ☐ Information Systems Plan
- ☐ Succession Plan
- ☐ I have no knowledge

18. Select the scenario(s) of failure identified in your company's Business Continuity Plan.

- ☐ Employee Failure
- ☐ Equipment Failure
- ☐ Supplier Failure
- ☐ Infrastructure Failure
- ☐ Production Line Failure
- ☐ Process Failure
- ☐ Storage Failure
- ☐ I have no knowledge

19. Did your company's Business Continuity Plan have answers to the following scenarios?

	Employee Failure	Equipment Failure	Supplier Failure	Infrastructure Failure	Production Line Failure	Process Failure	Storage Failure
Yes	☐	☐	☐	☐	☐	☐	☐
No	☐	☐	☐	☐	☐	☐	☐
I have no knowledge	☐	☐	☐	☐	☐	☐	☐

20. Were the responses contained in the Business Continuity Plan effective for the following issues?

	1) Strongly Disagree	2) Disagree	3) Neutral	4) Agree	5) Strongly Agree
Employee Failure	☐	☐	☐	☐	☐
Equipment Failure	☐	☐	☐	☐	☐
Supplier Failure	☐	☐	☐	☐	☐
Infrastructure Failure	☐	☐	☐	☐	☐
Production Line Failure	☐	☐	☐	☐	☐
Process Failure	☐	☐	☐	☐	☐

Storage Failure | ☐ | ☐ | ☐ | ☐ | ☐

21. Did your company's Business Continuity Programme include an event similar to the COVID-19 Pandemic?

- ☐ Yes
- ☐ No
- ☐ I have no knowledge

22. Please rate the following statements taking into account your company's Business Continuity Programme during the COVID-19 Pandemic.

	1) Strongly Disagree	2) Disagree	3) Neutral	4) Agree	5) Strongly Agree
The plan activation process went without incidents.	☐	☐	☐	☐	☐
The employees knew their roles and responsibilities.	☐	☐	☐	☐	☐
The teams communicated well with each other.	☐	☐	☐	☐	☐
The teams kept in contact with the local health authorities.	☐	☐	☐	☐	☐
The plan's escalation process followed the development of the Pandemic.	☐	☐	☐	☐	☐

23. Has the Business Continuity Programme helped your company to overcome/mitigate the impacts of the COVID-19 Pandemic? Consider the scale presented where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree".

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Section 4: The Recovery

24. Does your company intend to develop a Business Continuity Programme to address risks similar to the COVID-19 Pandemic?

- ☐ Yes
- ☐ Yes, it is in development
- ☐ No
- ☐ I don't have knowledge

25. Indicate the likelihood of your company implement the following strategies, considering the impact of the COVID-19 Pandemic.

Diversify the supplier network.

A horizontal bar chart with a grey bar extending to approximately 85% of the total length. The bar has a 3D effect with a darker top and bottom edge.

Relocate part of production.

A horizontal bar chart with a grey bar extending to approximately 85% of the total length. The bar has a 3D effect with a darker top and bottom edge.

Invest in the digitisation of the supply chain.

A horizontal bar chart with a grey bar extending to approximately 85% of the total length. The bar has a 3D effect with a darker top and bottom edge.

Map the supply chain.

A horizontal bar chart with a grey bar extending to approximately 85% of the total length. The bar has a 3D effect with a darker top and bottom edge.

Increase due diligence on suppliers.

A horizontal bar chart with a grey bar extending to approximately 85% of the total length. The bar has a 3D effect with a darker top and bottom edge.

By "due diligence" is meant the actions a company takes to get to know its partners.

* The categories have not been translated, to avoid losing substance as they represent the official INFARMED categories.

Annex D – The Process of Construction of the Questionnaire

Section 1: General Characterization of the Company and the Respondents			
Question	Type	Answer Options	Pertinence
1: If you wish, please indicate your company's name.	Open-ended (short-text)		Optional question, aiming at identifying the company and developing the respective profile.
2: Which of the following areas best describes your role?	Single-choice question (list dropdown)	- Administration - Commercial - Business Continuity - Risk Management - Quality Management / Environment - Logistics / Supply Chain - Production / Operations - HR / ISHR - Information Systems - Other	Fundamental in constructing the respondent's profile. Moreover, the respondent's role is often an indication of the type of information they have access too. A specific question requires specific information that may not be available to every collaborator.
3: What is the (approximate) annual turnover of your company, in millions of euros?	Single-choice question	- Less than 1 - Between 1-25 - Between 26-50 - Over than 50 - I have no knowledge	Important for developing the company's profile, considering that it provides a perception of its size. The ranks were developed according to the available statistics (INE).
4: Select the category (ies) of activity your company belongs to.	Multiple choice question	- Distribuidor por Grosso de Medicamentos de Uso Humano - Exportador de Substâncias Controladas - Fabrico de Substâncias Controladas - Importador de Substâncias Controladas - Titular de AIM - Distribuição por Grosso de Medicamentos	Important when tracing the company's profile in order to understand under which INFARMED categories the companies are registered and the nature of authorizations they have.

5: Characterize your company's business model, by indicating the percentage of business that refers to own production.	Single choice question (slider question)	Scale from 0 to 100 percent	Understanding the business model is important, not only to establish the company's profile but to comprehend the level of impacts experienced.
Section 2 – The Impact on the Supply Chain			
Question	Type	Answer Options	Pertinence
6: Did the COVID-19 Pandemic impact your company's supply chain? Consider the scale presented where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree".	Single choice question (5-point choice)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is important to understand if there was an impact and the level of impact perceived by the respondent in general, before evaluating the specific dimensions.
7: Rate the following statements taking into account the impact of the COVID-19 Pandemic (context) on the Supply Chain Structure, regarding the Planning dimension.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is important to analyse the impacts on the Plan (sP) processes, considering that disruptive events may force businesses to adapt and rethink their operational models.
7.1: This context forced changes in the supplier network.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Supply Network Planning (sP1.1-BP.086) may have been affected considering the dependency on China for inputs (Pharma Logistics IQ, 2020).
7.2: This context forced the establishment of new partnerships.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	New partnerships for supplies and deliveries have been reported in international supply chains in accordance with Gauer <i>et al.</i> (2021).
7.3: This context triggered employee succession problems.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Succession problems have been reported in international supply chains in accordance with Gauer <i>et al.</i> (2021).
7.4: This context highlighted the lack of demand forecasting models.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree	Demand Planning & Forecasting (sP1.1-BP014) may have been affected considering the fluctuations in demand that

		5 – Strongly Agree	are expected as a result of a Pandemic (Engemann & Henderson, 2012).
8: Rate the following statements taking into account the impact of the COVID-19 Pandemic (context) on the Supply Chain Structure, regarding the Sourcing dimension.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is important to analyse the impacts on the Source (sS) processes, considering that the emergence of the Pandemic in China and later in India is expected to affect the industries that depend on these countries for inputs (Pharma Logistics IQ, 2020; PwC Nigeria, 2020).
8.1: This context impacted the communication with the suppliers.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The Supplier Relationship (sS1.1-HS.0139) may have been impacted considering the unpredictability revolving around the COVID-19 Pandemic.
8.2: This context led to the closure of suppliers.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Closure of suppliers have been reported in international supply chains in accordance with Gauer <i>et al.</i> (2021).
8.3: This context made it difficult to access inputs (ex. active ingredients, excipients, packaging, etc.)	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Raw Materials Receiving Process (sS1.1-BP.069) may have been diffculted due to the restrictive measures imposed by governments worldwide, for instance border constrains (PwC Nigeria, 2020).
8.4: This context resulted in an increase in input prices.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Fluctuations in the price of the inputs have been reported in international supply chains in accordance with Gauer <i>et al.</i> (2021).
9: Rate the following statements taking into account the impact of the COVID-19 Pandemic (context) on the Supply	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is important to analyse the impacts on the Make (sM) processes, considering that a Pandemic tends to disrupt the flow of business (Wallace &

Chain Structure, regarding the Making dimension.			Webber, 2017).
9.1: This context forced the suspension of the production.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The Schedule Production Activities (sM1.1) and the Produce and Test (sM1.3) dimensions may have been affected considering the Pandemic's expected impacts, such as absenteeism, business slowdown and input related restrictions PwC Nigeria, 2020; Wallace.
9.2: This context forced a slowdown in production.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The Schedule Production Activities (sM1.1) and the Produce and Test (sM1.3) dimensions may have been affected considering the Pandemic's expected impacts, such as absenteeism, business slowdown and input related restrictions (PwC Nigeria, 2020; Wallace & Webber, 2017).
9.3: This context triggered adaptations in the technologies and the processes involved in the production.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The Production Scheduling Optimization Using Enabling Technologies (sM1.1-BP.172) may have been impacted considering the expected impacts on the flow of business (Wallace & Webber, 2017), forcing companies to adapt their processes.
9.4: This context resulted in an increase in the stock of the final product.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The Stage Product (sM1.5) dimension may have been impacted considering the fluctuations in demand (Engemann & Henderson, 2012).
10: Rate the following statements taking into	Array (Likert	1 – Strongly Disagree 2 – Disagree	It is important to analyse the impacts on the Deliver (sD)

account the impact of the COVID-19 Pandemic (context) on the Supply Chain Structure, regarding the Distribution dimension.	scale)	3 – Neutral 4 – Agree 5 – Strongly Agree	processes, considering that a Pandemic tends to disrupt the flow of business (Wallace & Webber, 2017), but also considering the movement restrictions imposed worldwide (PwC Nigeria, 2020).
10.1: This context impacted the storage capacity of the final product.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Overcapacity has been reported in international supply chains in accordance with Gauer <i>et al.</i> (2021).
10.2: This context impacted the communication with the distribution companies.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Miscommunication has been reported in international supply chains in accordance with Gauer <i>et al.</i> (2021).
10.3: This context resulted in restrictions on the flow of the final product.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The Deliver Stocked Product (sD1) dimension may have been affected considering SC related impacts and the restrictions in the flow of goods (PwC Nigeria, 2020).
10.4: This context resulted in a delay in the deliveries of the final product.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The Ship Product Cycle Time (sD1.12-RS.3.126) may have also been impacted considering the restrictions in the flow of both people and goods (PwC Nigeria, 2020).
10.5: This context resulted in a change in distribution channels.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The Carrier Selection (sD1.5-HS.0018) dimension may have been affected considering the restrictions in the flow of goods and the overall climate of business slowdown, pressing companies to find suitable alternatives (PwC Nigeria, 2020).
10.6: This context resulted in an increase of the	Array (Likert	1 – Strongly Disagree 2 – Disagree	The Order Delivery and / or Install Costs (sD1.7-CO.3.15)

distribution tariffs.	scale)	3 – Neutral 4 – Agree 5 – Strongly Agree	may be affected as a result of the restrictions in the flow of goods (PwC Nigeria, 2020).
10.7: This context resulted in a decrease in demand.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Decreased demand has been reported in international supply chains in accordance with Gauer <i>et al.</i> (2021).
Section 3 – The Business Continuity Programme			
Question	Type	Answer Options	Pertinence
11: Did your company have a Business Continuity Programme prior to the COVID-19 Pandemic?	Single choice question with pre-defined conditions	- Yes (continues into question 12) - No (skips to question 24) - I have no knowledge (skips to question 24)	Understanding if the company had or not a business continuity programme prior to the Pandemic is a necessary condition before starting the second part of the analysis.
12: Does your company's Business Continuity Programme follow a referential standard (ex: ISO 22301, BCI, etc.?)	Single choice question	- Yes - No - I have no knowledge	If the business continuity programme is developed in accordance with a referential standard, in theory, it follows the necessary steps and good practices in business continuity.
13: Rate the following statements taking into account the Incorporation and Management of your company's Business Continuity Programme.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The business continuity programme should be carefully incorporated in the company and managed in accordance with the company's characteristics (ISO, 2019).
13.1: The Business Continuity Programme is suited to the company's objectives.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The business continuity programme should be defined taking into account the company's specific objectives (ISO, 2019).
13.2: The Administration is committed to the success of the Business Continuity Programme.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Clause 5.1: "Top management shall demonstrate leadership and commitment with respect to the Business Continuity Programme" (ISO, 2019).
13.3: The Business	Array	1 – Strongly Disagree	Clause 5.2: "Top Management

Continuity Policy was established and communicated.	(Likert scale)	2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	shall establish a policy, containing the objectives that shall be documented and communicated” (ISO, 2019).
13.4: Business Continuity is an integral part of the company's culture.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The Programme will only succeed if, the business continuity culture is incorporated into the organization's policies and operations (Blos <i>et al.</i> , 2012; Gallagher, 2003; Kildow, 2011)
13.5: The roles and responsibilities associated with the Business Continuity Programme were established and communicated.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Clause 5.3: The roles and responsibilities should be assigned and communicated within the organization (ISO, 2019), in order for the Programme to work.
13.6: The Business Continuity Programme is properly documented.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Clause 7.5: The business continuity programme should be documented and the document should be made available to the collaborators (ISO, 2019).
14: Rate the following statements taking into account the process of Analysis of your company's Business Continuity Programme.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The Process of Analysis is fundamental when developing the business continuity programme, considering that it provides companies with the necessary information in order to complete this process.
14.1: Critical processes were identified through a Business Impact Analysis (BIA).	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Clause 8.2.2. (ISO, 2019). Identifying the critical processes is a necessary pre-condition when developing a business continuity programme, considering that this tool aims at securing these particular activities.
14.2: The recovery time objective (RTO) was	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree	Setting particular time frames for the resume of operations, is

established for each critical process.	scale)	3 – Neutral 4 – Agree 5 – Strongly Agree	an important step in the development of a business continuity programme as it sets companies with a particular focus (ISO, 2019).
14.3: The maximum tolerable period of disruption (MTPD) was established for each critical process.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Identify the time frame within which the impacts of not resuming activities would become unbearable is extremely important in order to avoid major impacts and long-term disruptions (ISO, 2019).
14.4: The risks associated with the disruption of critical processes were identified through a Risk Assessment.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Clause 8.2.3: “The organization shall implement and maintain a risk assessment process” (ISO, 2019).
14.5: The risks associated with the disruption of critical processes were evaluated.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The risks should be identified, analysed and evaluated in order to identify the pressing risks (ISO, 2019) and treat them accordingly.
14.6: The scenarios of failure were identified and prioritized.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The scenarios of failure should be identified and prioritized in order to create specific strategies and gather the requirements needed for the selected solutions (ISO, 2019).
15: Rate the following statements taking into account the Design and Implementation of your company's Business Continuity Programme.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The Design and Implementation of the business continuity programme are particular important processes as they lead to a materialization in terms of strategies and plans (ISO, 2019).
15.1: Risk mitigation strategies were established.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Clause 8.3.5: “The organization shall implement and maintain selected business continuity solutions so they can be activated when needed” (ISO,

			2019).
15.2: Solutions were established for each scenario of failure, taking into account the response and recovery times.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is important to establish specific solutions for the scenarios of failure identified, taking into account their specific particularities (ISO, 2019).
15.3: The solutions were analysed taking into account their effectiveness and cost.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The solutions should be evaluated in order to measure their effectiveness and cost to understand if they are appropriate and doable (ISO, 2019).
15.4: The necessary requirements for exercising the solutions were identified and approved.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Clause 8.3.4: “The organization shall determine the resource requirements to implement the selected business continuity solutions”.
15.5: The Business Continuity Plan documents the processes during and after the disruption.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Clause 8.4.5: “The organization shall have documented processes to restore and return business activities during and after a disruption” (ISO, 2019).
15.6: The Business Continuity Plan includes a response framework for activation, escalation, and control.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	The documented plan should take into consideration the different moments in a disruptive event and contain specific strategies of action for each moment (ISO, 2019).
15.7: The Business Continuity Plan was communicated to all the interested parties.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is fundamental that the Plan is communicated to all the interested parties, not only to boost business continuity awareness but in order for the collaborators understand their roles and responsibilities (ISO, 2019).
16: Rate the following statements taking into account the Validation of	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral	The Validation is the last and one the most important steps when developing a business

your company's Business Continuity Programme.		4 – Agree 5 – Strongly Agree	continuity programme, considering its dynamic nature (ISO, 2019).
16.1: The Business Continuity Programme is revised according to an established time interval or after a change.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Clause 9.3.1: “Top management shall review the organization's Programme, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness” (ISO, 2019).
16.2: The Business Continuity Programme is reviewed regularly (at least once a year).	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is important to review the Programme on a regular basis (for instance, once a year) in order to guaranty its adequacy and effectiveness. (ISO, 2019).
16.3: The Business Continuity Plan is tested after each review.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	After each review and, especially, when alterations are made, the Plan should be tested (ISO, 2019).
16.4: The results of the exercises, tests and reviews are communicated to High Administration.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Every validation process, including exercises, tests and reviews should be communicated to High Administration considering their role and responsibility (ISO, 2019).
17: Select the Plan(s) established in your company's Business Continuity Programme.	Multiple choice question	- Critical Business Areas Plan - Contingency Plan - Infrastructure and Equipment Plan - Information Systems Plan - Succession Plan - I have no knowledge	It is particular important to understand which plan or plans are established in the business continuity programme, in order to understand and analyse the level of readiness of a specific company in the verge of a disruptive event.
18: Select the scenario(s) of failure identified in your company's Business Continuity Plan.	Multiple choice question	- Employee Failure - Equipment Failure - Supplier Failure - Infrastructure Failure - Production Line	The scenarios of failure identified in the plan or plans are extremely important when managing a disruptive event, as they help professionals with

		Failure - Process Failure - Storage Failure - I have no knowledge	specific guidelines in order to move forward and deal with the specific disruption.
19: Did your company's Business Continuity Plan have answers to the following scenarios?	Single choice question	- Yes - No - I have no knowledge	Prior to understanding if the scenarios of failure were identified, it is important to understand if they had answers, considering that the lack of specific solutions may lead to considerable impacts.
19.1: Employee Failure	Single choice question	- Yes - No - I have no knowledge	A Pandemic, as a large-scale health crisis impacts first and foremost people. Employee failures are expected due to absenteeism (Kildow, 2011), urging for responses and solutions in order to ensure operations.
19.2: Equipment Failure	Single choice question	- Yes - No - I have no knowledge	Even though the loss of physical property is not as straightforward in a Pandemic, the company should still be prepared for this type of failures (Engemann & Henderson, 2012).
19.3: Supplier Failure	Single choice question	- Yes - No - I have no knowledge	The movement restrictions of both people and goods, the climate of business slowdown and the emergence of the Pandemic in China (PwC Nigeria, 2020) – the “world’s factory” (Kilpatrick & Barter, 2020), tend to pave the way for supplier failures that should be considered.
19.4: Infrastructure Failure	Single choice question	- Yes - No - I have no knowledge	The outbreak of the Pandemic in specific areas lead to the closure of specific plants and urged for adaptations in terms

			of infrastructures with many companies opting for remote working conditions. Even though, the pharmaceutical manufacturing companies, as essential services, would not be forced to close, it is still important to consider these types of failures and specific solutions.
19.5: Production Line Failure	Single choice question	- Yes - No - I have no knowledge	The expected high absenteeism rates (Kildow, 2011), combined with supplier failures may lead to specific production line failures, that should be considered and properly treated.
19.6: Process Failure	Single choice question	- Yes - No - I have no knowledge	The expected high absenteeism rates (Kildow, 2011), combined with supplier failures may lead to specific process failures, that should be considered and properly treated.
19.7: Storage Failure	Single choice question	- Yes - No - I have no knowledge	The fluctuations in demand expected as a result of the Pandemic (Engemann & Henderson, 2012) may lead to specific storage failures (Gauer et al., 2021) that should be properly addressed.
20: Were the responses contained in the Business Continuity Plan effective for the following issues?	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Prior to understanding if the scenarios of failure were identified and had specific answers, it is crucial to understand if these answers were effective, especially when trying to determine the relevance of the business continuity programme.
20.1: Employee Failure	Array (Likert	1 – Strongly Disagree 2 – Disagree	It is crucial to understand if these answers were effective,

	scale)	3 – Neutral 4 – Agree 5 – Strongly Agree	especially when trying to determine the relevance of the business continuity programme.
20.2: Equipment Failure	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is crucial to understand if these answers were effective, especially when trying to determine the relevance of the business continuity programme.
20.3: Supplier Failure	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is crucial to understand if these answers were effective, especially when trying to determine the relevance of the business continuity programme.
20.4: Infrastructure Failure	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is crucial to understand if these answers were effective, especially when trying to determine the relevance of the business continuity programme.
20.5: Production Line Failure	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is crucial to understand if these answers were effective, especially when trying to determine the relevance of the business continuity programme.
20.6: Process Failure	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is crucial to understand if these answers were effective, especially when trying to determine the relevance of the business continuity programme.
20.7: Storage Failure	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	It is crucial to understand if these answers were effective, especially when trying to determine the relevance of the business continuity programme.
21: Did your company's Business Continuity Programme include an event similar to the COVID-19 Pandemic?	Single choice question	- Yes - No - I have no knowledge	It is important to understand the degree to which the company was ready to manage a disruptive event of this nature, by understanding if the business continuity programme actually acknowledged this scenario.

22: Please rate the following statements taking into account your company's Business Continuity Programme during the COVID-19 Pandemic.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Having analysed the process of development and application of the business continuity programme, it is important to evaluate this tool in this specific disruptive scenario.
22.1: The plan activation process went without incidents.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Clause 8.4.4.3: Each plan shall include: d) “supporting information needed to activate (including activation criteria), operate, coordinate and communicate the team’s actions” (ISO, 2019). It is extremely important for the smooth functioning of the programme.
22.2: The employees knew their roles and responsibilities.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Clause 5.3: Top management shall ensure that the responsibilities and authorities for relevant roles are assigned and communicated (ISO, 2019). Given this, it is fundamental that the employees know their roles and responsibilities when a disruption occurs, in order to understand how they should act.
22.3: The teams communicated well with each other.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Communication is key for the success of the business continuity programme (ISO, 2019).
22.4: The teams kept in contact with the local health authorities.	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	Communicating with local health authorities is extremely important in order to coordinate the business continuity programme (Engemann & Henderson, 2012).
22.5: The plan's escalation process followed the development of the	Array (Likert scale)	1 – Strongly Disagree 2 – Disagree 3 – Neutral	The escalation of the plan should follow the progression of the event to guarantee its

Pandemic.		4 – Agree 5 – Strongly Agree	adequacy (Engemann & Henderson, 2012).
23: Has the Business Continuity Programme helped your company to overcome/mitigate the impacts of the COVID-19 Pandemic? Consider the scale presented where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree".	Single choice question (5-point choice)	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree	After analyzing the business continuity programme in terms of its development, adequacy, and function, it is important to understand the respondent's opinion on the relevance of the business continuity programme for mitigating the impacts of this specific disruptive event.
Section 4 – The Recovery			
Question	Type	Answer Options	Pertinence
24: Does your company intend to develop a Business Continuity Programme to address risks similar to the COVID-19 Pandemic?	Single choice question	- Yes - Yes, it is in development - No - I don't have knowledge	For the companies who answered "No" or "I don't have knowledge" to having a business continuity programme prior to the Pandemic (Question 11) it is important to understand if they plan of developing one and if the process is already underway.
25: Indicate the likelihood of your company implement the following strategies, considering the impact of the COVID-19 Pandemic.	Single choice question (slider question)	Scale from 0 to 100 percent	After a disruptive event, companies tend to adapt and implement strategies in order to create more resilience in the verge of future disruptive events. Given this, it is important to analyse the likelihood of implementation of these strategies that according to Kilpatrick & Barter (2020) led companies to be more prepared to this event.
25.1: Diversify the supplier network.	Single choice question (slider question)	Scale from 0 to 100 percent	Kilpatrick & Barter (2020) acknowledge the importance of having a diversified supplier network, in order to ensure the normal flow of operations in the

			verge of a disruptive event. Given this, the companies that depend on a specific supplier may consider diversifying their network.
25.2: Relocate part of production.	Single choice question (slider question)	Scale from 0 to 100 percent	Kilpatrick & Barter (2020, p.4) acknowledge the importance of “agility within their production networks”. In this view, and in particular the companies that have a very strict and concentrated production may consider relocating this production to other locations.
25.3: Invest in the digitization of the supply chain.	Single choice question (slider question)	Scale from 0 to 100 percent	Kilpatrick & Barter (2020, p.4) acknowledge the importance of investing on the “planning” and “digitalization” of the supply chain.
25.4: Map the supply chain.	Single choice question (slider question)	Scale from 0 to 100 percent	Kilpatrick & Barter (2020, p.4) acknowledge the importance of prompting “the visibility of the extended supply chain”. Given this, a clear mapping of the supply chain would allow companies to go beyond Tier 1 suppliers and have a clearer vision on their nodes and links.
25.5: Increase due diligence on suppliers.	Single choice question (slider question)	Scale from 0 to 100 percent	Kilpatrick & Barter (2020, p.4) acknowledge the importance of creating “strong relationships with key suppliers”. In this view, increasing the due diligence – the actions a company takes to get to know its partners – on suppliers is extremely important in order to develop bonds.

Annex E – Population’s Draft List forward to APIFARMA

1.	A. MENARINI PORTUGAL - FARMACÊUTICA, S.A.
2.	<u>ABBOTT LABORATORIOS LDA.</u>
3.	ABBVIE, LDA.
4.	ACCORD HEALTHCARE, UNIPessoal, LDA.
5.	<u>ALCON PORTUGAL - PRODUTOS E EQUIPAMENTOS OFTALMOLÓGICOS, LDA.</u>
6.	<u>ALEXION PHARMA SPAIN, S.L. - SUCURSAL EM PORTUGAL</u>
7.	ALFASIGMA PORTUGAL, LDA.
8.	ALMIRALL - PRODUTOS FARMACÊUTICOS, LDA.
9.	ALTER, S.A
10.	AMGEN-BIO-FARMACÊUTICA, LDA.
11.	ANGELINI PHARMA PORTUGAL UNIPessoal, LDA.
12.	ARISTO PHARMA IBERIA, S.L. - SUCURSAL EM PORTUGAL
13.	ASTELLAS FARMA, LDA.
14.	ASTRAZENECA - PRODUTOS FARMACÊUTICOS, LDA.
15.	<u>AUROVITAS, UNIPessoal, LDA.</u>
16.	BAUSCH & LOMB, S.A - SUCURSAL EM PORTUGAL
17.	BAXTER - MEDICO-FARMACEUTICA, LDA
18.	BAYER PORTUGAL, LDA.
19.	BENE FARMACÊUTICA, LDA.
20.	BIAL PORTELA & CA, S.A.
21.	BIOCODEX, UNIPessoal, LDA.
22.	BIOGEN PORTUGAL - SOCIEDADE FARMACÊUTICA, UNIPessoal, LDA
23.	BLUEMED, UNIPessoal, LDA.
24.	BLUEPHARMA GENERICOS - COMERCIO DE MEDICAMENTOS, S.A.
25.	BOEHRINGER INGELHEIM PORTUGAL, LDA.
26.	BOIRON SOCIEDADE UNIPessoal, LDA.
27.	BRILL PHARMA, UNIPessoal, LDA.
28.	BRISTOL - MYERS SQUIBB FARMACÊUTICA PORTUGUESA, S.A.
29.	BSG - PHARMACEUTICALS - PRODUTOS FARMACÊUTICOS INOVADORES, S.A.
30.	<u>CELGENE, SOCIEDADE UNIPessoal, LDA.</u>
31.	<u>CPCH - COMPANHIA PORTUGUESA CONSUMER HEALTH, LDA.</u>
32.	CS PORTUGAL - PRODUTOS FARMACÊUTICOS, LDA.
33.	CSL BEHRING, UNIPessoal, LDA.
34.	DAIICHI SANKYO PORTUGAL, LDA.
35.	DECOMED - FARMACÊUTICA UNIPessoal, LDA.
36.	EISAI FARMACÊUTICA, UNIPessoal, LDA.
37.	EUSA PHARMA (UK) LIMITED - SUCURSAL EM PORTUGAL
38.	F.H.C. - FARMACÊUTICA, S.A.
39.	<u>FARMALABOR - PRODUTOS FARMACÊUTICOS, S.A.</u>
40.	FERRAZ LYNCE, ESPECIALIDADES FARMACÊUTICAS, S.A.
41.	FERRER PORTUGAL, S.A.
42.	FERRING PORTUGUESA - PRODUTOS FARMACÊUTICOS, SOC. UNIPessoal, LDA.
43.	FRESENIUS KABI PHARMA PORTUGAL, LDA.

44. GENERIS FARMACÊUTICA, S.A.
45. GILEAD SCIENCES, LDA.
46. GLAXOSMITHKLINE - PRODUTOS FARMACÊUTICOS, LDA.
47. GP - GENÉRIOS PORTUGUESES, LDA.
48. GRÜNENTHAL, S.A
49. HIKMA FARMACÊUTICA (PORTUGAL), S.A.
50. HRA PHARMA IBERIA S.L., SUCURSAL EM PORTUGAL
51. IFC SKINCARE PORTUGAL - PRODUTOS DERMATOLÓGICOS, UNIPessoal, LDA.
52. INTERCEPT PHARMA PORTUGAL, UNIPessoal, LDA.
53. IPSEN PORTUGAL - PRODUTOS FARMACÊUTICOS, S.A
54. ISDIN - LABORATÓRIO FARMACÊUTICO, UNIPessoal, LDA.
55. JABA RECORDATI, S.A
56. JOHNSON & JOHNSON, LDA / JANSSEN - CILAG FARMACÊUTICA, LDA
57. KEDRION PORTUGAL - DISTRIBUIÇÃO DE PRODUTOS FARMACÊUTICOS, UNIPessoal, LDA.
58. KORANGI - PRODUTOS FARMACÊUTICOS, LDA.
59. KRKA FARMACÊUTICA, SOCIEDADE UNIPessoal, LDA.
60. KYOWA KIRIN FARMACÊUTICA, UNIPessoal, LDA.
61. LABESFAL - LABORATORIOS ALMIRO, S.A.
62. LABIALFARMA - LABORATÓRIO DE PRODUTOS FARMACÊUTICOS E NUTRACÊUTICOS, S.A.
63. LABORATOIRES BAILLEUL PORTUGAL, S.A.
64. LABORATÓRIO EDOL - PRODUTOS FARMACÊUTICOS, S.A.
65. LABORATÓRIO MEDINFAR - PRODUTOS FARMACÊUTICOS, S.A.
66. LABORATÓRIOS ATRAL, S.A.
67. LABORATÓRIOS AZEVEDOS - INDÚSTRIA FARMACÊUTICA, S.A.
68. LABORATÓRIOS BASI - INDÚSTRIA FARMACÊUTICA, S.A.
69. LABORATÓRIOS FARMACÊUTICOS ROVI, S.A.
70. LABORATÓRIOS GALDERMA, S.A. - SUCURSAL EM PORTUGAL
71. LABORATÓRIOS INIBSA, S.A
72. LABORATÓRIOS VITÓRIA, S.A.
73. LECIFARMA - LABORATÓRIO FARMACÊUTICO, LDA.
74. LEIRUZ MED., INDÚSTRIA QUÍMICA E FARMACÊUTICA, LDA.
75. LEO FARMACÊUTICOS, LDA.
76. LIFEWELL - PHARMACEUTICAL & HEALTHCARE, LDA.
77. LILLY PORTUGAL - PRODUTOS FARMACÊUTICOS, LDA.
78. LUBEFAR - PRODUTOS FARMACÊUTICOS, LDA.
79. LUNDBECK PORTUGAL - PRODUTOS FARMACÊUTICOS, UNIPessoal, LDA.
80. LUSOMEDICAMENTA - SOCIEDADE TÉCNICA FARMACÊUTICA, S.A.
81. MATERFARMA - PRODUTOS FARMACÊUTICOS, S.A.
82. MEDA PHARMA - PRODUTOS FARMACEUTICOS, S.A.
83. MEDAC GESELLSCHAFT FÜR KLINISCHE SPEZIALPRÄPARAT M.B.H. - SUC. EM PORTUGAL
84. MEDINFAR SOROLÓGICO - PRODUTOS E EQUIPAMENTOS, S.A.
85. MERCK SHARP & DOHME, LDA.
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87. MUNDIPHARMA - FARMACÊUTICA, LDA.
88. MYLAN, LDA.

89. NEURAXPHARM PORTUGAL, UNIPESSOAL, LDA.
90. NOREVA PORTUGAL - UNIPESSOAL, LDA.
91. NORGINE PORTUGAL FARMACÊUTICA, UNIPESSOAL, LDA.
92. NOVARTIS FARMA - PRODUTOS FARMACÊUTICOS, S.A.
93. NOVO NORDISK - COMÉRCIO DE PRODUTOS FARMACÊUTICOS, LDA
94. OCTAPHARMA - PRODUTOS FARMACÊUTICOS, LDA.
95. OM PHARMA, SA.
96. OPELLA HEALTHCARE PORTUGAL, UNIPESSOAL, LDA.
97. ORGANON PORTUGAL, SOCIEDADE UNIPESSOAL, LDA.
98. ORIGINPHARMA, S.A.
99. PAUL HARTMANN, LDA.
100. PARKE, DAVIS - PRODUTOS FARMACÊUTICOS, LDA.
101. PFIZER BIOFARMACÊUTICA, SOCIEDADE UNIPESSOAL, LDA (LABORATORIO PFIZER, LDA)
102. PHARMA BAVARIA INTERNACIONAL (PBI) PORTUGAL UNIPESSOAL, LDA.
103. PHARMAKERN PORTUGAL - PRODUTOS FARMACÊUTICOS, SOCIEDADE UNIPESSOAL, LDA.
104. PHARMIS BIOFARMACÊUTICA, LDA.
105. PHF - PRODUTOS HOSPITALARES E FARMACEUTICOS, LDA.
106. PIERRE FABRE MÉDICAMENT PORTUGAL LDA.
107. PLS PHARMA, PRODUTOS FARMACEUTICOS, LDA.
108. QPLAB – PHARMA SERVICES, LDA.
109. QUALIUM FARMA - INDÚSTRIA FARMACÊUTICA, LDA.
110. RATIOPHARM - COMÉRCIO E INDÚSTRIA DE PRODUTOS FARMACÊUTICOS, LDA.
111. RECKITT BENCKISER HEALTHCARE, LDA.
112. ROCHE FARMACÊUTICA QUÍMICA, LDA.
113. SANOFI - PRODUTOS FARMACEUTICOS, LDA.
114. SERVIER PORTUGAL - ESPECIALIDADES FARMACÊUTICAS, LDA.
115. SIDEFARMA - SOCIEDADE INDUSTRIAL DE EXPANSÃO FARMACÊUTICA, S.A.
116. SOCIEDADE FARMACÊUTICA GESTAFARMA, LDA.
117. SOFARIMEX - INDÚSTRIA QUÍMICA E FARMACÊUTICA, S.A.
118. STADA PORTUGAL, LDA.
119. TAKEDA - FARMACÊUTICOS PORTUGAL, LDA.
120. TECNIFAR - INDÚSTRIA TÉCNICA FARMACEUTICA, SA.
121. TECNIMEDE - SOCIEDADE TÉCNICO-MEDICINAL, S.A
122. TEVA PHARMA – PRODUTOS FARMACÊUTICOS, LDA.
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125. TRADE MEDIC, S. A.
126. UCB PHARMA (PRODUTOS FARMACÊUTICOS), LDA.
127. UNITED HEALTHCARE - DISTRIBUIÇÃO FARMACÊUTICA, LDA.
128. VELVET MED - HEALTHCARE SOLUTIONS, LDA.
129. VIIHVIV HEALTHCARE, UNIPESSOAL, LDA.
130. VITALION - PRODUTOS FARMACÊUTICOS, SOCIEDADE UNIPESSOAL, LDA.
131. ZAMBON - PRODUTOS FARMACÊUTICOS, LDA.
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Annex G – Data Analysis (Extended)

