Thesis Declaration Page

Submission of Thesis and Dissertation

National College of Ireland

Research Students Declaration Form

(Thesis/Author Declaration Form)

Name: RAFAEL PINEDA VEGA

Student Number: 23239921

Degree for which thesis is submitted: MBA

Material submitted for award

(a) I declare that the work has been composed by myself.

(b) I declare that all verbatim extracts contained in the thesis have been distinguished by quotation marks and the sources of information specifically acknowledged.

(c) My thesis will be included in electronic format in the College Institutional Repository NORMA (thesis reports and projects).

(d) ***Either*** *I declare that no material contained in the thesis has been used in any other submission for an academic award.

Or ***I declare that the following material contained in the thesis formed part of a submission for the award of**

(State the award and the awarding body and list the material below)

Signature of research student: RAFAEL PINEDA VEGA

Date: 15.08.2025

Thesis Submission Form

All thesis submissions must be accompanied by a thesis submission form. The current guidelines for submission are available through the library at the following URL: http://libguides.ncirl.ie/thesisguide. The guidelines specific to the School of Business guidelines are listed here: https://libguides.ncirl.ie/business.

Submission of Thesis to Norma Smurfit Library, National College of Ireland

Student name: RAFAEL PINEDA VEGA Student number: 23239921

School: NCI Course: RESEARCH METHODS

Degree to be awarded: MBA

Title of Thesis:

Impact of Disruptive Global Events Such as Covid-19 and the Russian/Ukraine War in the Supply Chains and Countering Strategies for Pharmaceutical Manufacturing Companies.

An electronic copy of your thesis will be lodged in the Norma Smurfit Library and will be available for consultation. This electronic copy will be accessible in NORMA https://norma.ncirl.ie the National College of Ireland's Institutional Repository. In accordance with normal academic library practice all theses lodged in the National College of Ireland Institutional Repository (NORMA) are made available on open access.

I agree to an electronic copy of my thesis being available for consultation within the library. I also agree to an electronic copy of my thesis being made publicly available on the National College of Ireland's Institutional Repository NORMA.

Signature of Candidate: RAFAEL PINEDA VEGA

_____

For completion by the School:

The aforementioned thesis was received by _____

Date:_____

This signed form must be appended to all copies of your thesis submitted to your school.

National College of Ireland

Project Submission Sheet

Student Name:	RAFAEL PINEDA VEGA		
Student ID:	23239921		
Programme:	MBA	**Year:**	2025
Module:	RESEARCH METHODS		
Lecturer:	James O'Connor		
Submission Due Date:	15.08.2025		
Project Title:	DISSERTATION		
Word Count:	15000+		

I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.
ALL internet material must be referenced in the references section. Students are encouraged to use the Harvard Referencing Standard supplied by the Library. To use other author's written or electronic work is illegal (plagiarism) and may result in disciplinary action. Students may be required to undergo a viva (oral examination) if there is suspicion about the validity of their submitted work.

Signature:	RAFAEL PINEDA VEGA
Date:	15.08.2025

PLEASE READ THE FOLLOWING INSTRUCTIONS:

1. Please attach a completed copy of this sheet to each project (including multiple copies).
2. Projects should be submitted to your Programme Coordinator.
3. **You must ensure that you retain a HARD COPY of ALL projects**, both for your own reference and in case a project is lost or mislaid. It is not sufficient to keep a copy on computer. Please do not bind projects or place in covers unless specifically requested.
4. You must ensure that all projects are submitted to your Programme Coordinator on or before the required submission date. **Late submissions will incur penalties.**
5. All projects must be submitted and passed in order to successfully complete the year. **Any project/assignment not submitted will be marked as a fail.**

Office Use Only	
Signature:	
Date:	
Penalty Applied (if applicable):	

AI Acknowledgement Supplement

[Insert Module Name]

[Insert Title of your assignment]

Your Name/Student Number	Course	Date
RAFAEL PINEDA VEGA	RESEACH METHODS	15.08.2025

This section is a supplement to the main assignment, to be used if AI was used in any capacity in the creation of your assignment; if you have queries about how to do this, please contact your lecturer. For an example of how to fill these sections out, please click here.

AI Acknowledgment

This section acknowledges the AI tools that were utilized in the process of completing this assignment.

Tool Name	Brief Description	Link to tool
DEEPSEEK	HELP LOCATING MORE ACEDEMIC JOURNALS AND FOR MY RESEACH TOPIC	www.deepseek.com
CHATGPT	HELP LOCATING MORE ACEDEMIC JOURNALS AND FOR MY RESEACH TOPIC AND RESTURCTURING OF MY PARAGRAPHS AND IDEAS	www.chatgpt.com

Description of AI Usage

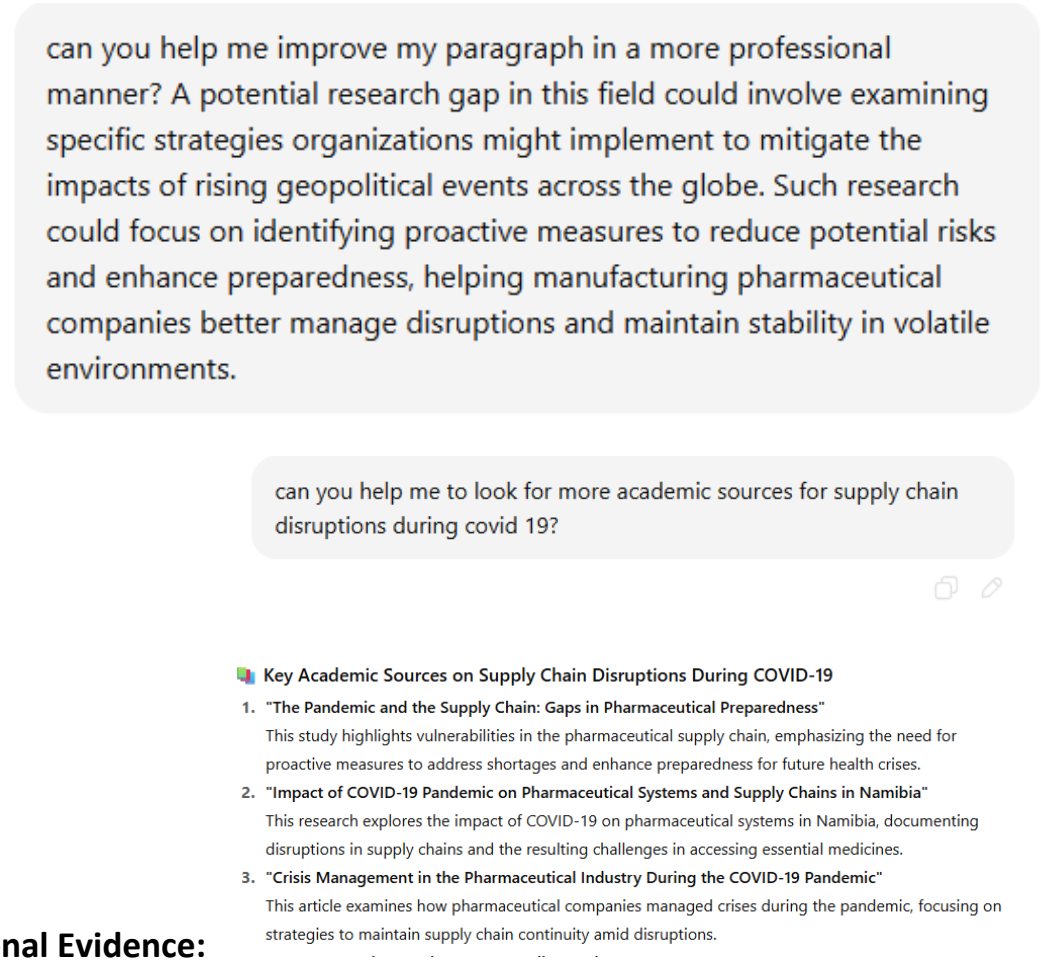
This section provides a more detailed description of how the AI tools were used in the assignment. It includes information about the prompts given to the AI tool, the responses received, and how these responses were utilized or modified in the assignment. **One table should be used for each tool used**.

CHATGPT	
To find further academic sources for my research and assist me to develop my ideas in a more professional manner.	
[Insert Sample prompt]	[Insert Sample response]

Evidence of AI Usage

This section includes evidence of significant prompts and responses used or generated through the AI tool. It should provide a clear understanding of the extent to which the AI tool was used in the assignment. Evidence may be attached via screenshots or text.

Additional Evidence:



Additional Evidence:

[Place evidence here]

Here's a more professional and polished version of your paragraph:

A notable research gap in this area pertains to the investigation of specific strategies that organizations can adopt to mitigate the effects of escalating geopolitical events worldwide. Future studies could focus on identifying proactive measures that minimize potential risks and strengthen organizational preparedness, thereby enabling pharmaceutical manufacturing companies to effectively manage supply chain disruptions and sustain operational stability in highly volatile environments.

Table of Contents

TITLE:

Impact of Disruptive Global Events Such as Covid-19 and the Russian/Ukraine War in the Supply Chains and Countering Strategies for Pharmaceutical Manufacturing Companies.

Abstract:

The purpose of this paper is to provide clarity on how the pharmaceutical supply chain is impacted when a major global disruptive event takes place. As well this paper aims to provide strategies and counter measures for a pharmaceutical manufacturing companies; therefore, these types of companies can build resilience with robust supply chains and keep providing medicine to the final consumers, which could potentially be a life or dead situation.

Methodology:

This study employs a qualitative and abductive research approach to investigate the impact of global disruptive events on the supply chain and explore how pharmaceutical companies can implement preventive measures to mitigate such events.

The primary instrument used was semi-structured interviews, developed based on themes identified in the academic literature on supply chain resilience, risk management, and adaptive strategies.

The study employed thematic analysis.

Conclusion:

In sum, the study confirms that resilience in pharmaceutical supply chains is not built in the moment of crisis but in the months and years beforehand—through mapping, planning, diversification, and, above all, cultivating trust across the supply network. These lessons, while born of exceptional global events, are likely to remain relevant as the industry faces future disruptions, whether predictable or not.

Chapter I

Introduction:

The increasing interconnection and interdependence of different number of global economies, cultures, and populations, driven by cross-border trade, investment, and technology is known as Globalisation (Held & McGrew, 2007). In the context of supply chains, globalisation has transformed the way goods and services are produced and delivered by extending operations across multiple countries and regions.

Globalised supply chains enable businesses to source raw materials, manufacture products, and distribute them to global markets more effectively and at lower costs. This interconnectedness allows firms to capitalise on comparative and competitive advantages such as cheaper labor, specialised skills, or access to scarce resources (Christopher, 2016). As a result, companies can increase efficiency, reduce costs, and meet growing global demand with more flexible and scalable operations.

However, globalisation also increases supply chain complexity and vulnerability. With production and distribution spread across multiple regions, global supply chains are more susceptible to disruptions from geopolitical events, pandemics, trade barriers, and natural disasters (Gereffi, 2020). For instance, the COVID-19 pandemic and the Russia–Ukraine war exposed the fragility of global supply networks, causing delays, shortages, and rising transportation costs.

A supply chain refers to the interconnected system of organisations, people, processes, information, and resources involved in the creation and delivery of a product or service to the end customer. It includes every stage of the production and distribution process; from the sourcing of raw materials and manufacturing to transportation, warehousing, and final delivery (Chopra & Meindl, 2016).

The smooth functioning of supply chains is constantly threatened by various risks. Disruptions are the visible consequences of these underlying risks, and they require timely, strategic responses to maintain operational continuity (Habermann, Blackhurst & Metcalf, 2015). Long before the COVID-19 pandemic, global supply chains were already vulnerable to a **wide range of risks,** ranging from natural disasters and geopolitical tensions to cyber threats and unpredictable market shifts. These issues often resulted in delays, cost overruns, and diminished service levels, all of which underscored the fragility of globally interconnected supply networks (Scheibe & Blackhurst, 2018).

The pandemic served as a global stress test, exposing the weaknesses in supply chain infrastructures across nearly every industry. It caused widespread shutdowns, port congestion, labour shortages, and disruptions to logistics and sourcing activities. These challenges underscored the urgent need for resilient and adaptive supply chain strategies capable of withstanding both anticipated and unforeseen disruptions.

In the pharmaceutical sector, such vulnerabilities are particularly acute. Any unexpected, unplanned, or exceptional event that interrupts the normal flow of goods or raw materials

especially active pharmaceutical ingredients (APIs) is classified as a supply chain disruption risk (Revilla, 2014). These disruptions can result in a cascade of operational consequences: physical damage to facilities, production and distribution delays, revenue losses, and rising costs. Over time, they can erode market share, lead to budget overruns, and damage long-term financial performance. Beyond the balance sheet, such disruptions can also undermine investor confidence, negatively affect shareholder value, and increase the cost of capital, ultimately threatening the company's long-term viability and reputation.

Recent global crises have further highlighted these vulnerabilities. The COVID-19 pandemic and the Russia–Ukraine war have introduced a new level of uncertainty into global supply networks. The pandemic caused severe disruption across manufacturing and logistics, while the war triggered spikes in energy prices, trade restrictions, and political instability (Ivanov, 2021). Industries reliant on global supply chains—including automotive, semiconductors, and pharmaceuticals—experienced critical shortages, production delays, and volatile demand patterns. These events revealed key weaknesses in just-in-time (JIT) inventory systems and over-reliance on single-source suppliers (Christopher & Peck, 2004).

This paper seeks to present a comprehensive examination of supply chain disruptions, with a particular focus on their underlying causes, resulting impacts, and the distinct challenges they pose to industries operating within an increasingly interconnected global economy. Special attention and potential solutions will be given to the pharmaceutical manufacturing sector, where currently there is a huge research gap, the manufacturing pharmaceutical sector is especially vulnerable due to its dependence on intricate, multi-tiered supply chains. These companies face heightened risks associated with the sourcing of raw materials, strict regulatory requirements, and the need to adhere to demanding production schedules. By analysing these specific vulnerabilities, the paper aims to shed light on the critical importance of resilient supply chain strategies in maintaining operational continuity and ensuring public health outcomes.

In addition to examining the risks associated with supply chain disruptions, this paper will propose a range of strategic countermeasures that pharmaceutical companies can adopt to prevent or mitigate their impact. These recommendations will include diversifying supplier networks to reduce dependency on single sources, leveraging digital technologies to enhance supply chain visibility and enable predictive analytics, and reinforcing risk management frameworks to better anticipate and respond to potential threats. Furthermore, the paper will emphasize the importance of fostering stronger collaboration with suppliers and logistics partners to build more agile, transparent, and resilient supply chains.

By integrating a comprehensive review of existing literature with practical, industry-relevant insights, this paper aims to make a meaningful contribution to the field of supply chain management. It seeks to offer actionable recommendations that pharmaceutical manufacturing companies can apply to strengthen the resilience, efficiency, and adaptability of their supply chains. In doing so, the paper aspires to support the development of robust systems capable of withstanding future disruptions and ensuring continuity in the delivery of critical healthcare products.

Chapter II

Literature review:

Sub Section 1 - Global Supply Shocks and Rising Inflation

Major global disruptions are not limited to pandemics or armed conflicts; they also include localised natural disasters such as earthquakes, hurricanes, floods, and wildfires. Even though these events may be geographically confined, their effects can be seen throughout global supply chains due to the deeply interconnected nature of today's industries, globalisation at its best. For example, Längle, Xu, and Tian (2021) demonstrate how U.S. hurricanes in 2005 disrupted Chinese manufacturers with strong trade ties to the U.S., reducing their imports and exports temporarily. Importantly, the study shows that firms with diversified supplier networks were less affected, underscoring the need for resilient and diversified supply chain strategies to withstand such shocks (Längle, Xu & Tian, 2021).

For instance, if a country that plays a critical role in supplying essential raw materials, such as rare earth elements, experiences a natural disaster, the resulting supply interruption could bring production to a standstill across multiple industries worldwide. Similarly, if that country serves as a key manufacturing hub for vital components, such as semiconductors, or is the exclusive producer of certain specialised devices, the disruption may cascade through various sectors, causing production delays, escalating costs, and widespread shortages in the global market. In an era defined by complex and interdependent supply networks, even localized disruptions possess the potential to unsettle entire industries. This reality highlights the urgent need for resilient, diversified, and adaptive supply chain strategies that can effectively mitigate the risks posed by such events.

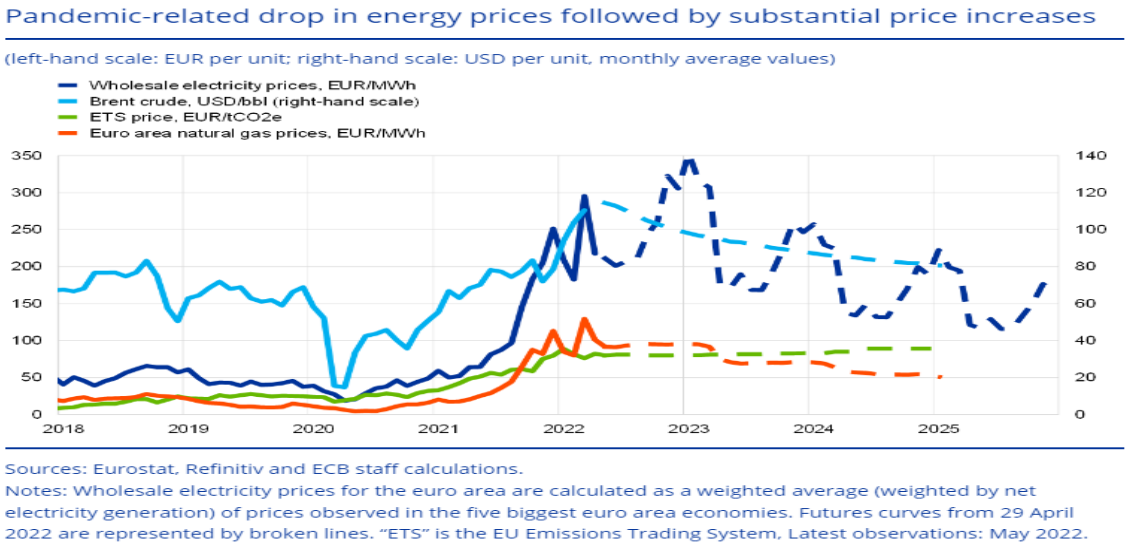
According to (Revilla et al. 2014), the far-reaching implications of supply chain disruptions on global operations have become increasingly apparent across multiple industries over the past decade. A notable example is the 2011 tsunami in Japan, which severely impacted global supply chains, especially within the electronics sector. Cisco, a global leader in communication technology, exemplified effective disruption management by rapidly assessing the situation, evaluating the impact on its network of 300 suppliers within just 12 hours. This swift response allowed Cisco to minimize operational setbacks and avoid substantial revenue losses. In contrast, Apple encountered significant challenges during the launch of the iPad 2, as the tsunami led to stock shortages and delayed deliveries, generating frustration among customers and shareholders alike. These contrasting outcomes underscore the vital importance of implementing proactive and resilient supply chain management strategies to effectively navigate and mitigate the consequences of global disruptions.

A well-functioning supply chain relies on two critical components: efficient transportation networks and the consistent availability of input materials required for production. In the context of global supply chains, commodities play a foundational role as essential inputs across a wide

range of industries. When a supply shock occurs in a commodity market, often triggered by geopolitical events, it can significantly disrupt distribution channels. Such disruptions typically lead to sharp price increases, which in turn fuel inflationary pressures and dampen overall economic activity (Ngoc - Hong, 2024).

The COVID-19 pandemic and the energy crisis triggered by Russia's invasion of Ukraine have significantly contributed to a surge in global inflation. Supply chain pressures began to intensify in April 2020, reaching a peak in December 2021. In particular, the European Union's heavy reliance on Russian energy and subsequent efforts to reduce that dependence led to sharp increases in energy prices. By early 2022, crude oil prices had doubled, coal prices had tripled, and natural gas costs had risen fivefold. Additionally, Ukraine's critical role as a major agricultural exporter drove up prices for key commodities. These compounded shocks pushed inflation rates to 8.1% in the United States, 9.1% in the United Kingdom, and 8.5% in Germany by October 2022. Inflation driven by such global supply-side shocks presents a heightened risk of stagflation, making it increasingly difficult for domestic monetary policies to manage inflation effectively (Díaz, 2024).

Let us dig dipper into what happened to supply chains during these 2 major events. Figure 1 below illustrates that at the start of the COVID-19 pandemic, energy prices fell sharply. Brent crude oil dropped by 75% and Dutch gas prices by 44%. However, both rebounded quickly. Gas prices returned to pre-pandemic levels by September 2020, and oil followed by February 2021. Unlike the 2008 financial crisis recovery, when prices remained lower, this time energy prices surged beyond pre-crisis levels. Gas prices saw the biggest spike, rising 145% between middle of 2021 and middle of 2022, while oil increased by 46%. This led to record-high gas prices in Europe and contributed to soaring electricity costs (Kuik et. al, 2022).



(Figure 1 Source ecb.eurpa)

The COVID-19 pandemic significantly disrupted the balance between supply and demand for perishable goods, including items with short shelf lives such as food, beverages, and cosmetics. While retailers have always faced challenges in selling such products before expiration, the pandemic intensified these difficulties. Changes in consumer behaviour, such as reduced use of

cosmetics due to social distancing and remote working, led to declining demand and increased waste from expired stock. Conversely, demand for certain food items surged, causing early supply chain stress. Panic buying shifts in consumption patterns, and reduced incomes further exacerbated food availability issues, not due to raw material shortages, but as a result of systemic failures in the supply chain (Yardımcı Özkul et al., 2022).

During the early stages of the COVID-19 pandemic, global supply chains remained largely intact due to reduced consumer demand and the temporary shutdown of manufacturing facilities. However, from November 2020 onward, maritime freight shipping faced substantial disruptions, particularly along routes originating from China and East Asia. The resulting bottlenecks led to dramatic increases in containerized maritime freight shipping (CMFS) costs, most notably a 220% year-on-year rise from East Asia alone, fueling inventory shortages, delivery delays, and price hikes across global markets. While many attributed this crisis to a shortage of containers, deeper analysis reveals that pandemic-induced inefficiencies, such as reduced port productivity, logistical delays, and a trade imbalance favoring East Asian exports are the underlying contributors to the container backlog (LaRocca, 2021).

These rising costs have disproportionately affected small-volume shippers, who now face limited access and inflated rates, while larger firms are prioritised by freight companies. This pricing disparity has forced businesses to adapt, as Peloton, a gym equipment manufacturer, absorbed the cost spike via expedited shipping methods, while others, such as European agricultural exporters, reduced output entirely. As maritime transport supports 80% of global trade by volume, the implications of these disruptions are far-reaching. Looking forward, industry experts anticipate that CMFS cost pressures may ease by mid-2021. However, the volatility has sparked strategic reassessment. Firms are beginning to shift away from "just-in-time" models towards more resilient supply chain practices, such as stockpiling critical components, evident in the automotive sector's response to semiconductor shortages. This marks a potential long-term transformation in how global supply chains are managed post-pandemic (LaRocca, 2021).

A good example of a disruption during Covid-19 as follows: European printing companies have issued warnings about widespread disruption to supply chains across essential sectors, including food, consumer goods, **pharmaceuticals**, and publishing, due to a growing shortage of paper, which has been exacerbated by ongoing strikes at UPM-Kymmene, a major Finnish forestry group. The shortage follows an unexpected post-lockdown surge in demand, creating a mismatch between supply and market needs, with paper prices spiking and availability dropping sharply. UPM alone supplies around 40% of the backing sheets for labels used across various industries, and the strike has significantly reduced its production output. Label manufacturers were facing severe production slowdowns, with some companies unable to meet orders and forced to put staff on hold. This is particularly concerning as labels are essential components in the packaging and tracking of goods in sectors ranging from healthcare and personal care to automotive and electronics (FINAT, 2022).

The crisis has also impacted the publishing industry and financial services, with some newspaper groups facing material shortages and companies like asset manager Abrdn being forced to delay significant corporate actions, such as a £1.5 billion shareholder vote, due to an inability to print mandatory documents. As a result, the paper shortage is exposing vulnerabilities in supply chains

and highlighting how disruptions in one raw material sector can ripple through and affect a wide range of industries across Europe (FINAT, 2022),

Critically speaking, if a pharmaceutical manufacturing company lacks either an approved backup vendor or an alternative raw material to address supply shortages or sufficient stock levels to navigate this, it is only a matter of time before production comes to a halt. This not only disrupts operations but poses a serious threat to the health and wellbeing of millions of patients who rely on timely access to essential medications. Pharmaceutical companies used very specific grade of paper for their products, which include labels for the device, labels for the outer packaging, product inserts with all the important information for customers, as well as the boxes to pack this products, as mentioned above the pharmaceutical was not the only sector impacted by this, however, the difficult and lengthy process to approve a vendor makes the pharmaceutical sector extremely vulnerable to this type of disruptions.

Figure 2. Source FINAT, (2022)

During the COVID-19 pandemic, **Novartis** demonstrated how strategic inventory management and digital transformation could buffer severe supply chain disruptions. Faced with a sudden 20–30% surge in global demand driven by national stockpiling and COVID-19 treatment needs, Novartis leaned heavily on its business continuity and pandemic response plans, which prioritized maintaining high inventory levels of finished products across its entire value chain. This strategic foresight gave the company critical flexibility to absorb operational shocks and continue fulfilling global demand even with a significantly reduced on-site workforce.

To maintain momentum, **Novartis** implemented dual supply points for essential drugs, allowing for redundancy and regional flexibility in production. The company also worked closely with suppliers to ensure "end-to-end" visibility, investing heavily in digital tools to monitor, adapt, and coordinate supply chain flows in real time. These technological investments supported faster decision-making and improved communication across global operations.

This case serves as a compelling example of how proactive, integrated supply chain strategies can offer resilience in times of global disruption. **Novartis'** ability to maintain production despite workforce limitations and demand surges reflects the effectiveness of aligning operational continuity with strategic inventory buffers and digital infrastructure. Critically speaking, it demonstrates the value of not only having contingency plans but embedding flexibility into supply networks through measures like dual supply points and real-time digital monitoring. Rather than reacting to disruptions, **Novartis** anticipated vulnerabilities and invested early in systems that allowed rapid adaptation an approach that many companies lacked at the onset of the pandemic. This highlights the broader lesson that resilience is not merely about recovery, but about preparedness, agility, and cross-functional visibility across the entire value chain (FP, 2020).

In late 2020, **Pfizer** significantly revised its earlier production target for its COVID-19 vaccine, cutting the expected output for the year from 100 million doses to approximately 50 million , primarily due to supply chain disruptions linked to raw materials essential for vaccine manufacture (Reuters, 2020). The company disclosed that certain early batches of materials "failed to meet standards," and scaling up the raw material supply chain "took longer than expected," directly impacting dose availability by year-end.

At the core of **Pfizer's** recovery was its inventory and supply chain resilience strategy. While initially the limited raw materials constrained output, Pfizer leveraged production line flexibility and accelerated resupply once materials met quality standards. Contingency measures included diversifying supplier sources for critical lipid nanoparticles, enzymes, and specialized vials and filters, mitigating future single-point failures (WSJ, 2020).

In Taiwan during the pandemic in the middle of March 2020, the **Taiwanese Food and Drug Administration (FDA)** had to announce and reassure the public that even though in similarity to other countries up to 40% of medications in this country rely on active pharmaceutical ingredients (APIs) that are produced in China, but there were no threats of shortages or supply chain disruptiosn as the pharmaceutical companies had up to 6 months of inventory of key ingredients, however if Covid 19 pandemic persist, certain medications would be in short supply and cost could increase substantially by 30% or higher (Shihchen et. al, 2020)

At the height of the COVID-19 pandemic's early disruptions, India, the world's largest supplier of generic medicines, introduced export restrictions on 26 active pharmaceutical ingredients (APIs) and associated products, including paracetamol, several antibiotics, progesterone, and vitamin B12. These products accounted for around 10% of India's pharmaceutical exports. The move aimed to secure domestic supply amid fears of shortages, as Indian manufacturers rely on China for nearly 70% of their API imports.

The decision created uncertainty for importing countries, particularly the United States, where Indian exports comprised 24% of finished medicines and 31% of medicine ingredients in 2018 (US FDA data). The U.S. Food and Drug Administration (FDA) began assessing the potential impact, having already reported its first COVID-related drug shortage caused by a lack of API materials. Industry experts warned that if the outbreak persisted, global shortages could become acute. Companies such as **Mylan (now Viatris)** warned of potential drug shortages**. Eli Lilly** stated theta they did not expect any shortages due to the corona virus outbreak for any of its therapies, including insulin products.

India's government assured the public that there were sufficient stocks to support two to three months of domestic production, while instructing state authorities to monitor output and prevent black marketing or hoarding. However, industry leaders cautioned that some products could face shortages regardless of the ban, highlighting the fragility of global pharmaceutical supply chains in the face of concentrated sourcing dependencies (Reuters, 2020).

The Russia-Ukraine war has significantly disrupted global supply chains, the energy sector as well as the agricultural and fertilisers sectors were greatly impacted. Before this conflict Russia was a key participant in the energy and fertiliser global markets supplying around 25% of the world's nitrogen fertilizers and a huge share of the European Union's natural gas, as well Ukraine was a key exported of semifinished goods and agricultural products. Together, Russia and Ukraine accounted for 28% of global wheat exports, making the war's onset especially disruptive. Grain exports from Ukraine plummeted, with sunflower oil, maize, and wheat exports declining by 50%, 25%, and 10% respectively. Although initiatives like the Black Sea Grain Initiative provided some relief, countries heavily reliant on these exports—particularly in Africa—have experienced shortages and rising food prices, exacerbating inflation and food insecurity (University of Florida, 2023).

One would assume a huge impact for Russian after being sanctioned by major economies around the world, but for their fertilizer sector the opposite happened, and their exports jump by 70% in the first 10 moths of 2022. This is due to food and fertilisers exports from Russia are exempt from western sanctions (FT, 2023).

The energy sector had also been severely impacted. Reductions in Russian gas supplies through the Nord Stream pipeline led to dramatic price increases, natural gas rose by over 120% and coal by around 95% in the six months following the invasion. These shortages underscore the urgency for nations to diversify supply sources. As a result, reshoring strategies are gaining traction, with firms relocating supply operations closer to manufacturing bases to mitigate future disruptions. These shifts will place new demands on U.S. transportation infrastructure and elevate the importance of developing alternative, politically stable supply channels. Strategic collaborations—such as partnerships with African nations for metals and Australian firms for ore—are viewed as critical to creating more resilient supply chains (UF, 2023).

The indirect economic consequences of the Russia–Ukraine conflict have been substantial, though difficult to quantify precisely. Several companies with minimal direct exposure to Russia reported significant cost increases. Saint-Gobain, a building materials producer, experienced a €3 billion

year-on-year increase in energy and raw material expenses. Swedish telecoms group Telia reported a SKr800 million (US$74.5 million) rise in energy costs in 2022. Ryanair estimated a loss of up to 2 million passengers in 2023 following the suspension of all flights to and from Ukraine. Similarly, Swiss piping manufacturer Georg Fischer stated that the conflict had driven energy prices up by 100 per cent in 2022, noting that even a 25 per cent increase in its energy bill would add 17 million (Swiss Franc) or (US$19.4 million) in costs, posing a critical financial challenge (Financial Times, 2023).

For any nation is a fundament objective to sustain economic growth, with inflation serving as a key factor in shaping future economic conditions. Volatile inflation rates complicate the analysis and forecasting of monetary policy outcomes, underscoring the difficulty of implementing effective policy measures (Comin et. al, 2023). In an increasingly competitive market environment, businesses—particularly small and medium-sized enterprises—face growing constraints on pricing power during periods of inflation. These pressures can significantly disrupt day-to-day operations, heightening the importance of dependable partnerships across the supply chain. Consequently, effective supply chain risk management becomes essential for maintaining both operational continuity and overall supply chain performance in the face of rising inflation.

Despite growing awareness of global geopolitical risks, there remains a notable research gap in understanding the specific, actionable strategies that organizations particularly in the pharmaceutical manufacturing sector can implement to mitigate their impact. Existing literature often highlights the consequences of such disruptions but offers limited insight into proactive measures that enhance risk preparedness and operational resilience for this specific sector. Addressing this gap could provide valuable guidance for pharmaceutical companies seeking to strengthen supply chain stability in the face of rising geopolitical volatility.

Sub Section 2 - Building a Good Supply Chain Risk Management & Resilience

2.1 Supply Chain Management, effective communication and effective account management

Supply chain management focuses on effectively managing upstream supplier relationships and downstream customer connections to deliver enhanced customer value while minimizing total supply chain cost. It builds upon principles of process linkage and coordination across organizations, aiming to eliminate redundant inventory buffers through real-time sharing of demand and stock information. This approach marks a departure from traditional arms-length or adversarial relationships, instead fostering trust, transparency, and cooperation. When managed collaboratively, the supply chain can achieve performance that exceeds what individual entities could deliver alone — truly illustrating that the whole can be greater than the sum of its parts (Martin C, 2011).

This principle is especially critical in the pharmaceutical manufacturing industry, where the dependency on approved vendors and tightly regulated supply networks adds layers of complexity

to supply chain operations. Given the stringent requirements for quality, compliance, and traceability, pharmaceutical firms cannot simply switch suppliers in response to disruptions.

According to (Wantao Yu et al., 2022), supply chain disruptions can originate either within a firm or across its broader network of partners. Mitigating the impact of these disruptions requires a strong emphasis on effective communication and seamless information exchange, both internally and externally. The timely sharing of accurate, trustworthy information helps reduce task uncertainty and fosters a sense of informational justice, where all parties actively collaborate to identify and disclose potential risks. This culture of transparency and mutual accountability not only strengthens trust among stakeholders but also enables faster, more coordinated responses during crises. For pharmaceutical manufacturing companies where timing, compliance, and product availability are critical, such proactive information-sharing practices can play a decisive role in maintaining operational continuity and resilience during periods of disruption.

This commitment to transparent and equitable information sharing builds trust and credibility among supply chain partners, enabling firms to make aligned decisions and respond more agilely to rapidly changing business environments. Ultimately, fostering interpartner informational justice enhances coordination and significantly strengthens supply chain resilience (Wong et al., 2024). This is especially critical for pharmaceutical manufacturing companies, which often operate within highly restrictive frameworks and rely heavily on a limited number of qualified and approved vendors. In such contexts, effective collaboration and mutual trust can make the difference between navigating disruptions successfully and facing costly operational setbacks.

Strategic supplier management, when treated as an ongoing, collaborative partnership rather than a series of transactional purchases, materially improves supply-chain and firm outcomes. Research shows supplier collaboration enhances both process and incremental product innovation by enabling knowledge transfer, joint problem-solving, and co-development activities; these collaborative mechanisms increase innovation efficiency and raise the likelihood that supplier ideas are effectively integrated into the buyer's product and process improvements. (Anni-Kaisa K. et al. 2017)

Beyond innovation, supplier relationship management (SRM) practices strengthen operational performance and supply-chain responsiveness. Empirical studies demonstrate that SRM enhances operational flexibility and procurement performance, which in turn mediates improvements in firm performance and resilience to disruptions. Well-designed SRM programmes help firms share risk and coordinate response actions with suppliers during shocks, improving recovery speed and continuity of supply. (Amoako K., et al, 2019)

Effective supplier management fosters long-term, collaborative partnerships that strengthen supply chain performance. Strategic alliances with suppliers not only share responsibility for organizational success but also promote innovation, enhancing both processes and incremental product development. Such partnerships are integral to achieving supply chain excellence and ensuring sustained competitive advantage (Abdelsalam, 2013).

2.2 Inventory Management & Forecasting

Despite recent global supply chain disruptions, the Just-in-Time (JIT) approach to inventory management remains an efficient production system. Rather than abandoning JIT in favour of "just-in-case" inventory accumulation, the authors advocate for a **revamped JIT model** that incorporates strategic buffers. These buffers, comprising limited inventory, flexible capacity, or alternative supply arrangements, can protect against volatility while maintaining lean operations. Toyota's post-2011 earthquake strategy exemplifies this approach, using targeted stockpiles for vulnerable components such as semiconductors to safeguard production without incurring excessive carrying costs. From an inventory management perspective, the proposed JIT network model encourages firms to map their supply chains extensively, identify segments suited for pure JIT, and place buffers at critical junctions. Such buffers are not solely physical stock but may include redundant suppliers, excess production capacity, or shared facilities. This targeted buffer placement ensures inventory is built only where it adds resilience, reducing waste while supporting continuity in the face of geopolitical, environmental, or logistical disruptions (Sodhi, M.S and Choi, T.Y., 2022)

Within the Just-in-time system follows a great inventory management strategy called the Kanban pull system, integral to the Just-in-Time (JIT) manufacturing approach, is designed to align production directly with market demand, enabling companies to achieve lean manufacturing objectives. Research highlights significant benefits, including reduced inventory levels, shorter lead times, improved value-added time, higher process productivity, and enhanced product quality. Widely applied in repetitive manufacturing settings, Kanban minimizes work-in-progress (WIP) inventory by triggering production only when downstream demand occurs, using visual cards to signal replenishment. Singh and Shek's (2019) study demonstrates how simulation tools can support Kanban implementation, helping align material flow, eliminate waste, and address the seven recognised waste categories: transportation, over inventory, excess motion, waiting, over-processing, overproduction, and defects. Kanban systems can take the form of single-card setups—using Production Instruction Kanbans (PIKs) to initiate production—or two-card systems, which combine production and withdrawal signals for greater control overflow

Pharmaceutical supply chains are complex, highly regulated, and leave little room for error due to their direct impact on public health, making demand forecasting critical to avoid costly stockouts. To maintain continuity, companies often hold higher inventory levels than in consumer-focused industries, using metrics such as Forecast Bias, Mean Absolute Deviation (MAD), Mean Squared Error (MSE), and Mean Absolute Percentage Error (MAPE) to assess forecast accuracy, which improves closer to the point of demand and through collaborative forecasting. Forecasting methods vary by product lifecycle, with judgement-based approaches used for new products lacking historical data, and quantitative or mixed models—most commonly time-series analysis—applied to in-market products to anticipate market share changes and industry trends (Merkuryeva et al., 2019).

Understanding the complexities and risks of supply chain disruptions, it is crucial for a manufacturing company to thoroughly analyse and map its entire supply chain. This process involves identifying and understanding every component of the supply chain, from raw material sourcing to production, distribution, and delivery to the end customer. By mapping the entire

supply chain, a company gains a clear overview of its interconnected processes, key suppliers, logistics partners, inventory management systems, and the potential risks at each stage.

This analysis allows the company to identify vulnerabilities, such as over-reliance on a single supplier, geographic risks (e.g., disruptions caused by natural disasters or geopolitical tensions in a specific region), and any inefficiencies in the flow of materials. Understanding these factors enables companies to develop proactive strategies to mitigate risks, such as diversifying suppliers, adopting alternative sourcing strategies, or increasing inventory buffers for critical components.

Chapter III

Subsection 1

Research Questions:

Hypothesis: Pharmaceutical manufacturing companies that implement proactive and transparent supply chain risk management strategies are better able to mitigate the operational and inflationary impacts of global supply shocks

How do global supply shocks, such as pandemics and geopolitical conflicts, affect inflationary pressures and operational continuity within pharmaceutical manufacturing supply chains?

What supply chain risk management strategies are most effective in enhancing resilience and mitigating the impact of global disruptions in pharmaceutical manufacturing?

Subsection 2 - Research Philosophy:

This study employs a qualitative and abductive research approach to investigate the impact of global disruptive events on the supply chain and explore how pharmaceutical companies can implement preventive measures to mitigate such events. While total avoidance of disruption may be unrealistic, the goal is to understand the impact of disruptive events and how resilience can be built to overcome these effectively. This approach is particularly suitable as it allows for deep exploration of the lived experiences and professional insights of supply chain professionals (Sounders, Lewis & Thornhil, 2006).

Qualitative research is especially effective when participants possess both practical and theoretical understanding of the subject matter, enabling meaningful insights to emerge from the data (Barends and Rousseau, 2018). In this study, the participants, experienced decision-makers in pharmaceutical supply chains are expected to have significant experience and knowledge of the field, thus ensuring a strong grounding between theoretical frameworks and real-world application.

An abductive approach allows the researcher to move iteratively between theory and empirical data, generating new insights through a continuous dialogue between the two (Dubois and Gadde, 2002). This is aligned with a pragmatist philosophical stance, which prioritises practical outcomes and theoretical development through flexible, context-driven inquiry (Saunders, Lewis and Thornhill, 2009).

The study follows Yin's (2018) design principles for case study research to ensure rigour and credibility:

- Construct Validity: Multiple data sources are used (e.g., interviews, academic journals, books, newspapers) to triangulate findings and strengthen evidence chains.

- Internal Validity: Causal links between disruptions and strategic responses are explored using conceptual frameworks such as the Resource-Based View (Barney, 1991) and network theory.
- External Validity: Research questions are adapted from existing academic literature and contextualised for the pharmaceutical industry, enhancing relevance without compromising academic integrity.
- Reliability: Data collection protocols are standardised, interviews are audio-recorded and transcribed, and consistent procedures are applied throughout the study.

Subsection 3 - Research Sample & Research Ethics

The study used **purposeful sampling** to select participants who hold critical roles within pharmaceutical supply chains, including; **Buyers, Planners, Planning Managers, Procurement Mangers, Sr. Supply Chain Managers, Supply Chain Directors, and Warehouse Managers**. This range ensured representation across both operational and strategic levels of the supply chain.

To capture a diversity of perspectives, participants were drawn from different organisational functions and geographies, offering a more holistic view of resilience in practice. Their in-depth knowledge and experience allowed for rich insights into how companies respond to, and recover from, disruptions.

The core rationale behind purposeful sampling lies in its intentional selection of information-rich cases, those individuals, groups, or settings that are especially knowledgeable or experienced with the phenomenon under investigation (Patton, M., 1990). Rather than seeking representativeness or generalisability, purposeful sampling prioritises depth, relevance, and insight. The goal is to engage with participants who can offer detailed, nuanced, and contextually grounded perspectives, allowing the researcher to uncover patterns, meanings, and processes that are centrally important to the research objectives.

This sampling strategy is particularly well-suited to qualitative research, where understanding complexity, diversity of experiences, and lived realities is more valuable than statistical inference. By focusing on cases that are most likely to illuminate the topic in meaningful ways, purposeful sampling contributes to theoretical development, conceptual clarity, and practical relevance. In this sense, the "power" of the approach lies in its ability to maximise learning from limited yet strategically chosen sources, thereby enhancing the overall richness and credibility of the study.

To reduce the potential for common method bias, the researcher was mindful of their influence during data collection. Interviewees, as subject matter experts, may be susceptible to cognitive shortcuts, particularly intuitive or "System 1" thinking (Barends, 2018). Careful question design, varied sequencing, and follow-up probing were used to encourage reflection and reduce socially desirable or overly consistent responses (Podsakoff et al., 2003).

For Research Ethics; each participant was initially contacted to confirm their willingness to take part in the research study. Participation was entirely voluntary, and interviewees were selected based on their expertise in pharmaceutical supply chains and their experience with global disruptions such as COVID-19 and the Russia-Ukraine conflict. Participants received an email containing a Word document introducing the researcher, outlining the study's objectives, and including a voluntary consent form to be signed, which this consent process follows ethical guidelines for research involving human participants, ensuring adequate information, voluntariness, and comprehension, in line with the highest standards of research ethics according to the European Commission (Ethics for Researchers, 2013).

Participants were also given the opportunity to review and approve a transcript of their interview upon completion. Ensuring participants' privacy is essential to ethical research. Individuals must feel confident that their personal information will remain protected and that their participation will not expose them to any risk. Because research is voluntary, maintaining strict privacy standards helps foster trust and encourages open, honest contributions from participants (Brandimarte et al., 2013).

Participants were informed that they could skip any questions they felt uncomfortable with or were not qualified to answer.

The participants were professional contacts or collaborators known to the researcher through academic or industry networks. Throughout the interviews, attention was paid to cultural sensitivity, and care was taken to interpret non-verbal cues and always respect the comfort levels of the participants.

Subsection 4 - Research Instrument:

The primary instrument used was semi-structured interviews, developed based on themes identified in the academic literature on supply chain resilience, risk management, and adaptive strategies. These interviews balanced structure and flexibility, providing a consistent framework while allowing participants to elaborate freely on areas of importance to them.

Interview questions were informed by prior scholarly work and refined to ensure clarity, openness, and relevance. This allowed for the collection of both anticipated and emergent insights.

As recommended by Eisenhardt and Graebner (2007), participants were encouraged to share contrasting or "polar type" experiences to help identify boundary conditions and deepen understanding.

Subsection 5 - Data Analysis Method:

The study employed thematic analysis using a framework adapted from (Makkonen et al. 2012), which enables structured examination of patterns across different levels:

- Individual Narratives: Capturing subjective, personal reflections and interpretations of disruption and resilience.
- Group Narratives: Aggregating perspectives to identify shared or diverging themes among different professional roles.
- Theoretical Narratives: Interpreting patterns in the data to refine or challenge academic theories, particularly in relation to resilience, resource-based strategies, and network coordination.

The use of abductive reasoning during analysis allowed findings to emerge both from participant accounts and through comparison with theoretical frameworks. This approach facilitated an iterative refinement of emerging insights, supporting both practical relevance and theoretical contribution.

Subsection 6- Limitations:

While this study provides valuable insights, several limitations should be acknowledged:

- Generalisation is limited due to the qualitative design and the purposive nature of the sample. Findings are context-specific and may not apply to all supply chains or industries.
- Researcher involvement introduces the possibility of subjective bias, although this was mitigated through reflexivity, triangulation, and transparent documentation of the research process.
- Common method bias, while reduced through careful design, cannot be entirely eliminated in interview-based research.
- Time constraints limited the ability to observe long-term strategic adaptations beyond immediate crisis responses.

Despite these limitations, the study offers significant contributions to understanding how pharmaceutical supply chains conceptualise and operationalise resilience in the face of global disruption.

CHAPTER IV

Subsection 1 - Analysis & Findings:

This section presents the thematic analysis of qualitative data gathered from seven semi-structured interviews conducted with supply chain professional within pharmaceutical manufacturing organsations. The main goal was to explore the impact of global disruptions, particularly Covid-19 and Russia/Ukrain War on supply chains for this type of organisation and to provide some clarity of what strategies could be followed as well as the challenges faced.

Overview of Themes.

Five Key themes were identified:

1. **Supply Chain Vulnerability and Risk Exposure**
2. **Supply Collaboration and Relationship Management**
3. **Strategic Risk Preparedness and Resilience**
4. **Limited Formalization of Risk Management Practices**
5. **Lessons learned and recommendations**

1.1 - Theme 1: Supply Chain Vulnerability and Risk Exposure

COVID-19 exposed deep vulnerabilities within global pharmaceutical supply chains, which aligns with the literature review in section 1. Interviewees cited overreliance on single source for Active Pharmaceutical Ingredients (API's) which are major key components for the manufacturing of medicines and a very rigorous process is required to approve a vendor to provide these key materials. And offshore suppliers, particularly in Asia for small components for manufacturing machines, gloves, and Active Pharmaceutical Ingredients.

"Our biggest lesson learned it was how vulnerable we are to global supply chains. I think that was the lesson learned, you know, before COVID, we never really looked downstream. We didn't know that our gloves came from Asia, and we didn't understand the length of these supply chains, and I think after COVID, we had to learn real fast. Of how it really is a global marketplace, you know. So I think that's the biggest lesson". **Purchasing Manager 1**

"Just to make sure that we're, we're giving ourselves enough free time or getting materials in even though supplier will have a specifically lead time and you know we found that during COVID-19, the lead time you know, that our logistics Partners were all taking a lot longer for the transit times and we were seeing backlogs in ports, getting containers released so yet really just to pay close attention to anything that's manufactured outside of the EU being in Ireland we seem

to have our own set of issues with, you know, like, thus getting material out of ports, there was huge backlog in the ports in an Amsterdam" **Purchasing Manager 2**

"Few lessons learned during these times, there was a backlog of orders, and the lead times increased for some vendors, we saw a big issues with the vendors providing labels and cartons due to paper shortages as well as price increases for shipments to the extend of some vendor charging us energy surcharges. Big vulnerabilities were shown as for so many key items we depend on one particular vendor or specific material specially around Packaging and API's ". **Sr. Buyer 1**

1.2 - Theme 2: Supplier Collaboration and Relationship Management

All respondents or interviewees emphasized strong supplier relationships were critical during disruptions and that such a good quality business relation needs to be built, maintained and improved at all times. Having Business Reviews and visiting sites were part of the key components to enhance these relations. Collaborative forecasting, ringfencing of inventory, and trusted communication channels enabled faster response and resource prioritization. These statements fall in line with section 2.1 in the literature review.

"My company works very closely with its suppliers. It has a almost daily contact in some cases with some suppliers, but as a general route of thumb, at least once a week, there are conversations going on between the buyers and the suppliers about what's happening in the market and if there's any issues so that we ensure that we meet the requirements for production. In addition to that, we also have business review meetings, which happened on a quarterly basis or by annual basis depending on the supplier". **Sr. Buyer 2**

"So I think that collaboration is vital. Yeah, I think it's it goes hand in hand I think they're directly linked, if you want flexibility and you want expediting, you need to have a good relationship with your vendor so on regard to how it could be further developed, I think just keep working on the relationship over time, I think they do get better overtime. They get stronger over trying the more meetings you have. The more presentations, the more maybe you go to visit their site, the more the more you get higher on their list, you know". **Purchasing Manager 1**

"Yes, so communication obviously is key in everything that you do with suppliers. But we would have a lot of Partners or partnership rather than just a mere supplier, we would work very closely with them, we would review with them a minimum of twice a year and we would have in depth reviews with our suppliers, which would help you know, in case of disruptions". **Procurement Buyer 1**

"The main collaboration with suppliers is forecasting, if we can give them sufficient forecasts, they can look ahead, they can prepare their raw materials and cover our requirements if our forecast changes and obviously, if they know they have materials in advance if we're trying to pull materials in, it gives us a little bit more scope". **Purchasing Manager 2**

1.3 - Theme 3: Strategic Risk Preparedness and Resilience

Some of the Firms or Organisations where respondents currently work, implemented strategic practices after the big disruptions caused by Covid-19 and the Russian/Ukraine war, these strategies included dual sourcing, safety stocks and business continuity plans (BCPs). However, these strategies were not so easily implemented due to regulatory constraints and high resource demands.

"So for contingency plans, if there are any changes, we, we consider bridging stocks and high level of stocks. If we see any potential risk of supply disruption. So we tried to build up some stock prior to the event". **Senior Supply Chain Manager**

"Want to have like, you know, tow suppliers of three suppliers for the same key material, you know, and if one supplier cannot provide or has quality issues, so then we can order from another vendor". **Senior Supply Chain Manager**

"So We would have we would have a BCP which is a business contingency plan. For all vendors vendors would have to have A BCP as part of their auditing, depending on the type of vendor so some vendors wouldn't need the BCP, others would and quality make that distinction, but for all our big key vendors, they would have a BCP and they would outline what they would do with their sites just stopped in the morning. And due to have a sister site that could take over our business. And they could they potentially outsourced to a competitor and the bcp, will dictate various events and what they would do in the event of them of those things happening. So and Yeah, I think that's part of it. Also, then from our company point of view, we would identify potential companies that we could get something from without setting them up". **Purchasing Manager 1**

"So we tend to not really have any API or component risks, and if we do, we just kind of mitigate the risk by insuring that recovered from stocks, a safety stocks point of view" **Planning Manager**

1.4 - Theme 4: Limited Formalization of Risk Management Practices

Participants or interviewees stated the absence of formalised risk management systems and formalised proper training. Risk dashboards and KPIs were underused, and much of the response to disruption was rather reactive than active.

"Even though there is no formal training material in our organisation for risk mitigation, we relay heavily in our account management skills, but a sort of official play book to distribute to the supply chain team would be nice" **Sr. Buyer 1**

“Yeah, from my point of view, in purchasing in a group of a team of 4, I'm not aware of any risk management training that's going on in this company. It's unfortunate, can't answer that” **Purchasing Manager 1**

“I'm not aware of a risk management system, and if our risk management system is are risk matrix. and well, then it's only myself and one of the person that has access to that and use the that and we would feed back to management our findings but there would be no training caried out”. **Purchasing Manager 1**

“If there is any risk of supply, we do not have any particular training for risk management, but what we have, we have support from different levels of management and you know, then you can learn by yourself”. **Senior Supply Chain Manager**

“Yeah, well, I think, you know, from manufacturing perspective for a supply chain, and this is something we're encountering, you know, daily, you know, trying to reduce our first supply chain. So I don't know about training. I mean, the training that I have for my team is escalation, as soon as there is an issue the at the moment we hear it, it's escalation” **Purchasing Manager 2**

1.5 - Theme 5: Lessons Learned and Recommendations

This section is a great, as it provides firsthand insights of what issues these supply chain professionals in manufacturing pharmaceutical companies faced and what key strategies they offered as potential solutions. A lot of them stated the importance of mapping your supply chain and that relaying in a single source is not the best strategy to follow, and how pharmaceuticals are so limited and slow to bring new vendors or back up materials, thus you need to be ahead of the curve and do so before anything like this happens again, which is likely at some point.

“A biggest lesson learned it was how vulnerable we are to global supply chains. I think that was the lesson learned, you know, before COVID, we never really looked downstream”. **Purchasing Manager 1**

“Yeah, so I guess you know. Just checking the supply route, so any of the manufacturers that are outside of the the EU trading zone and to just make sure that we're, we're giving ourselves enough free time or getting materials in even though supplier will have a specifically time and you know we found that during COVID-19”. **Purchasing Manager 2**

“The importance of mapping the supply chain. That's incredibly important and initially before this, we didn't have a map of our supply chain. If you are on the approved vendor list and it's an API because we have to have traceability right back to batches, that is produced by a particular supplier. So that would have existed, but I think the biggest change for us is being trying to map the supply chain and I think we've had so many near misses, and we've also had to learn too collaborate much better within our own organisation” **Sr. Buyer 2**

“I think it's really important that we have a business continuity plan within our own organisation that all of our own people are aware of because we do have business continuity plans, which we only pull out from our suppliers if this emergency, we don't actually review them on a regular basis, so it might be no harm if we are doing business reviews with our suppliers that we ask them has your business continuity plan, updated and here or are the latest list of people, if your own points, a contact or change, so contacts list is going to be really important”. **Sr. Buyer 2**

“It is important to have a second source or alternative vendor, and it is as important to have a back up material approved that is widely available. Unfortunately, in pharma this takes a lot of time and extra work, so we need to be prepared”. **Sr. Buyer 1**

“Yeah, a single strategy would be dual dual sourcing, so trying to get the same product from 2 different sources, and if you can’t do that to have a backup material and that you can put in with the minimum disruption and approval so maybe you can approve 2 items and only use one and have the second one as backup, but it's approved ready to go”. **Purchasing Manager 1**

“I think probably having a dual supply for critical materials is probably the best and you know, and just I'm keeping your 2 suppliers happy and you know when I keep things apply from both of them and just relying on one sink of supply” **Purchasing Manager 2**

“So the biggest is probably the time that it takes to, you know. The complaints time made up for regulatory issues, the time that it takes to introduce a new supplier” **Purchasing Manager 2**

“Always have a proper plan B for your supply and you know, at least identify alternative defenders”. **Senior Supply Chain Manager.**

CHAPTER V

Discussion:

The literature review established that pharmaceutical supply chains operate in an environment of heightened vulnerability, where regulatory complexity, quality requirements, and supplier dependencies can magnify the impact of major global disruptions. Events such as pandemics and geopolitical conflicts—often described as *black swan* events—cannot be precisely predicted, yet their occurrence is inevitable over a long enough horizon. What emerged from both the literature and this study's findings is that resilience in this sector depends less on prediction, and more on preparation, visibility, and relationships.

The interviews provided clear, real-world examples of this. As seen in Theme 2: Supplier Collaboration and Relationship Management, regular supplier contact, ranging from quarterly reviews to weekly calls was described as essential, not optional. These interactions went beyond transactional updates; they were about maintaining trust and ensuring that when disruptions occurred, communication lines were already open. This directly reinforced the literature's assertion that strong supplier relationships are a cornerstone of effective risk management, while also showing how this plays out in practice in a highly regulated industry.

Equally, the interviews confirmed the vulnerabilities identified in Theme 1: Supply Chain Vulnerability and Risk Exposure. Many organisations entered the pandemic with no comprehensive supply chain mapping, often discovering too late that they were overly reliant on a single supplier for critical APIs or packaging materials. This lack of visibility meant that upstream issues, such as a supplier's supplier facing shortages were only noticed once they had already caused delays. The literature warned about these hidden dependencies, but the interviews brought home how damaging they can be when paired with the long lead times and stringent approvals required to onboard new suppliers in pharmaceuticals.

To address these challenges, respondents described a shift toward measures aligned with Theme 3: Strategic Risk Preparedness and Resilience. Dual sourcing for critical components, maintaining buffer stocks, and securing pre-approval for alternative materials were all strategies put into place after COVID-19. Some of these responses were reactive, prompted by specific incidents; for example, one participant negotiated with a packaging supplier to increase minimum raw material stock levels exclusively for their company after lead times spiked. Others were more strategic, becoming part of broader business continuity planning.

Yet, Theme 4: Limited Formalisation of Risk Management Practices shows there is still progress to be made. While some organisations have introduced more formal resilience measures, many continue to rely on informal processes, individual experience, and reactive decision-making. This flexibility can be useful, but without standardised tools such as risk dashboards, consistent KPIs, or structured training, resilience remains uneven across teams and locations.

The shift in mindset captured in Theme 5: Lessons Learned and Recommendations marks one of the clearest changes since the pandemic. Supply chain mapping, once a secondary priority, is now seen as fundamental to operational continuity. Diversifying suppliers, approving backup materials, and regularly reviewing suppliers' business continuity plans are no longer "nice-to-haves" but essential risk mitigation steps. These actions come with costs, many respondents reported higher prices, energy surcharges, and increased freight rates but are viewed as necessary trade-offs to protect operational continuity.

In sum, the integration of literature and interview findings makes it clear that pharmaceutical supply chain resilience is multi-layered. It depends on proactive risk identification, operational flexibility, and above all, strong, trust-based supplier relationships. These strategies do not eliminate the risks posed by black swan events, but they enable organisations to navigate them with greater stability and less disruption.

CHAPTER VI

Conclusions & Recommendations:

This study set out to explore the impact of disruptive global events, particularly COVID-19 and the Russia/Ukraine conflict, concentrating on pharmaceutical manufacturing supply chains, and to identify strategies that could strengthen resilience in the face of such shocks. Through thematic analysis of seven semi-structured interviews with experienced procurement, purchasing, and supply chain professionals, the research has provided an in-depth, practice-based understanding of both the vulnerabilities exposed and the adaptive measures employed in this highly regulated sector.

The findings reaffirm much of the existing literature in supply chain risk management, especially the critical role of supplier relationship management, but they also add new layers of insight specific to the pharmaceutical manufacturing context. For example, while dual sourcing and contingency planning are well-known strategies in theory, their practical execution in pharma is far more complex and constrained by regulatory requirements, long qualification timelines, and stringent quality controls. This nuance expands the theoretical conversation by showing that resilience strategies cannot be divorced from the compliance environment in which they operate.

One of the most striking insights to emerge was how, prior to the pandemic, many companies lacked complete visibility of their supply chains beyond first-tier suppliers. Mapping exercises were often reactive, triggered by crisis rather than prevention. The COVID-19 experience has shifted this mindset: supply chain mapping, coupled with more formalised business continuity plans, is now seen as essential to operational stability. Additionally, the study highlighted the inflationary pressures caused by global shocks, not just on raw materials, but also through unexpected cost drivers such as energy surcharges and extended logistics lead times.

While the study has achieved its aim of identifying key vulnerabilities and effective resilience strategies, it also has its limitations. The sample size, though sufficient for qualitative depth, was small and drawn solely from pharmaceutical manufacturing organisations operating in or linked to Ireland. Broader representation, both geographically and across other high-regulation industries, could strengthen generalisability. Furthermore, the interview guide, while effective in generating rich narrative accounts, could have included more targeted prompts on specific cost impacts, digital supply chain tools, and risk metrics, which in hindsight might have yielded additional quantitative context.

These limitations are not drawbacks in themselves, but rather opportunities for further research. Future studies could:

- Compare pharmaceutical supply chain resilience strategies with those in other critical sectors, such as aerospace or medical devices, to identify cross-industry best practices.
- Investigate the role of digital supply chain mapping tools and predictive analytics in enabling earlier detection of potential disruptions.

- Explore the intersection of regulatory reform and resilience, examining whether certain compliance requirements could be adapted to facilitate faster onboarding of alternative suppliers in times of crisis.

Several findings also have practical relevance beyond academia. For industry practitioners, the evidence strongly supports investing in continuous supplier engagement, not only during crises but as a standard operating practice. Forecast sharing, joint contingency planning, and regular site visits emerged as low-cost, high-impact measures that can preserve production continuity when disruption strikes. For policymakers, the research underscores the need to consider regulatory flexibility during extraordinary circumstances, balancing the imperative for patient safety with the operational realities of globalised supply networks.

Finally, this research has influenced my own perspective. Before undertaking the study, I viewed supply chain resilience largely as a matter of planning and inventory control. I now recognise it as a more complex, human-centred challenge, rooted in relationships, collaboration, and the capacity to adapt within the constraints of a regulated environment. The professionals interviewed were not just managing flows of goods; they were navigating uncertainty, negotiating trade-offs, and making decisions that could ultimately affect patient access to essential medicines.

In sum, the study confirms that resilience in pharmaceutical supply chains is not built in the moment of crisis but in the months and years beforehand—through mapping, planning, diversification, and, above all, cultivating trust across the supply network. These lessons, while born of exceptional global events, are likely to remain relevant as the industry faces future disruptions, whether predictable or not.

Recommendations for Supply Chain Professionals:

- Supply Chain Management is key – Maintain regular, structured engagement with key suppliers through quarterly or bi-annual business reviews, site visits, and joint risk planning sessions to strengthen trust and prioritisation during crises.
- Implement Comprehensive Supply Chain Mapping – Develop and maintain visibility beyond first-tier suppliers, including geographic sourcing data, lead-time dependencies, and potential choke points. This should be updated annually.
- Adopt Dual Sourcing and Approved Backup Materials – Where regulatory conditions permit, ensure at least two approved suppliers for critical APIs and components, and pre-approve alternative materials to reduce switching delays.
- Build Strategic Safety Stocks – Maintain buffer inventory for high-risk, long-lead-time items, either in-house or through supplier-managed stock agreements, to bridge temporary disruptions.

For Policymakers and Regulators:

- Introduce Flexible Regulatory Mechanisms During Crises – Develop emergency approval pathways for alternative suppliers or materials without compromising patient safety, to accelerate response times.
- Support Industry in Supply Chain Mapping Initiatives – Offer incentives or frameworks for critical sectors to map and share non-commercially sensitive supply chain data to enhance collective preparedness.
- Facilitate Cross-Sector Collaboration – Encourage partnerships between pharmaceuticals and other critical industries to share best practices in resilience planning and crisis response.

For Further Research:

- Cross-Industry Comparative Studies – Examine resilience strategies in other high-regulation sectors to identify transferable lessons.
- Technology Adoption in Risk Management – Assess the impact of digital mapping, predictive analytics, and AI-driven forecasting on disruption response.
- Regulation Resilience Balance – Explore how regulatory frameworks might adapt in emergencies without weakening safety standards.
- Quantifying Cost Impacts – Measure the full financial effects of global shocks, including inflationary and logistics costs, to guide investment in resilience, furthermore quantitative research with a much wider spectrum could be a great research topic and more impactful.

References:

Abdelsalam, H.M.E. (2013) *Supply chain management practices and supply chain performance: a comparative study between manufacturing and service organizations*. Available at:https://www.academia.edu/download/34574174/abdelsalam_paper.PDF Accessed: [20 May 2025]

Brandimarte, L., Acquisti, A. & Loewenstein, G., 2013. Misplaced confidences: Privacy and the control paradox. *Social Psychological and Personality Science*, doi:10.1177/1948550612455931. Available at: https://doi.org/10.1177/1948550612455931

Bounds, A. (2023) *Russia fertiliser export revenue surged 70% in 2022 as prices jumped*. Financial Times, 10 January. Available at: https://www.ft.com/content/c10bcdb9-d01d-4a01-a4a1-38736e263a1e (Accessed:).

Barends, E. (2018) *Common Method Bias and How to Avoid It*. Center for Evidence-Based Management.

Available at:
https://books.google.co.uk/books?hl=nl&lr=&id=hQVrDwAAQBAJ&oi=fnd&pg=PP1&ots=PFDTjVn4iK&sig=QeQadBCKE73vbZcKGc8N1nHvuag&redir_esc=y#v=snippet&q=system%20one&f=false

Christopher, M. & Peck, H., 2004. *Building the Resilient Supply Chain*. The *International Journal of Logistics Management*, 15(2), pp.1–13. doi:10.1108/09574090410700275. Available at: https://www.researchgate.net/publication/228559011_Building_the_Resilient_Supply_Chain [20 January 2025]

Christopher, M., 2016. *Logistics & Supply Chain Management*. 5th ed. Harlow: Pearson Education.
https://learning.oreilly.com/library/view/logistics-supply/9781292083827/html/contents.html

Chopra, S. and Meindl, P., 2016. *Supply Chain Management: Strategy, Planning, and Operation*. 6th ed. Boston: Pearson.

Christopher, M. (2011) *Logistics & Supply Chain Management*, Chapter 1. Available at: https://learning.oreilly.com/library/view/logistics-and-supply/9780273731139/chapter-01.html (Accessed: 27 July 2025).

Comin, D.A., Johnson, R.C., & Jones, C.J. (2023) *Supply Chain Constraints and Inflation*, NBER Working Paper No. 31179, April; revised August 2024. Available at: https://www.nber.org/system/files/working_papers/w31179/w31179.pdf [24 Jun 2025]

Diego A et al. (2023) 'Supply chain constraints and inflation. National Bureau of Economic research'. Available at: https://www.nber.org/system/files/working_papers/w31179/w31179.pdf [3 January 2025]

David T. W. Wong, Eric W. T. Ngai (2024) 'An Empirical Analysis of the Effect of Supply Chain Innovation on Supply Chain Resilience'. Available at: https://ieeexplore.ieee.org/document/10430477 [4 January 2025]

Elena Diaz, Juancal C. & Fernando P. (2024) 'Global drivers of inflation: The role of supply Chain disruption and commodity price shocks'. Economic Modelling – Sciencedirect. Available at https://www.sciencedirect.com/science/article/pii/S0264999324002177 [8 January 2025]

Elena Revilla, Maria Saenz (2014) 'Supply chain disruption management: Global convergence vs national specificity'. Available at:https://www.sciencedirect.com/science/article/abs/pii/S0148296313002129 [11 January 2025]

European Commission (2013) *Ethics for researchers: Facilitating research excellence in FP7*. Luxembourg: Publications Office of the European Union. Available at: https://ec.europa.eu/research/participants/data/ref/fp7/89888/ethics-for-researchers_en.pdf (Accessed: 01 July 2025).

Financial Times (2023) *Russia–Ukraine war causes mounting indirect costs for global companies*. 24 February. Available at: https://www.ft.com/content/29d1618e-b6da-45d0-a7cf-067735aca1d6 (Accessed: 14 July 2025).

FINAT, (2022) Paper shortages threaten food and consumer goods supply chains, printers warn. Financial Times. Available at: https://www.ft.com/content/6430685f-2754-4e76-a940-eaad4e32bcdb (Accessed: 14 June 2025).

Gereffi, G., 2020. What does the COVID-19 pandemic teach us about global value chains? The case of medical supplies. *Journal of International Business Policy*, 3(3), pp.287–301. https://doi.org/10.1057/s42214-020-00062-w

Held, D. & McGrew, A., 2007. *Globalization/Anti-Globalization: Beyond the Great Divide*. 2nd ed. Cambridge: Polity Press.

Habermann, M., Blackhurst, J. and Metcalf, A.Y., 2015. Keep your friends close? Supply chain design and disruption risk. *Decision Sciences*, 46(3), pp.491–526. https://doi.org/10.1111/deci.12131

Kuik, F., Adolfsen, J.F., Lis, E.M. & Meyler, A., 2022. Energy price developments in and out of the COVID-19 pandemic – from commodity prices to consumer prices. *ECB Economic Bulletin*, Issue 4/2022. Available at: https://www.ecb.europa.eu/press/economic-bulletin/articles/2022/html/ecb.ebart202204_01~7b32d31b29.en.html [Accessed 7 July 2025].

Kuo, S., Ou, H.-T. & Wang, C.J. (2021) *Managing medication supply chains: Lessons learned from Taiwan during the COVID-19 pandemic and preparedness planning for the future*. *Journal*

of the American Pharmacists Association. Available at: https://www.sciencedirect.com/science/article/pii/S1544319120304404 (Accessed: [10 MAY 2025]).

Kleindorfer, P.R. and Saad, G.H., 2005. Managing disruption risks in supply chains. *Production and Operations Management*, 14(1), pp.53–68. https://doi.org/10.1111/j.1937-5956.2005.tb00009.x

Kwasi Amoako-Gyampah, Kwabena Gyasi Boakye, Ebenezer Adaku, Samuel Famiyeh, (2019) "Supplier relationship management and firm performance in developing economies: A moderated mediation analysis of flexibility capability and ownership structure", International Journal of Production Economics, Volume 208, (Article). Available at: https://www.sciencedirect.com/science/article/abs/pii/S0925527318304729

Kähkönen, A.-K., Lintukangas, K., Ritala, P. and Hallikas, J. (2017) 'Supplier collaboration practices: implications for focal firm innovation performance'. *European Business Review*, doi:10.1108/EBR0420160058. Available at : https://www.researchgate.net/publication/316529915_Supplier_collaboration_practices_Implications_for_focal_firm_innovation_performance

LaRocca, G., 2021. *Rising maritime freight shipping costs impacted by COVID-19*. Executive Briefings on Trade. U.S. International Trade Commission, April. Available at: https://www.usitc.gov/publications/332/executive_briefings/ebot_greg_larocca_freight_costs_weighing_covid_pdf.pdf [15 May 2025].

Merkuryeva, G., Smirnov, A., Kashevnik, A., and Ponomarev, A. (2019) 'Demand forecasting in pharmaceutical supply chains: a case study', *Procedia Computer Science*, 149, pp. 3–10. doi:10.1016/j.procs.2019.01.090.

Mark Saunders et al. (2006) Research Methods for Business Students. Fourth Editions, available at: https://r4.vlereader.com/Reader?ean=9781408212653# [10 January 2025].

Makkonen, H., Aarikka-Stenroos, L. and Olkkonen, R. (2012) 'Narrative approach in business network process research – Implications for theory and methodology', *Industrial Marketing Management*, 41(2), pp. 287–299. doi: 10.1016/j.indmarman.2012.01.009.

Ngoc- Hong (2024) 'The Influence of Risk Management Practices on Operational Performance and Supply Chain Performance: A Moderation Effect of Inflation Rate'. Journal of Distribution Science. Available at: https://accesson.kr/jds/v.22/9/27/45056 [7 January 2025]

O'Donnell, C. (2020) *Pfizer slashed its COVID-19 vaccine rollout target after facing supply-chain obstacles*. Wall Street Journal, 3 December. Available at: https://www.wsj.com/articles/pfizer-slashed-its-covid-19-vaccine-rollout-target-after-facing-supply-chain-obstacles-11607027787 Accessed: [6 May 2025].

O'Donnell, C. (2020) *Pfizer says supply chain challenges contributed to slashed target for COVID-19 vaccine doses in 2020*. Reuters, 3 December. Available at: https://www.reuters.com/article/business/healthcare-pharmaceuticals/pfizer-says-supply-chain-challenges-contributed-to-slashed-target-for-covid-19-v-idUSKBN28D3B8/ Accessed: [6 May 2025].

Patton, M. Q. (1990). *Qualitative Evaluation and Research Methods*. 2nd edn. Beverly Hills, CA: Sage. https://www.scribd.com/document/196774829/Patton-1990 Accessed: [15 July 2025].

Reuters (2020) "*Global supplier India curbs drug exports as coronavirus fears grow"*. Available at: https://www.reuters.com/article/world/global-supplier-india-curbs-drug-exports-as-coronavirus-fears-grow-idUSKBN20Q0ZQ/ Accessed: [10 July 2025].

Scheibe, K.P. and Blackhurst, J., 2018. Supply chain disruption propagation: a systemic risk and normal accident theory perspective. *The International Journal of Production Research*, 56(1-2), pp.43–59. https://doi.org/10.1080/00207543.2017.1355123 Accessed: [15 July 2025].

Sodhi, M.S. and Choi, T.Y. (2022) 'Don't abandon your just-in-time supply chain, revamp it', *Harvard Business Review*, 20 October. Available at: https://hbr.org/2022/10/dont-abandon-your-just-in-time-supply-chain-revamp-it Accessed: [10 June 2025].

Sagonowsky, E. (2020) *Novartis braces for supply chain shocks, sees teamwork—and planning—as key to COVID-19 response*. Fierce Pharma. Available at: https://www.fiercepharma.com/manufacturing/novartis-supply-chain-chief-teamwork-and-planning-are-helping-drugmaker-keep-up-covid Accessed: [30 June 2025].

Singh, N. and Shek, K.H. (2019) 'Implementation of just in time production through Kanban system', *International Journal of Industrial Management*, 7(1), pp. 1–6. Available at: https://www.researchgate.net/publication/331274310_Implementation_of_Just_in_Time_Production_through_Kanban_System Accessed: [20 June 2025].

Wantao Yu, et. al (2022) ‘Openness to Technological Innovation, Supply Chain Resilience, and Operational Performance: Exploring the Role of Information Processing Capabilities’. Available at: https://ieeexplore.ieee.org/document/9740218/citations#citations [10 January 2025] DOI: 10.1109/TEM.2022.3156531

Yin, R. K. (2018) *Case Study Research and Applications: Design and Methods*, 6th ed. Los Angeles: SAGE.

Yardımcı Özkul, S., Şahin, E., Yildiz, B. and Demir, E., 2022. *Impact of the COVID-19 pandemic on perishable food supply chains*. Technological Forecasting and Social Change, 174, p.121235.

Available at: https://www.sciencedirect.com/science/article/pii/S0160791X21003225 [Accessed 10 JUNE 2025].

Appendix:

Questionnaire:

1. Market information:

1. Which key markets or regions represent the primary demand for your products, and how have these evolved over time?
2. Can you provide an estimate of your company's annual product sales, and how does this reflect recent trends or growth in your sector?
3. What types of raw materials or components does your company typically source, and are there any critical or high-risk materials in your supply chain?

2 . Supply Management Capabilities

4. In what ways has collaboration with suppliers specifically contributed to increased operational flexibility, and how can this approach be further developed to respond to future supply chain disruptions?
5. Can you describe how your organization builds long-term relationships with suppliers beyond individual transactions?
6. What kind of collaborative programs or initiatives are in place?
7. To what extent do your key suppliers have formal processes or programs in place to respond to your company’s special requests or urgent needs? Can you give an example?

3. Enterprise Risk Management Integration

8. How does your organization scan the business environment to identify potential risks within the supply chain?
9. How does your organization prioritize potential risk events in the supply chain?
10. Can you describe your organization’s contingency planning process for supply chain risk events? How are these plans developed and implemented?

4. Improvement of Risk Management Processes

11. How does your organisation ensure that risk management training remains engaging and relevant for employees across different roles and experience levels?
12. What key indicators do you use to measure the effectiveness of your risk management system, and how do you act on those findings?

13. What strategies have you used to encourage active participation and collaboration from supply chain partners in risk management improvements?

Section 5: Professional opinion

14. In your professional opinion, what was the biggest lesson your organization learned during the most recent supply chain disruptions (e.g., Covid-19 & Russia/Ukraine war)?
15. What single strategy would you recommend to pharmaceutical manufacturers to best prepare for future disruptions?
16. What do you think are the biggest challenges in implementing risk mitigation strategies in pharma supply chains?

Thank you for your valuable insights. Your responses will help support research into building more resilient pharmaceutical supply chains.

Impact of Disruptive Global Events Such as Covid-19 and the Russian/Ukraine War in the Supply Chains and Countering Strategies for Pharmaceutical Manufacturing Companies.

- I……., on (___/__/_____)voluntarily agree to participate in this academic research study. I have been provided with clear, detailed information about the aims, methods, and nature of the study in written form, and I have had the opportunity to ask questions and receive satisfactory answers. I understand that my participation involves a recorded interview, and that the information I provide will be used solely for academic research purposes.
- I am aware that I may withdraw from the study at any stage, without needing to give a reason and without facing any consequences. I also understand that I may revoke my consent for the use of my interview data within two weeks following the interview, after which the material will be permanently deleted. Participation is entirely voluntary, and I understand that I will not receive any direct personal benefit or compensation from participating in this research.
- I give permission for the interview to be audio recorded and for anonymised extracts to be quoted in the researcher's Master's dissertation. I have been informed that all personal identifiers will be

removed from the data to protect my privacy and that any details which might reveal my identity or the identity of individuals I mention will be changed or omitted to ensure full confidentiality.

- I understand that both the signed consent form and audio recordings will be stored securely in a password-protected digital file until the completion of the researcher's academic assessment, and that anonymised transcripts will be retained for up to two years following the conclusion of the study for academic verification purposes.
- I also understand that, in accordance with data protection regulations and ethical guidelines, I have the right to access the information I have provided at any time while it is stored, and I may contact the researcher with any questions or concerns regarding the use of my data or my rights as a participant.

This consent process follows ethical guidelines for research involving human participants, ensuring adequate information, voluntariness, and comprehension, in line with the highest standards of research ethics.

Reference:

European Commission (2013) *Ethics for researchers: Facilitating research excellence in FP7*. Luxembourg: Publications Office of the European Union. Available at: https://ec.europa.eu/research/participants/data/ref/fp7/89888/ethics-for-researchers_en.pdf (Accessed: 01 July 2025).

INTERVIEW SAMPLE

SECTION 1 MARKET INFORMTION

Speaker 1 (00:00)

Today is Tuesday, 29 of July 2025 Interviewing a Purchasing Manager, I'm gonna start with part one market information. Hi there, **Which key markets or regions represent the primary demand for your products, and how have these evolved over time?**

Speaker 2 (00:29)

Hi Rafa, and so our products are sold into the US and Canada. They're the only 2 regions that we sell our producst.

Speaker 1 (00:41)

Perfect number 2. Can you provide an estimate of your company's annual product sales, and how does this reflect recent trends or growth in your sector?

Speaker 2 (00:52)

So Our annual product sales would vary between 7.2 and 7.6 million devices and both, you know, in the combined US and Canada, and recently of the last probably 2 to 3 years, there has been a slight decline in our figures, and I don't know whether that's mark trend or a competitive marketplace or certain deals within pharmacies, not being renewed etcetera, so would the marketplace fluctuates quite a bit in the US, some Canada, but this is a generic product you know?

Speaker 1 (01:32)

Yeah, okay. Thank you number 3. **What types of raw materials or components does your company typically source, and are there any critical or high-risk materials in your supply chain?**

Speaker 2 (01:46)

So typically, we would buy plastic,s foil of API's, excipients, cartons, labels, desiccant, pills consumables for production and engineering, like gloves and and PPE gear. So regarding whether any of them a high risk, I think they're all high risk, a lot of our products coming into site would be single source. So we wouldn't have dual source on them, which means we're a totally dependent on number one, the relationship warking well.

Speaker 2 (02:24)

And then we're totally dependent on the vendor supplying as we expect them to, so that it is all quite high risk, I would say.

SECTION 2 SUPPLY MANAGEMENT CAPABILITIES

Speaker 1 (02:34)

Okay, thank you, let's move on 2 section 2 supply management capabilities question four. **In what ways has collaboration with suppliers specifically contributed to increased operational flexibility, and how can this approach be further developed to respond to future supply chain disruptions?**

Speaker 2 (02:55)

Yeah, yeah, yes, I think collaboration is very important, and it's vital when you have supply chain issues that your vendor listens to you, understand your issue and maybe potentially puts you in ahead of somebody else in the queue, and so I think it's all about favours. And You know? I think it's very important to build relationships vendors, and so that when you need a favour, then do it do do favour for you.

Speaker 2 (03:35)

So I think that collaboration is vital. Yeah, I think it's it goes hand in hand I think they're they're directly linked, if you want flexibility and you want expediting, you need to have a good relationship with your vendor so on regard to how it could be further developed, I think just keep working on the relationship over time, I think they do get better overtime. They get stronger over trying the more meetings you have. The more presentations, the more maybe you go to visit their site, the more The more you get higher on their list, you know.

Speaker 1 (04:21)

Okay, question number 5, **Can you describe how your organization builds long-term relationships with suppliers beyond individual transactions?**

Speaker 2 (04:33)

Yep, so we would have A vendor management plan where we would set out ahead of time all our meetings throughout the year that we would have so we might have some vendors might have a quarterly meeting. Other vendors might have a monthly meeting and some vendors even have a weekly meeting, so depending on the criticality of the vendor. And just decides how much effort to put into that relationship so and we would have Monthly, supply & operations meetings.

Speaker 2 (05:10)

We would have montage quality and technical meetings. And we might visit their silly wounds or twice a year, we might invite them over to our site, to see our production and and how we use their product in our our device. So I think They're good initiatives to have Yeah, I think that's that's more when this answer is that okay.

Speaker 1 (05:39)

Perfect, thank you number 6, **what kind of collaborative programs or initiatives are in place?**

Speaker 2 (05:47)

Like I said, with the meetings and the visits, but we also have them we also walk closely with vendors regarding stockholding, so we would have vendors. On the island of Ireland that would hold our product just for us and we would call it off and so it's ready-made and that that leaves a lot of A lot of pressure off our warehouse to store.

Speaker 2 (06:18)

and so it's like a can ban system that we would have where there's min and Max levels and we just we know what's made and we just call it in and the vendor just tops up the the quantity, then so we would have that some labels and carton Vendors, I think that's very important.

Speaker 1 (06:37)

Okay, perfect, thank you number 7 **to what extent do your key suppliers have formal process or programs in place to respond to your company's special requests or urgent needs? Can you give an example?**

Speaker 2 (06:50)

Yeah, I don't think as many formal processes. Obviously in every contract there's an escalation Path and that if that you can escalate to boss.

Speaker 2 (07:04)

You know, if we had a special request for an urgent need or let's say a quality issue, I think certain vendors would have a very high response level, other vendors would not have as high response levels. So for one example, I have a foil supplier in Germany and I know that if I have an issue at 9 o'clock that I can have Their management on a meeting by 12 and to try to help and hear our problem, so I think that's quite good. That's quite good to get that level response.

Speaker 2 (07:39)

So I'm not sure performance processes there are, but definitely in informal processes just depends on the vendor and You know how important we are to them. Just that I would answer if that one ways

Speaker 1 (07:56)

SECTION 3 Enterprise Risk Management Integration

Speaker 1 (00:00)

Moving on to section 3 enterprise risk management integration. **How much your organisation scans the business environment to identify potential risks within the supply chain.?**

Speaker 2 (00:14)

And well, we would have a risk matrix where we would have every vendor on The Matrix, and we would rate them on a scale of 1 to 10 of the risk current risk-based on the supply chain, where it's coming from, production, whether a single source of dual source, whether it's in an area prone to Earthquakes, all things, there's a, there's A There's a risk analysis tone that weighs up all those things, and it comes out with score, and we would score them. As well as that, we would ask each vendor on our business calls.

Speaker 2 (00:59)

Is there any potential risks that they can see coming in coming into the business? So if you don't get me, yeah.

Speaker 1 (01:06)

Okay, number 9, **how does your organisation prioritise potential risk events in the supply chain?**

Speaker 2 (01:14)

Yeah, so just like that's like I said that the risk matrix with prioritise risks end So I think we we have our riskiest vendor and we have our, you know, less risky vendor, and that's how we prioritise things.

Speaker 1 (01:38)

Number 10, **Can you describe your organisation's contingency planning process for supply chain risk events? How are these plans developed and implemented?**

Speaker 2 (01:50)

So We would have we would have a BCP p which is a business contingency plan. For all vendors vendors would have to have A BCP as part of their auditing, depending on the type of vendor so some vendors

wouldn't need the BCP, others would and quality make that distinction, but for all our big key vendors, they would have a BCP and they would outline what they would do with their sites just stopped in the morning. And due to have a sister site that could take over our business.

Speaker 2 (02:28)

and they could they potentially outsourced to a competitor and the bcp, will Dictate various events and what they would do in the event of them of those things happening. So and Yeah, I think that's part of it. Also, then from our company point of view, we would identify potential companies that we could get something from without setting them up.

Speaker 2 (03:00)

So we would kind of have them in the background. Waiting for action if we ever needed them to, without doing any work or setting them up, and so we would, we would know a little bit about that. That answers that

SECTION 4 Improvement of Risk Management Processes

Speaker 1 (03:18)

Yep. thank you, is section for improvement of risk management process. **How does your organisation ensure that risk management training remains engaging and relevant for employees across different roles and experience levels?**

Speaker 2 (03:36)

Yeah, from my point of view, in purchasing in a group before or like a team of 4, I'm not aware of any risk management training that's going on his company. It's unfortunate, can't answer that.

Speaker 1 (03:51)

I think number 12**. What key indicators do you use to measure the effectiveness of your risk management system, and how do you act on those findings?**

Speaker 2 (04:00)

Yeah, again, I'm not aware of a risk management system, and if our risk management system is are risk matrix. and well, then it's only myself and one of the person that has access to that and use the that and we would feed back to management our findings but there would be no training caried out.

Speaker 2 (04:27)

K, p, I's Yeah, it's a hard one to know. How you measure how effective they are. I mean, if you have a contingency for every product you'll cover be covered.

Speaker 2 (04:48)

But yeah, I don't really don't really have an answer to that.

Speaker 1 (04:54)

Number 13**. What strategies have you used to encourage active participation and collaboration from supply chain partners in risk management improvements?**

Speaker 2 (05:05)

Yeah, so we've had a bit of experience at this with Brexit and Covid where we've, you know, specifically run into vendors and ask them what their supply chain looks like we've asked them to go deep into their supply chain to see if there was any disruptions, I remember for Brexit, we asked every single vendor. Had they any materials coming from the UK?. and then we came up with mitigation for that, and we understood the risk with COVID as well, which, you know, international shipping shutdown and in China, there was nothing coming out of China from month to months.

Speaker 2 (05:48)

Again, the vendor would have to tell the staff and so I think Discussing haven's risk management conversations with the vendors is important, and that was really really the strategy, you know, to discuss each part, each vendor their supply chain and their risks depending on what the what the issue was. I think that's I think that's improved our understanding of the supply chain. So I think that's heavy from brokers.

Speaker 1 (06:27)

Okay, thanks for that.

SECTION 5 Professional opinion

Speaker 1 (00:00)

Section 5 professional opinion, question 14**. In your professional opinion, what was the biggest lesson your organization learned during the most recent supply chain disruptions (e.g., Covid-19 & Russia/Ukraine war)?**

Speaker 2 (00:19)

A biggest lesson learned it was how vulnerable we are to global supply chains. I think that was the lesson learned, you know, before COVID, we never really looked downstream.

Speaker 2 (00:36)

We didn't know that our gloves came from Asia, and we didn't understand the length of these supply chains, and I think after COVID, we had to learn real fast. Of how it really is a global marketplace, you know. So I think that's the biggest lesson and What's the biggest lesson learned?

Speaker 2 (01:14)

It is less than earned Yeah. Yeah, I suppose I don't know if that answer thash. You could say the biggest lesson to learn is, you know, you should be prepared.

Speaker 2 (01:30)

You should be prepared and and have a backup supplier or a backup material In case something happens, you know, I think the supply agreements are great. They're great thing to have you know supply agreement and it makes that the vendor responsible for all those supplying product to you and that's important.

Speaker 2 (01:55)

Okay.

Speaker 1 (01:56)

Number 15, **What single strategy would you recommend to pharmaceutical manufacturers to best prepare for future disruptions?**

Speaker 2 (02:05)

Yeah, a single strategy would be dual dual sourcing, so trying to get the same product from 2 different sources, and if you can't do that to have a backup material and that you can put in with the minimum disruption and approval so maybe you can approve 2 items and only use one and have the second one as backup, but it's approved ready to go.

Speaker 2 (02:33)

So I think that's That's the strategy that I would recommend pharmacies to best Prepare for future disruption duel sourcing. Yeah.

Speaker 1 (02:44)

Perfect. Thank you, number 16 and final. **What do you think are the biggest challenges in implementing risk mitigation strategies in pharma supply chains?**

Speaker 2 (02:56)

So the biggest challenges in implementing risk mitigation strategies is the additional cost. You know, the cost of supply dual supply costs money, you're bringing on a second vendor you may not be fully. Yeah, you know, committed to give thema business and if you do split your source and 2 or you're supplying 2, you're loose and volume, which loses efficiency, which loses the best price here.

Speaker 2 (03:28)

So all these things, add money 2 to you. So dual saucing cost money so that's the biggest challenge, also resources.

Speaker 2 (03:39)

Are risk management and risk mitigation for somebody to sit down every week and look at risk as its own separate challenge that costs money as well, and a lot of companies don't see that in there daily duties, I think resources and costs that's the biggest challenge.

Speaker 1 (04:01)

Okay, that concludes our interview. Thank you for your value insights.

Speaker 2 (04:06)

Thank you.