Impacts of pandemic outbreaks on Healthcare Supply Chains: Lessons from COVID-19 in developing nation

By
Manisha Tiwari

A thesis submitted in partial fulfilment of the requirements of Liverpool John Moores University for the degree of Doctor of Philosophy

November 2024

ABSTRACT

Purpose

The global COVID-19 crisis has significantly disrupted supply chains in the healthcare sector, leading to severe shortages of critical items like PPE kits, medicines, and sanitisers. This situation has highlighted the need for extensive research on the impact of pandemics on healthcare supply chains and the importance of building resilience. This thesis investigates the factors that enhance resilience in healthcare supply chains and their interconnections. It establishes a theoretical model based on the relational view, focusing on how relational competencies such as information visibility, swift trust, and collaboration affect healthcare supply chain resilience (HSCR). It also examines the role of crisis leadership in moderating the relationship between collaboration and HSCR. This research addresses gaps by integrating the relational view with the upper-echelon theory. It aims to contribute valuable insights to the academic literature and practical guidance for practitioners and policymakers. Overall, it seeks to make a meaningful impact on healthcare supply chain management.

Design/methodology/approach

I used the problematisation approach Alvesson & Sandberg (2011) recommended to identify research gaps. I established two objectives: creating an operational definition of HSCR and developing a theoretical model. To achieve these, I employed both inductive and deductive methods. For the first objective, I conducted a systematic literature review (SLR) to identify eighteen enablers of HSCR. I then performed a DELPHI study, contacting forty experts to rank these enablers. After collecting their feedback, I developed a structural self-interaction matrix (SSIM). I created an interpretive structural model (ISM) using MICMAC analysis to illustrate the enablers of a social support healthcare resilient system. I integrated the relational view and upper-echelon theory to address the second objective of developing a theoretical model. I created a survey questionnaire using a seven-point Likert scale, following Dillman's total design method, and collected responses from a diverse group of 111 participants from Indian hospitals and clinics. I calculated the minimum required sample size based on

Kock and Hadaya's (2018) methods to ensure sample size validity. This confirmed that my sample was sufficient for statistical analyses using WarpPLS 7.0 and PLS-SEM.

Findings

The study reveals key factors contributing to effective healthcare systems with strong social support. It highlights the crucial role of government support in driving top management to enhance visibility, financial backing, and family support. The research shows how these elements interconnect to improve information sharing and resilience in healthcare systems. Structural equation modelling (PLS-SEM) findings indicate that information visibility and swift trust are vital for collaboration in the healthcare supply chain during crises. Additionally, collaboration significantly affects the supply chain's resilience. Interestingly, the study finds that crisis leadership can negatively impact collaboration, as committed leaders may inadvertently create confusion during crises. These insights challenge traditional views on leadership and enhance our understanding of crisis dynamics. In conclusion, the research supports an integrated approach that merges relational views with upper-echelon theory, offering deeper insights into crisis leadership complexities.

Research Limitations

Upon reflecting on my work, I recognise the limitations of my study despite the considerable effort I put in. I used samples from India, but including samples from other developing nations could have provided a fuller understanding of the context. This would require extensive travel and communication with healthcare providers to gather rich insights. My literature review revealed that national culture greatly influences organisational strategies during crises. For instance, Japan's crisis management approach differs significantly from those of the United States, the United Kingdom, and India. Although I decided to exclude national culture as a moderating factor for simplicity, I now realise that exploring this dimension could have added valuable insight. I found that resource dependence theory (RDT) is crucial for understanding collaborative relationships during crises and enhancing the resilience of the healthcare supply chain. RDT highlights how organisations rely on external resources and the impact of these interdependencies on decision-making. I used interpretive structural modelling (ISM) to

explore the complex interrelationships among eighteen variables affecting healthcare supply chain resilience in my analysis. However, I encountered inconsistencies in the DELPHI study. To address this, I propose using fuzzy theory, which offers a more nuanced representation of relationships between variables. Lastly, I utilised cross-sectional data to test my hypotheses. While I took precautions to mitigate common method bias, longitudinal data could have been more beneficial, as it allows for observing changes over time for a deeper understanding of the phenomena.

Practical Implications

The research highlights the significant challenges faced by the healthcare sector during the COVID-19 crisis, including a lack of visibility, governance, collaboration, and ownership. These shortcomings led to severe shortages of PPE, sanitisers, medications, and healthcare facilities. Supported by qualitative and quantitative analyses, this study aims to provide insights for healthcare professionals and administrators to address similar issues in the future. Effective government support is crucial for a nation's well-being. It offers direction and ensures stability through policy implementation, resource allocation, and public services. Top management support and leadership are vital for healthcare supply chain resilience. Their commitment is essential for implementing strategic initiatives and providing the necessary resources. Understanding the qualities of crisis leaders can inspire collaboration, drive innovation, and foster a resilient organisational culture. Additionally, prioritising the well-being of employees' families during crises is important for healthcare workers, helping them manage stress and focus on their roles. Information visibility and trust also play critical roles in collaboration within healthcare organisations. Clear, accessible data promotes communication and strengthens relationships, improving patient care and outcomes. Finally, effective communication among healthcare managers is essential during crises. Being transparent, empathetic, and respectful fosters collaboration and is crucial for managing virtual teams in challenging situations.

Originality/value

The thesis represents an original and valuable contribution to existing theory. The research study significantly enhances the understanding of HSCR and further extends the boundaries of the relational

view to encompass the critical role of crisis leadership. The findings offer a nuanced and in-depth comprehension of crisis leadership, shedding light on an area that has traditionally received less attention. Collectively, the study's results contribute substantially to the ongoing theoretical discussions about healthcare supply chain resilience, relational competencies such as swift trust, information visibility, collaboration during times of pandemic, and crisis leadership.

Keywords: Healthcare Supply Chain, Healthcare Supply Chain Resilience, Information Visibility, Swift Trust, Collaboration, Relational View, Social Support Systems, Interpretive Structural Equation Modelling, Partial Least-Squares Structural Equation Modelling.

ACKNOWLEDGEMENTS

गुरुर्ब्रह्मा गुरुर्विष्णुः गुरुर्देवो महेश्वरः । गुरुः साक्षात् परब्रह्म तस्मै श्री गुरवे नमः ॥

I grew up in a family where my mother often recited above ancient Sanskrit slokas that revered teachers as dispelling the darkness of ignorance. As I completed my PhD thesis, I understood the meaning of this phrase. I am immensely grateful to my supervisors, Professor David J. Bryde, Dr Foteini Stavropoulou, and Professor Rameshwar Dubey, for their unwavering support and motivation throughout my doctoral journey. I also want to thank Professor Claire Hannibal (Moxham) for her valuable insights during my presentation for the confirmation of the PhD program and Dr. Sarah Schiffling for her supervision in the early stages of my doctoral journey. My heartfelt thanks go out to all my supervisors for their incredible support and excellent cooperation, without which this difficult journey would not have been possible.

I sincerely thank Professor Adam Shore, Dr Scott Foster, Dr H.M. Belal, Professor Timothy Nichol, Ms Yeni Aqoari, and the entire Liverpool Business School team and Librarian for their constant motivation, support, and empathy. Additionally, I am thankful to Professor Ramakrishnan Raman, Professor Niloy Sarkar, and Ms Celina Nateram for their excellent support in my data collection, which helped me complete my thesis on time and provided valuable insights about the healthcare sector. I also want to extend my heartfelt gratitude to all the experts and respondents who participated in the research studies. Without their invaluable support, this thesis would not have been possible.

I cannot overlook my friend Md Shahid, who has unconditionally supported me at every stage of my life for the past 16 years. His unwavering belief in me has been instrumental in my journey. Additionally, I acknowledge the love and care of my school friend Neetu Kaur, Priyanka Singh and other close friends who stood by me, both near and far, throughout this journey.

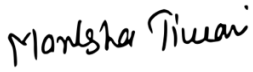
I am grateful to my father, Mr. Shiw Narain Tiwari, who always motivated me to excel despite numerous challenges. My heartfelt thanks go out to my sister, Mrs. Kiran Tiwari, my sister-in-law, Mrs. Bindu Tiwari, and my brothers, Rishikesh and Rakesh, who have always supported and encouraged me. My nieces, Sanskriti and Siddhi, and my nephews, Ansh and Vishesh, have brought joy to my life with their presence.

Finally, special thanks are owed to my mother, Mrs. Kamala Tiwari. I want to dedicate this work to her, as she played an instrumental role in my doctoral journey. Her encouragement led me to pursue a full-time PhD and leave my prestigious consulting job at E&Y. Despite being promoted and completing my offshore assignment in Italy, it was my mother's words that resonated with me when she expressed doubt about how her daughter could pursue a PhD. These words solidified my determination to fulfil her wishes and make my educational dream a reality. Her continuous prayers, exemplary core values, and genuine love have been the particular "wind beneath my wings" since childhood.

DECLARATION

I hereby declare that no part of this thesis entitled "*Impacts of pandemic outbreaks on Healthcare Supply Chains: Lessons from COVID-19 in Developing Nations*" has been submitted in support of an application for any other degree or qualification at this or any other university or institution of learning. Furthermore, I confirm that this thesis is entirely my work and that all references to the work of others have been cited and acknowledged.

Signature



PUBLICATIONS

Conference Presentation:

- M Tiwari, R Dubey, D Bryde - Faculty of Business and Law Research Day, 2022 Impacts of pandemic outbreaks on Healthcare Supply Chains: Lessons from Covid-19 in developing nations. (Extended Abstract) *Proceedings of the Faculty of Business and Law Annual Doctoral Conference. Dec 8, 2022, Liverpool, UK* https://doi.org/10.24377/BLRD.858

Published Journal Articles*

- Tiwari, M., Bryde, D. J., Stavropoulou, F., & Malhotra, G. (2024). Understanding the evolution of flexible supply chain in the business-to-business sector: a resource-based theory perspective. *International Studies of Management & Organization*. DOI: 10.1080/00208825.2024.2324245.

- Tiwari, M., Bryde, D.J., Stavropolou, F., Dubey, R., Kumari, S., & Foropon, C. (2024). Modelling supply chain Visibility, digital Technologies, environmental dynamism and healthcare supply chain Resilience: An organisation information processing theory perspective, *Transportation Research Part E: Logistics and Transportation Review*, 188, 103613.

** The articles are based on my research. However, the chapters I developed do not resemble the publications, as they are part of my extended study.*

TABLE OF CONTENTS

LIST OF FIGURES

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 7

LIST OF TABLES

Chapter 2

Chapter 3

Chapter 4

Chapter 5

LIST OF ABBREVIATIONS

A-M-C	Awareness-Motivation-Capability
AS	Antecedent Set
AVE	Average Variance Extracted
AVIF	Average Variance Inflation Factor
C-RBV	Contingent Resource-Based View
CB-SEM	Covariance-Based Structural Equation Modelling
CFA	Confirmatory Factor Analysis
CL	Crisis Leadership
CMB	Common Method Bias
CO	Collaboration
DCV	Dynamic Capability View
EFA	Exploratory Factor Analysis
EFA	Exploratory Factor Analysis
GoF	Goodness of fit
HFNs	Hastily Formed Networks
HSCR	Healthcare Supply Chain Resilience
HTMT	Heterotrait-Monotrait
ISM	Interpretive Structural Modelling
IV	Information Visibility
LJMU	Liverpool John Moores University
MACBETH	Measuring Attractiveness through a Categorical-Based Evaluation Technique
MICMAC	Matriced'Impacts Croisés Multiplication Appliquéea'un Classement

NLBCDR	Non-Linear Bivariate Causality Direction Ratio
OIPT	Organisational Information Processing Theory
PLS	Partial Least Squares
PLS-SEM	Partial Least Squares Structural Equation Modelling
PLSc	Consistent PLS
PPE	Personal Protective Equipment
R-C	Resource-Capability
RBV	Resource-Based View
RDT	Resource Dependence Theory
RS	Reachability Set
RV	Relational View
SCR	Scale Composite Reliability
SEM	Structural Equation Modelling
SSIM	Structural Self-Interaction Matrix
ST	Swift-Trust
TCE	Transaction Cost Economics
VIF	Variance Inflation Factor
WHO	World Health Organisation

CHAPTER 1: INTRODUCTION

The COVID-19 pandemic has caused significant disruptions in supply chains across the globe (Panwar et al., 2022; Ivanov, 2024). This has resulted in delays in manufacturing, transportation, and distribution of goods, impacting various industries and causing challenges for businesses to meet demands (Ivanov, 2020; Choi, 2021). The restrictions on movement, temporary closures of facilities, and changes in consumer behaviour have all contributed to the complexities of supply chain management during this time (Liu et al., 2020; Yu et al., 2021; Shen & Sun, 2021). The world was taken by surprise by an unprecedented global health crisis, which disrupted the supply chain for essential items (Orlando et al., 2022; Min, 2023). The crisis was characterised by severe government lockdowns and strict social distancing policies (Cairney, 2021; Madan et al., 2021; Caro et al., 2022). As a result, supply chains were massively impacted, causing widespread disruptions on a global scale. The unprecedented event sent shockwaves through the academic community, policymakers, and practitioners alike (Leach et al., 2021; Peleg et al., 2021). Never had the world experienced such a significant health crisis in recent decades (Tabish, 2020). Consequently, there needs to be more literature addressing the strategies for managing such a crisis or developing resilience in healthcare supply chains during the early stages (Chowdhury et al., 2021; Queiroz et al., 2022). The existing literature mainly comprised anecdotal accounts that offered minimal or no valuable insights.

1.1 Research Background

On March 11th, 2020, based on the assessment made of COVID-19, The World Health Organization (WHO) declared the COVID-19 epidemic a “pandemic” and advised its member countries to take urgent and aggressive action to safeguard their citizens (WHO, 2020). The COVID-19 pandemic has impacted various service sectors, such as hospitality, aviation,

consultancy, immigration, and many others, for an extended period (Nayak, 2022; Karniouchina et al., 2022). In 2024, the healthcare sector has demonstrated a commendable level of resilience in the face of numerous challenges. However, it continues to grapple with substantial uncertainties that have the potential to impact various aspects of its operations and delivery of care. One of the reasons the healthcare sector was adversely affected by the pandemic is due to demand fluctuations (Rozhkov et al., 2022; Pamucar et al., 2023). Before the virus outbreak of the COVID-19, the humanitarian supply chain encountered multiple challenges in improving critical aspects of disaster relief operations (Balcik et al., 2010; Akter & Wamba, 2019; Banomyong et al., 2019; Gupta et al., 2022). The COVID-19 pandemic has brought to light the weaknesses present in the healthcare supply chain of both developed and developing economies (Hossain et al., 2022). However, it has been particularly devastating for developing nations with high population density due to various factors such as limited healthcare infrastructure, higher risk of transmission in densely populated areas, and challenges in implementing widespread preventive measures (Khavarian-Garmsir et al., 2021). This has underscored the urgent need for global cooperation and support to address these underlying issues and ensure the health and well-being of all populations, regardless of their economic status (Dalingwater et al.,2023).

Nations such as India, Indonesia, Bangladesh, parts of China, African nations, and parts of South America have experienced significant strain on their healthcare systems during the COVID-19 crisis due to high population density (WHO, 2021). India, among these nations, has witnessed a sudden increase in demand for essential healthcare items, highlighting the vulnerability of the healthcare supply chain (Sengupta & Jha, 2020). The second wave of COVID-19, which occurred during March-April 2021 in India, left many hospitals and clinics grappling with a shortage of vital health supplies such as oxygen cylinders, face masks, medicine, healthcare facilities, and insufficient healthcare staff (Mehta et al., 2020).

Throughout the COVID-19 pandemic, the vulnerabilities within supply chains were dramatically revealed (Ivanov & Dolgui, 2021). During the second wave of the pandemic, developing economies like India experienced significant challenges (Singh et al., 2021). This led to the loss of millions of lives (See Figure 1.1) due to critical shortages of oxygen cylinders, essential medications, hospital facilities, and an overwhelmed healthcare workforce (Mirza et al., 2023) (Figure 1.2 and Figure 1.3). The situation highlighted the urgent need for support and resources to mitigate the impact of the crisis (Ganguly, 2020). The pandemic crisis and the fragile healthcare system in developing countries like India are mainly due to poor governance, lack of transparency, poor coordination among various stakeholders, and a fragile healthcare supply chain (Dubey, 2023; Sathiya et al., 2023). This has inspired me to undertake a theory-driven study that provides comprehensive findings. These findings can help the academic community advance theoretical boundaries and provide rich direction for policymakers and practitioners to reflect on their strategies to deal with such future crises.

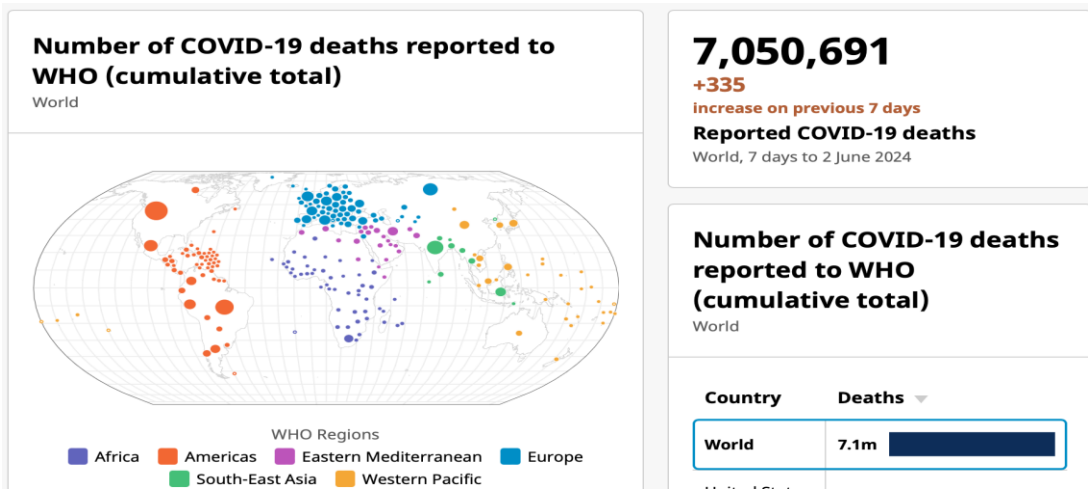


Figure 1.1 Number of COVID-19 deaths reported to WHO worldwide (Source: https://data.who.int/dashboards/covid19/deaths?n=o)

Figure1.2: The Oxygen Cylinder supply Crisis During the COVID-19 In India (Source: https://www.bbc.co.uk/news/uk-56841381)

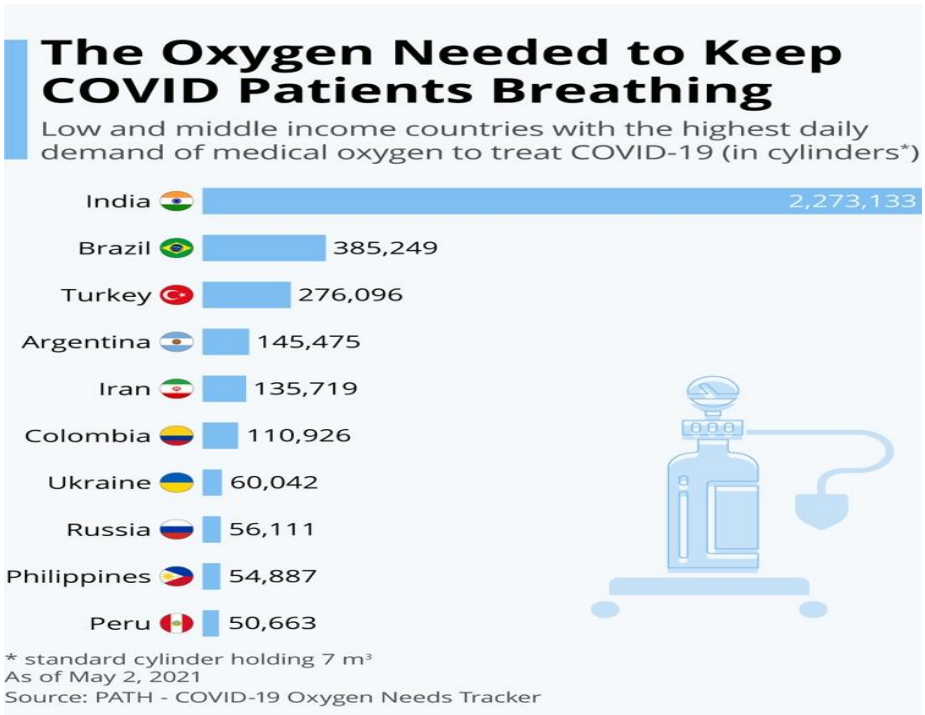


Figure 1.3: The Comparative Study of demand for the Oxygen Cylinder during COVID-19 among the Developing Nations. (Source: https://www.statista.com/chart/24749/oxygen-demand-covid-19/)

1.2 Research Motivation

The COVID-19 pandemic has led to significant disruptions in the operation of healthcare systems, which are vital to the well-being of communities. This is primarily due to the increased demand for essential healthcare items and equipment (Sodhi & Tang, 2021; Sodhi et al., 2023). In addition to the strain on healthcare resources, leaders are facing immense pressure as they witness healthcare workers and community members battling severe respiratory issues caused by COVID-19 (Stephens et al., 2020). Leaders are now tasked with the challenging responsibility of saving lives, mitigating the crisis's adverse effects on the economy, and ensuring job security, all of which demand great empathy and understanding (Dirani et al., 2020; Crayne & Medeiros, 2021).

Research by Usdin (2014) suggests that communities often exhibit resilience in crises, adapting and evolving rather than simply returning to normalcy. Sinha & Kohnke (2009) observed that the gap between the rising demand for high-quality healthcare items and the supply available at the right cost, time, and place is significantly widening in developed and developing economies. Mandal (2017) contends that hospitals and their healthcare supply chain partners must develop capabilities to reduce the risk of disruptions in the supply chain for healthcare items during disasters. Disruptions in the healthcare supply chain can harm patient care (Dobrzykowski et al., 2014; Mandal, 2017), posing potential dangers (Sawyerr & Harrison, 2023).

Healthcare is one of the most critical needs of a human being. The COVID-19 pandemic has put enormous strain on healthcare supply chains, leading to shortages of necessary healthcare items (Finkenstadt & Handfield, 2023). The disruptions in the supply chain and the sudden increase in demand have resulted in a lack of necessary medical equipment to provide quality healthcare services to patients (Finkenstadt & Handfield, 2021; Zamiela et al., 2022).

Therefore, a resilient healthcare supply chain is crucial for the prosperity and well-being of the nation (Zamiela et al., 2022).

Various nations and healthcare facilities have responded differently in times of crisis. While some have adeptly handled the challenges, others have encountered difficulties (Pattyn et al., 2021). This differing response is attributed not only to cultural disparities but also to the significant influence of leaders and senior managers (Garretsen et al., 2022). Leadership plays a pivotal role during a crisis by guiding teams to collaboratively mitigate the situation (Pring et al., 2021). One of the primary objectives of this thesis is to understand the influence of leaders and their approach to leading teams during adversities. The subsequent section will provide a detailed understanding of leadership within a specific context. Therefore, leadership and decision-making prowess are critical elements during a crisis (Usdin, 2014). Leadership in calamitous scenarios differs from other forms of leadership, aiming to reduce the adverse effects of disasters through effective planning and execution of strategies (Boin & Hart, 2003; James et al., 2011). Usdin (2014) contends that leadership is crucial in fostering community resilience. Sommer et al. (2016) also argue that leadership fosters organisational resilience during a crisis. However, crisis leadership often yields inconsistent outcomes, and the influence of crisis leadership on organisational resilience varies across different national cultural dimensions (Koronis & Ponis, 2018). The motivation behind my study stems from four key factors. Firstly, the COVID-19 crisis has resulted in a significant sense of helplessness, primarily attributed to disruptions in the supply chain that have impacted the availability of critical items, including essential healthcare supplies and commonly used toiletry products. This unprecedented global crisis has revealed significant gaps in the existing literature on supply chain management, as it has failed to adequately explain the magnitude of the challenges posed by the pandemic. Secondly, organisations across all sectors, especially in healthcare, face challenges due to high demand and supply uncertainties for crucial items like facemasks,

oxygen cylinders, medicine, PPEs, and adequate healthcare staff (see Figure 1.4). These challenges have highlighted inadequacies in the preparedness of hospitals, clinics, and national policies, indicating a clear gap in the healthcare sector's supply chain (Figure 1.5-Figure 1.7). Thirdly, the lack of healthcare supply chain resilience literature suggests that operations and supply chain management scholars have not paid enough attention to the healthcare field. Lastly, the significance of inter-organisational elements, such as communication, trust, cooperation, coordination, collaboration, top management commitment, and national leaders' support, remains insufficiently studied. These ontological, epistemological, axiological, and methodological assumptions have led me to undertake this study.

Figure1.4: PPE shortages are forcing some doctors to use raincoats and motorbike helmets (Source: https://www.aljazeera.com/news/2020/3/31/covid-19-panic-among-india-health-workers-over-ppe-shortages)

Figure 1.5: No space for the sacred funeral pyres in Delhi
(Source: USA Today 29 April 2021)

Figure 1.6: A healthcare worker attending COVID-19 patients in the banquet hall
(Source: USA Today 29 April 2021)

Figure 1.7: Distressed healthcare workers bring dead bodies for cremation during the COVID-19 pandemic in New Delhi
(Source: USA Today 29 April 2021)

1.3 Research context and problem

In this study, my primary focus is directed towards the complex and multifaceted challenges within the healthcare supply chain in the specific context of developing countries, with a particular emphasis on the Indian healthcare system (Bisht et al., 2021). As one of the most populous countries globally, India grapples with the formidable challenges posed by high population density, which significantly impacts the effective management of healthcare services, particularly during crises such as the recent pandemic (Kapoor et al., 2023). Despite the implementation of stringent measures, enforcing a strict lockdown proved arduous during the pandemic, amplifying the complexity of governing such vast and densely populated regions (Jain & Dupas, 2022). Compounded by these challenges, the infrastructure of the Indian healthcare sector is notably more fragile than that of developed economies (Gupta, 2020). The

need for more hospitals and clinics relative to the country's population presents a significant obstacle to providing comprehensive healthcare services.

Moreover, the inadequacy of physical infrastructure is further exacerbated by the glaring deficit in adequately trained healthcare staff. Astonishingly, most government-operated healthcare facilities also grapple with maintaining sufficient inventory of essential healthcare items, intensifying the strain on an already taxed system. Through this comprehensive analysis, the identified challenges present an unparalleled opportunity for researchers to delve into uncharted territory, critically interrogate existing paradigms, and develop robust theoretical frameworks. Additionally, this study aims to validate these theories empirically, ultimately contributing to the expansion and enhancement of the theoretical understanding of healthcare supply chain dynamics in developing countries such as India. My research delves deep into the intricacies of the Indian healthcare sector and its strategic responses to the intricate challenges posed by the COVID-19 crisis. This study will involve a comprehensive critical analysis of existing literature, focusing on the intricacies of healthcare supply chain management, the resilience of healthcare supply chains, the inter-organisational elements contributing to that resilience, and how these elements react to exceptional challenges like a pandemic. Through this in-depth exploration, I aim to identify significant research gaps and develop a robust theoretical framework to address the research objectives and questions effectively.

1.3.1 Supply chain disruptions due to pandemic

The COVID-19 pandemic has caused significant disruptions to the supply chains of essential goods, healthcare items, and even toiletry products like toilet paper (Paul & Chowdhury, 2021; Sodhi et al., 2023). Several factors have contributed to this disruption (Paul et al., 2021). Firstly, the lack of coordination among many countries failed to address the initial shortage of these items, leading to a lack of communication and visibility throughout the supply chain (Nikookar & Yanadori, 2022; Gebhardt et al., 2022). Secondly, the trade war between the US

and China worsened the situation as the US imposed restrictions on Chinese goods (Fan et al., 2022). Thirdly, in the early 1980s, Western countries' policies aimed at cost reduction and increased profitability resulted in the relocation of manufacturing operations to countries like China, which led to challenges related to employment, economic output, and competitiveness (Levy, 2005). During the global COVID-19 crisis, Western nations came to the stark realisation that their reliance on the production capabilities of China and other countries had reached an unprecedented level (Chen et al., 2022; Lee, 2023). This dependence proved crucial for meeting essential needs, such as medical supplies and personal protective equipment (Vadlamannati & Jung, 2023). The decision to offshore their manufacturing bases was identified as a significant contributing factor to this vulnerability, prompting a reconsideration of supply chain strategies and national security measures (Roscoe et al., 2022; Tsai & Urmetzer, 2024). During the global pandemic, developing nations in Asia, Africa, and South America faced challenges exacerbated by corruption, insufficient infrastructure, and a lack of transparency and governance (Adeyeye et al., 2023). As a result, these countries encountered major challenges in responding effectively to the pandemic and ensuring the welfare of their people. In summary, the pandemic underscored shortcomings in the healthcare sector, such as a lack of transparency, visibility, trust, and collaboration, leading to supply chain disruptions (Seuring et al., 2022).

1.3.2 Healthcare supply chain during the pandemic

The healthcare sector has experienced profound challenges due to the pandemic (Malik, 2022). One of the foremost issues confronting the healthcare industry is its supply chains, which have been notably impacted (Kovacs & Falagara Sigala, 2021). Despite the healthcare sector's essential role, its supply chains have not developed adequately (Gereffi, 2020). This can be attributed to the fact that the healthcare sector is predominantly state-owned and heavily reliant on taxpayer funds for support (Bergmann & Wagner, 2023). Consequently, the design and evolution of healthcare supply chains have not kept pace with the advancements seen in the

manufacturing sector's supply chains (Dixit & Dutta, 2023). The COVID-19 crisis has further laid bare the vulnerabilities in the healthcare supply chain, emphasising the urgent need for comprehensive intervention across various facets of the industry (Detwal et al., 2024). I have identified significant and noteworthy issues after reviewing academic literature, industry reports, and news coverage from reputable sources, including BBC, CNN, D&W, and NDTV (Ruparel et al., 2023). Firstly, the healthcare supply chain sector has historically overlooked the development of its supply chain capabilities (Kwon et al., 2016). This has resulted in a heavy reliance on front-line healthcare staff, such as doctors, nurses, and medical specialists (Ali & Kannan, 2022; Noort et al., 2023). While the NHS and specific sectors have made substantial investments in their procurement departments, centralised procurement departments in developing countries struggle to perform effectively (Skipworth et al., 2020). Despite past challenges, little action has been taken, highlighting the pressing need for substantial changes in governance, leadership approach, infrastructure, and collaboration across various levels within the healthcare sector of developing nations (Gostin & Mok, 2009; Morris et al., 2022). Secondly, compared to other supply chains, the healthcare supply chain is significantly more intricate due to its higher risk levels (Spieske et al., 2022). Managing the flow of pharmaceuticals, medical equipment, and supplies involves navigating stringent regulations, ensuring product safety, and maintaining the integrity of crucial medical products (Malone et al., 2022). This complexity often requires robust logistical strategies and innovative solutions to mitigate risks and efficiently deliver healthcare essentials to those in need.

1.3.3 Inter-organisational relationship during the pandemic

The healthcare supply chain is a complex sector that demands significant reorganisation and restructuring to optimise efficiency, cost-effectiveness, and overall effectiveness (Zamiela et al., 2022). This involves streamlining processes, implementing advanced technology, enhancing communication and collaboration among key stakeholders, and ensuring the

seamless flow of medical supplies and services from manufacturers to healthcare providers and, ultimately, to patients (Moreira et al., 2023). During the ongoing pandemic, inter-organisational elements' seamless functioning has proved crucial (Magableh, 2021). This includes the efficient exchange of information, maintaining transparency, ensuring visibility, fostering clear communication channels, establishing trust among stakeholders, and promoting collaboration (Krczal & Behrens, 2024). These elements are indispensable for effectively managing the current crisis and successfully navigating its challenges (Dubey et al., 2022). Understanding and effectively managing inter-organisational dynamics is essential, particularly during times of global crisis. Collaborating across organisations, industries, and countries becomes more challenging due to increased uncertainties, risks, and resource constraints. Therefore, developing strategies to navigate and foster effective inter-organisational relationships during crises is imperative for overall success and resilience in the health sector.

1.4 Research Objectives and Questions

The existing research has primarily focused on building supply chain resilience to address challenges caused by man-made or natural disasters. However, the COVID-19 pandemic is unprecedented in decades. This emphasises the necessity of a comprehensive theory that can clarify healthcare supply chain resilience during pandemics. Such a theory can ensure that the healthcare supply chain is resilient enough to handle future disruptions caused by pandemics. Therefore, conducting more detailed research to provide insights into the mechanisms of healthcare supply chain resilience during pandemics is crucial. This information can be invaluable in developing and implementing strategies to mitigate the effects of pandemics on healthcare supply chains. Craighead et al., (2020) have also emphasised the need for theory-focused research to examine supply chain management issues arising from pandemics such as COVID-19.

The initial gaps that prompted me to undertake the study that further guides to the framing of research objectives and the research questions. Firstly, there is relatively less literature on healthcare supply resilience. While a rich body of literature focuses on healthcare supply chain resilience, there is a lack of comprehensive studies specifically defining it in the context of unprecedented crises such as pandemics. Secondly, I have found that inter-organisational elements significantly enhance resilience in the healthcare supply chain. However, despite a considerable amount of literature on the subject, the interplay of information visibility, swift trust, and collaboration on healthcare supply chain resilience during unprecedented crises is limited regarding theoretical understanding and its application in real scenarios. Thirdly, the role of leadership in guiding organisations through times of crisis is a widely discussed topic in scholarly literature. However, my research has uncovered contradictory perspectives on how leadership impacts collaborative efforts to strengthen the resilience of healthcare supply chains during such critical periods. Notably, I have found a dearth of literature that delves into the specific influence of crisis leadership on fostering collaboration and its consequent effects on the resilience of healthcare supply chains. Finally, most studies utilise either a positivistic or interpretivist approach from a methodological standpoint to address the existing gaps in knowledge. Consequently, the depth of understanding provided by most studies is somewhat limited. According to Boyer & Swink (2008), there is a noticeable absence of comprehensive studies that effectively employ a combination of multiple research methods. This absence hinders the improvement of the reliability and validity of research findings. However, I have presented these overarching goals in the following chapter to provide greater clarity as the discussion progresses. The main objectives of the study are:

(a) To provide operational definitions of *healthcare supply chain management* and *resilience*.

After conducting an extensive and in-depth critical literature review, it became evident that despite the substantial volume of literature on healthcare supply chain resilience, there remains a dearth of definitive and operational definitions so that future researchers can replicate this definition in their studies in the healthcare sector. This observation underscores the significance of delving deeper into this aspect to better understand it.

(b) To develop and validate a *theoretical model* to explain how to build resilience in the healthcare supply chain during pandemics.

Once the operational definition of healthcare supply chain resilience has been established, developing a comprehensive theoretical framework becomes crucial. This framework will enable a deeper understanding of how various inter-organisational elements and effective leadership significantly enhance healthcare supply chain resilience. To fulfil the two research objectives mentioned above, I have formulated initial research questions that will be thoroughly explored in Chapters 4 and 5. In pursuit of first research objective, I have identified two specific research questions, which have been extensively addressed in Chapter 4:

RQ1 What are the enablers of healthcare supply chain resilience?

To investigate the enablers of healthcare supply chain resilience, I meticulously reviewed relevant literature and conducted an exploratory study using the DELPHI approach. Through this process, I aimed to gain a comprehensive understanding of the significance of these enablers in promoting resilient health care.

RQ2 How are these enablers interlinked?

To address "how" the enablers are interrelated, I have employed a graph theoretic approach to comprehend their interrelationships and comprehensively explain their impact on healthcare supply chain resilience.

Chapter 5 of the thesis extensively explores the second research objective. This chapter is firmly based on positivism and employs a deductive approach. The guiding research questions that help address the second research objective are discussed below.

I drew upon the relational perspective extensively covered in the following chapters to comprehend visibility and trust's impact on collaboration. As the discussion progresses, the layers of understanding become more apparent. I then set out to answer the following question:

RQ1' What are the distinct effects of visibility and swift trust on collaboration?
RQ2' How does collaboration affect the resilience of healthcare supply chains?

To gain deeper insight into crisis leadership's impact, I have formulated the following question:

RQ3' How does crisis leadership influence the link between collaboration and resilience?

I have incorporated Figure 1.8 to provide a clearer insight into the primary goals and research inquiries. This visual aid effectively encapsulates the fundamental aspects of the research objectives and the associated guiding research questions.

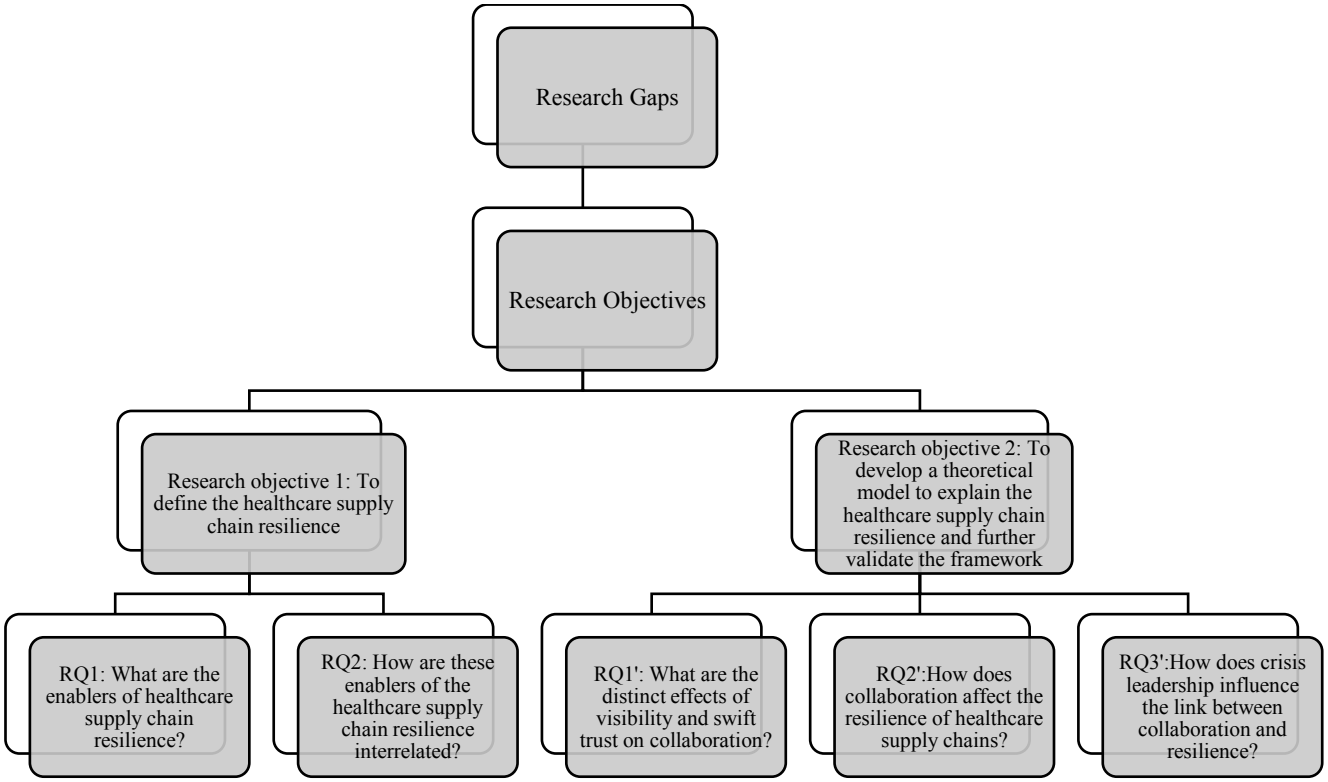


Figure 1.8: Research gaps, objectives and questions
(Source: Author's work)

1.5 Delimitations

The delimitations of a study are crucial in defining its parameters. It is essential to clearly distinguish between the scope and delimitations, as these terms are often used interchangeably. The scope can be broadly categorised into two types: general scope and specific scope. On the other hand, delimitations can be further classified into conceptual and operational aspects of the study, providing a clear framework for the research. In my thesis, I intend to elucidate that the research is centred on the healthcare sector, specifically analysing how the COVID-19 pandemic has impacted the conceptual framework and operational dynamics of the healthcare supply chain. This exploration is critical to comprehending the evolving challenges and adaptations required within the healthcare logistics and delivery systems due to the unprecedented global health crisis. I delved into various sources focusing on supply chain and resilience in the literature review. Throughout the development of my questionnaire, I took considerable care to pretest the language with the assistance of seasoned experts in healthcare

supply chain management. This was done to ensure the questions were pertinent to the specific healthcare context.

Diving deeper into the thesis, I dedicated it to exploring the experiences of developing countries. To facilitate this, I carefully selected my survey samples from hospitals and clinics in India. For the pretesting process and the subsequent DELPHI study, I made a concerted effort to assemble a panel of experts representing both developing and developed countries. By doing so, I aimed to establish a consistent line of arguments at a conceptual level, considering the varying perspectives.

Moreover, to mitigate potential biases, I obtained responses from various professionals, including medical specialists, doctors, nurses, and healthcare procurement managers. This approach allowed me to capture a holistic and well-rounded view of the intricacies of the healthcare supply chain.

In developing the theoretical model and the research hypotheses, I leveraged organisational theory as a foundational framework. Organisational theory was particularly relevant in my case as it provided a comprehensive understanding of how the various elements within an organisation are interconnected. By employing this approach, I conducted a highly detailed investigation into the subject matter. This method gave me many insights into the organisational context's intricate and multifaceted dynamics and relationships. Consequently, it is paramount to approach the interpretation of the study's findings with caution, particularly when considering their implications at the organisational level, as this represents the fundamental focus of the thesis.

1.6 Thesis outline

My thesis has seven chapters (See Figure 1.9). The ***second chapter*** is dedicated to a comprehensive critical analysis of the subject, focusing on the theoretical debates and various

organisational theories. This chapter delves into resolving debates about the theoretical model, selection of variables, application of organisational theory, methodological choices, and the diverse range of findings yielded by the study. Additionally, it explores the choice of research methods and their relevance to the overall study.

The ***third chapter*** presents a comprehensive overview of the research methodology. It thoroughly examines the various research philosophies and their underlying assumptions influencing the study. Furthermore, it provides a detailed analysis of different research approaches and their relevance to the study's context. Additionally, the chapter delves into the intricacies of sampling design, data collection methods aligned with the research objectives, and the selection of suitable data analysis techniques.

In the ***fourth chapter***, my research addressed the research questions RQ1 and RQ2, which aimed to understand the enablers of healthcare supply chain resilience and their interconnectedness within complex settings. To achieve this, I conducted a DELPHI study, a robust qualitative research method designed to elicit expert consensus on a particular topic. The approach I adopted for analysing the findings was interpretive structural modelling (ISM), a widely recognised technique rooted in graph theory that allows for the visualisation and understanding of complex relationships among various factors. By leveraging ISM, I developed a structured model that elucidated the interplay and hierarchy of the identified enablers, shedding light on their relative influence and interaction patterns. Furthermore, I delved into the MICMAC (Matrice d'Impacts Croisés Multiplication Appliquée à un Classement) analyses of the enablers, which provided valuable insights into the driving and dependence power of these factors within the context of healthcare supply chain resilience. This multifaceted approach not only facilitated a deeper understanding of the nature of resilience in healthcare supply chains but also contributed to establishing an operational definition pertinent to navigating the complexities of highly dynamic healthcare environments.

In the ***fifth chapter*** of my thesis, I delved into addressing the research questions RQ1', RQ2' and RQ3'. Utilising the relational view and upper-echelon theory as underpinning frameworks, I meticulously developed a comprehensive theoretical model and derived five research hypotheses. These hypotheses encompassed three direct relationships, a mediation effect of collaboration, and an examination of the moderating effect of crisis leadership.

Furthermore, I elaborated extensively on developing the theoretical framework and the core hypotheses, underscoring their significance within the thesis. A detailed account of the methodology employed in questionnaire development, the operationalisation of constructs, and the crucial pre-testing of the instrument were also provided. In addition, I elucidated the meticulous data collection process, which adhered to Dillman's (2007) total design test method and explicated the approach to mitigating non-response bias. Following the finalisation of data collection, I thoroughly discussed the rationale behind choosing variance-based structural equation modelling and the use of WarpPLS 7.0 for analysis. The culmination of this chapter entailed a comprehensive analysis of the results, spanning psychometric properties tests and an in-depth estimation test.

In ***the sixth chapter*** of my thesis, I delve into a comprehensive discussion centred around the synthesis of the DELPHI study, qualitative interviews, and quantitative analyses of the model. This synthesis has played a crucial role in shaping the theoretical contribution of my research, which stands as a pivotal element of the thesis. By merging the findings from various research methods, I have constructed compelling arguments that contribute significantly to the existing body of knowledge. Furthermore, I dedicate a substantial portion of the discussion to exploring how the amalgamated results can prove invaluable for healthcare staff grappling with crises stemming from short-term and long-term disasters that disrupt the supply chain of essential healthcare items. The implications of these findings for healthcare practitioners are thoroughly examined, emphasising their practical utility in managing such crises effectively. Additionally,

I offer an in-depth analysis of how the study's outcomes can serve as a guiding framework for policymakers operating within the critically important healthcare sector. Given the results' impact on a sector of such vital importance, it is imperative to highlight how they can inform and influence strategic decision-making. I provide a detailed overview of the study's limitations and an extensive list of opportunities for future research that could push the subject matter's theoretical boundaries even further. This roadmap for future research endeavours aims to lay the groundwork for continued exploration and expansion of the insights gained from this study.

In ***the seventh chapter*** of my thesis, I conclude my study by discussing an overview of the research gaps and the way I addressed them. Additionally, I provide a comprehensive reflection on the accomplishments related to my outlined research objectives. I further delved into the transition and personal growth I experienced during my doctoral journey, illustrating the transformative nature of the process.

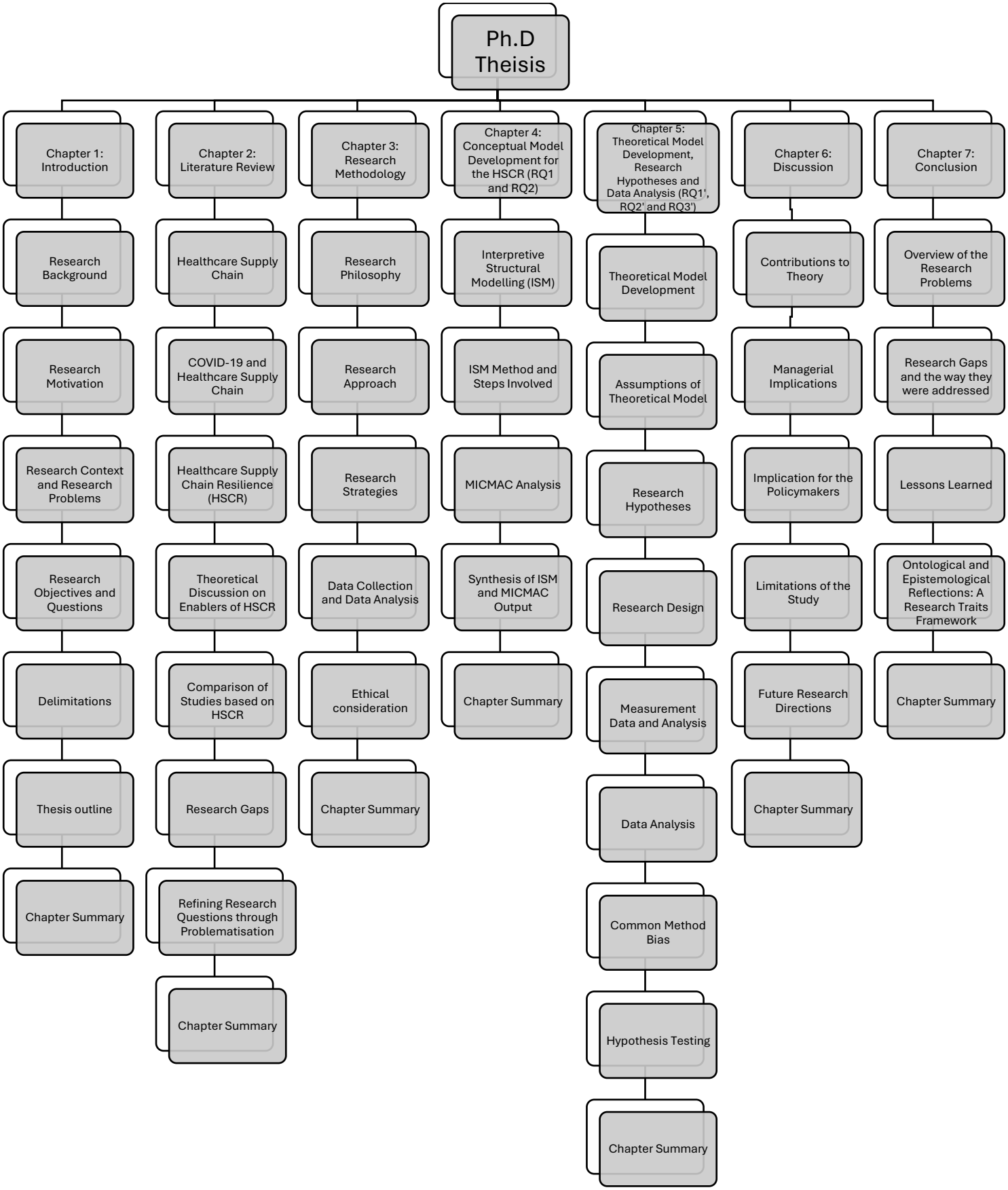


Figure 1.9: Thesis Structure (Source: Author's work)

1.7 Chapter Summary

In the first chapter of my thesis, I established a fundamental framework for the study. This chapter provides an exhaustive outline that elucidates various aspects and contexts of the research. It delves deeply into the background and motivation of the study, meticulously delineating research gaps and objectives while presenting three guiding questions. Additionally, careful attention was given to articulating the study's limitations and presenting a concise preview of each subsequent chapter. Following this foundational chapter, the second chapter embarks on a thorough critical review of pertinent literature.

CHAPTER 2: LITERATURE REVIEW

A comprehensive, free-from-bias search is one of the fundamental requirements for a systematic literature review that helps to differentiate the accurate review process from the traditional review process (Tranfield et al., 2003). I used the well-known scientific literature database (SCOPUS) to conduct a systematic and structured literature review. Scopus database is of significant advantage to users as it is updated daily and offers access to a large volume of the latest information and knowledge repository (Singh et al.,2021). Moreover, it is worth noting that Scopus covers modern materials and is considered to have a more user-friendly interface. Furthermore, other than the renowned journal database, I have utilised reports published by reputable agencies such as WHO, print magazines, and published conference articles in our extensive literature review section. The keywords used for the literature search are '*supply chain'*, '*resilience*', '*supply chain management*', '*healthcare*', '*healthcare resilience*', '*healthcare supply chain*', and '*healthcare supply chain resilience*' to ensure a comprehensive search of available resources in the selected database. Keywords related to COVID-19 were not included in the literature search because doing so significantly reduced the overall volume of relevant literature by 40%. Additionally, literature about COVID-19 was already included as part of our selected search string.

Table 2.1: Search syntax on Scopus Source

Data Source	Search syntax
Scopus Database: December 25, 2023 (https://www.scopus.com)	(TITLE-ABS-KEY (supply AND chain) **AND** TITLE-ABS-KEY (resilience) **AND** TITLE-ABS-KEY (supply AND chain AND management) **AND** TITLE-ABS-KEY (healthcare) **AND** TITLE-ABS-KEY (healthcare AND resilience) **AND** TITLE-ABS-KEY (healthcare AND supply AND chain) AND TITLE-ABS-KEY (healthcare AND supply AND chain AND resilience)) **AND** (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "ch") OR LIMIT-TO (DOCTYPE , "re")) **AND** (LIMIT-TO (LANGUAGE , "English")) **AND** (LIMIT-TO (SRCTYPE , "j") OR LIMIT-TO (SRCTYPE , "b"))

A rigorous method was developed for selecting articles by thoroughly reviewing existing literature and using specific search terms. Initially, 2,269 articles were found in the Scopus database. Then, certain criteria were applied to focus on articles about Healthcare Resilience in the Supply Chain domain published in high-impact peer-reviewed journals, substantially reducing the number to 163 articles. The selection was further refined by limiting the scope to "articles," "book chapters," or "reviews" published in English, resulting in 76 articles. Filtering out conference papers and ensuring the source type was restricted to journals and books led to a final selection of 72 articles. The detailed search syntax is provided in Table 2.1, and the specific inclusion and exclusion criteria are outlined in Figure 2.1.

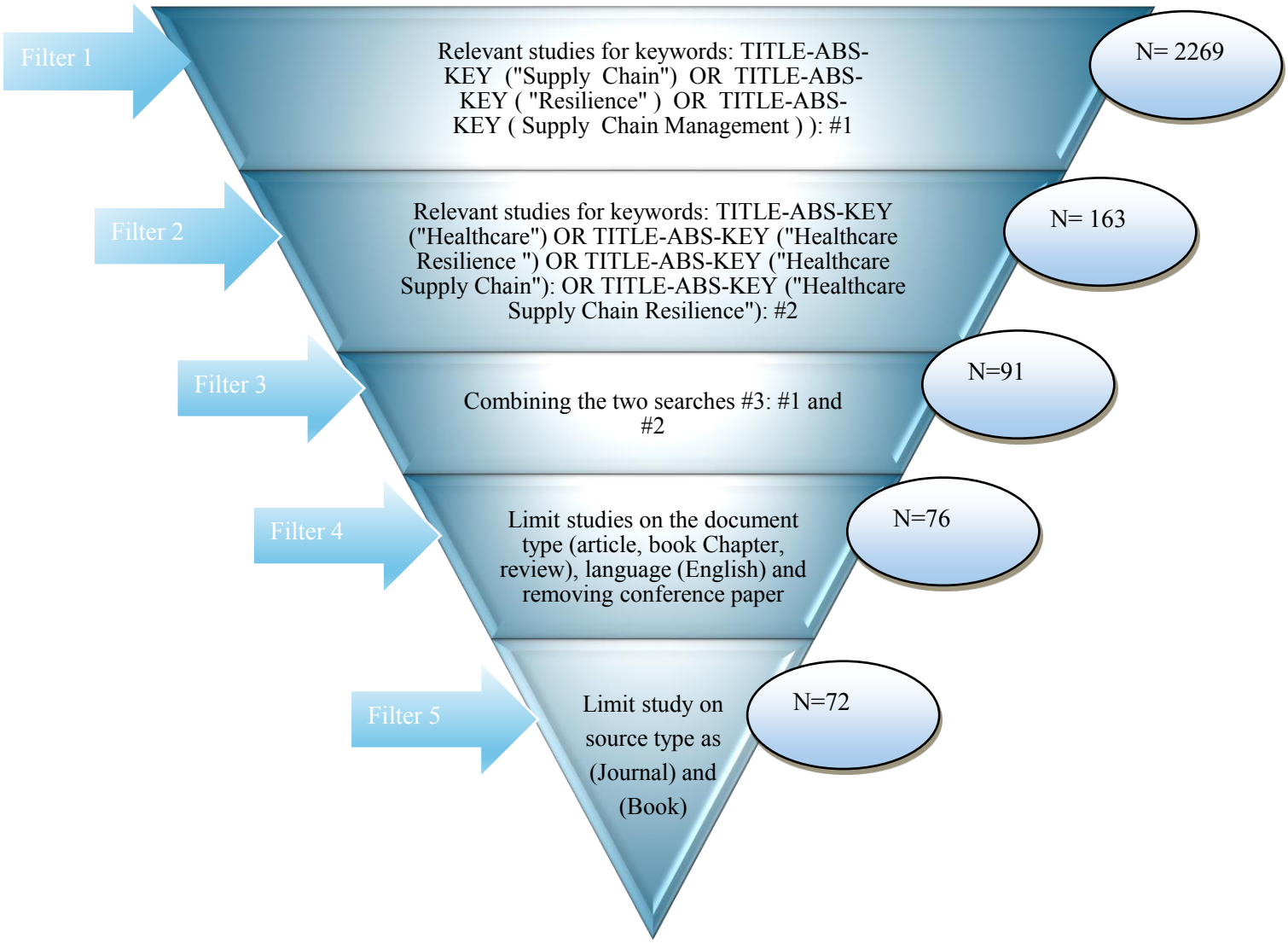


Figure 2.1: Systematic Literature Review (Source: Author's work)

2.1 Healthcare Supply Chain

Healthcare is one of the primary entities ensuring the smooth operations of all activities contributing to the nation's economy (McKone-Sweet et al., 2005; Dobrzykowski & Tarafdar, 2015; Kwon et al., 2016). The governments of all countries significantly invest in their healthcare systems to provide quality patient care. The infrastructure of the healthcare systems often differentiates developed economies from developing economies (Braa et al., 2007). The healthcare supply chain is often considered a complex system (see Figure 3) that manages the flow of products and desired services to fulfil the need of the healthcare service providers to take care of the patient (Polater et al., 2014). The healthcare supply chain is a complex network that involves various stakeholders, including manufacturers, distributors, healthcare providers, and patients, to manage the effective and efficient flow of raw materials and finished products, information, and funds (Bhakoo & Choi, 2013; Tseng et al., 2022).

The stakeholders involved in the healthcare industry cooperate to ensure that the appropriate products and services are delivered at the right place and time while minimising any errors, costs, and waste that may arise (Radnor et al., 2012; Hicks et al., 2015; Moons et al., 2019). The research labs are critical partners as they create the product designs, while the producers manufacture the medical equipment and medicine according to the designs. The distributors then stock these medical devices or drugs and dispatch them to various hospitals and healthcare centres, including pharmacies (Sinha & Kohnke, 2009; De Vries, 2011; Bhakoo et al., 2012; Zamiela et al., 2022). Manufacturers are responsible for producing medical equipment, drugs, and other supplies, while distributors transport these products to their intended destinations (Rossetti et al., 2011). Healthcare providers, such as hospitals, clinics, and pharmacies, use these products to diagnose, treat, and care for patients, while patients rely on these products to maintain their health and well-being (Keskinocak & Savva, 2020). Information and funds flow

throughout the supply chain to facilitate communication, transactions, and stakeholder decision-making (Hastig & Sodhi, 2020).

The healthcare supply chain ensures that patients receive quality care (Lee et al., 2011). By managing the healthcare supply chain effectively and efficiently, stakeholders can improve patient outcomes, reduce healthcare costs, and enhance overall healthcare quality (Senna et al., 2023). This involves optimising the flow of goods and services from manufacturers to patients while minimising waste and inefficiencies (Keskinocak & Savva, 2020). A rich body of literature on the healthcare supply chain provides detailed insights into its workings (Marques et al., 2020). The existing literature outlines the various stakeholders involved in the healthcare supply chain, including manufacturers, distributors, healthcare providers, and regulators (Sawyerr & Harrison, 2023). It also highlights the importance of trust and transparency in ensuring effective coordination among these stakeholders. During emergencies such as the COVID-19 crisis, the importance of trust and transparency becomes even more critical (Love et al., 2021; Golan et al., 2021; Zamiela et al., 2022). The literature suggests effective coordination among stakeholders is crucial for managing the healthcare supply chain during emergencies. This involves sharing information, resources, and best practices while maintaining high transparency and trust. In summary, the healthcare supply chain is a complex system that involves various stakeholders and processes. By managing it effectively, stakeholders can ensure that patients receive quality care while minimising costs and waste. The literature provides a wealth of information on the healthcare supply chain and highlights the importance of trust and transparency in ensuring its effective functioning, especially during emergencies (see Table 2.2).

Table 2.2: Definitions of healthcare supply chain management in selected studies

Author and Year	Definition
Zamiela et al. (2022)	The healthcare supply chain is a complex network of various stakeholders (See figure 2.2) to ensure the availability of suitable materials (medical equipment/ devices/medicine at the right time, at the right place through effective collaboration, information visibility, information sharing, redundancy, and robustness in the entire healthcare supply chain network.
Mathur et al. (2018)	The healthcare supply chain is the process of delivering various products with the involvement of multiple stakeholders to deliver an adequate quantity of products at the right time to the correct receiver to accomplish the needs of the providers.
Kwon et al. (2016)	Healthcare supply chain management is a tool to manage cost-efficiently and enhance the quality of products and services.
Yanamandra (2018)	Healthcare supply chain management is a process that improves business performance and enhances customer satisfaction.
Mandal (2017b)	The healthcare supply chain is a network of various stakeholders that ensures the availability of medical equipment and devices, medicine, and other critical items at the right time and place to improve patient healthcare services.
Poulin (2003); Yanamandra (2018)	Healthcare supply chain management is recognised as a performance metric for procuring and managing, receiving, storing, and renewing inventory.
Sinha & Kohnke (2009)	The healthcare supply chain is a complex network of producers, stockists, distributors, buyers, and financial intermediaries that care

	for healthcare needs. However, for the supply chain to function effectively, the inter-organizational relationships and interdependencies on each other are critical.
Schneller & Smeltzer (2006)	Healthcare supply chain management involves procuring and moving goods and services from the supplier to the final consumer to improve outcomes and simultaneously maintain and control costs in the healthcare sector.
Burns (2005)	The healthcare supply chain revolves around five significant stakeholders: producers, buyers, sellers, product intermediaries, and financial intermediaries.

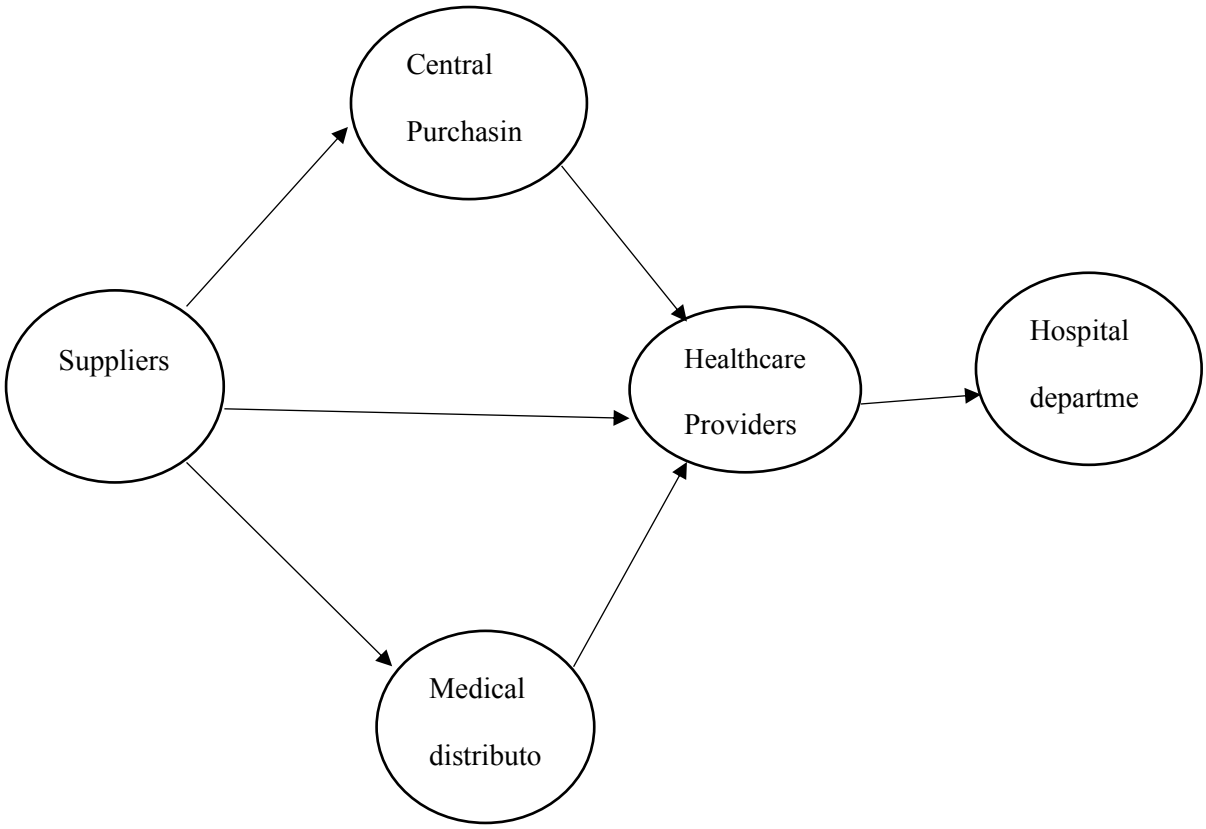


Figure 2.2: Healthcare Supply Chain Network
(Source: Polater et al. 2014, p. 117)

2.2 COVID-19 and Healthcare Supply Chain

The COVID-19 crisis has led to an unprecedented rise in the demand for personal protective equipment (PPEs), ventilators, and some essential drugs such as Azithromycin, Hydroxychloroquine, and Chloroquine, sedation medicines, and many others (Berlin et al., 2020). The producers, the distributors, and the pharmacies were not prepared for such a sudden rise in demand, which caused severe strain on the production and global distribution of these necessary items (Fairgrieve et al., 2020; Anderson et al., 2023). Based on the selected literature review, I provide an overview of the root causes of the disruption in the healthcare supply chain (see Table 2.3).

Table 2.3: The root cause of the disruption in the healthcare supply chain during the COVID-19

Causes	Literature
Global dispersion of supply base	Ivanov (2020); Ivanov & Das (2020); Harland et al. (2021); Alam et al. (2021); Pujawan & Bah (2022); Spieske et al. (2022); Hosseini & Ivanov (2022); Sindhwani et al. (2022).
Supply chain complexity	Gunessee &Subramanian (2020); Chowdhury et al. (2021); Flynn et al. (2021); Kovacs & Sigala (2021); Spieske et al. (2022)
Lack of visibility	Scala & Lindsay (2021); Ivanov (2021); Sodhi &Tang (2021); Kovacs & Sigala (2021) ; Dohmen et al. (2023).
Lack of trust	Scala & Lindsay (2021); Schumacher et al. (2021); Orlando et al. (2022); Zamiela et al. (2022) ; Hossain et al. (2023)
Poor coordination	Harland et al. (2021); Finkenstadt & Handfield (2021 b); Hu (2022) ; Xu et al. (2023)
Poor leadership	Van Hoek (2020) ; Alam et al. (2021) ; Harland et al. (2021); Sodhi et al. (2021); Falcone et al. (2022) ; Bag et al. (2022) ; Snowdon & Saunders (2022)

2.3 Healthcare Supply Chain Resilience

Due to globalisation, supply chains are vulnerable to disruptions (Juttner & Maklan, 2011; Chowdhury & Quaddus, 2016). The past few decades' disruptions have caused severe economic losses (Sodhi et al., 2012). External factors such as natural disasters (Craighead et al., 2007), global outsourcing (Bakshi & Kleindorfer, 2009), short product lifecycle (Sodhi, 2005), and pandemics (Craighead et al., 2020) have further increased the risk exposure of the supply chain (Sodhi & Tang, 2021). Hence, to reduce such fragilities in the supply chain, scholars have proposed to build "*resilience*" (Sheffi, 2005; Ambulkar et al., 2015; Scholten et al., 2020).

Following COVID-19, the healthcare supply chain faced enormous strain, severely affecting the quality of the healthcare services to the patient (Harland et al., 2021; Senna et al., 2021; Zamiela et al., 2022). Hence, in response to the disruptions caused by the COVID-19 crisis, scholars call for building resilience in the healthcare supply chain resilience (see Friday et al., 2021; Spieske et al., 2022). Based on a selected review, I present an overview of the healthcare supply chain resilience enablers (see Table 2.4).

Table 2.4: Enablers of Healthcare Supply Chain Resilience

Source	Antecedents of healthcare supply chain resilience
Furstenau et al. (2022)	• Digital technologies • Collaborative planning • Remote monitoring of inventories • Trust • Sharing of vision and goals
Zamiela et al. (2022)	• Redundancy • Robustness • Collaboration • Supply chain design • Communication capabilities • Supply chain risk management

Spieske et al. (2022)	• Supply chain partnership/ alliance management capability • Public-private partnership • Coordination among various partners • Visibility • Improving interdependencies • Improving trust
Harland et al. (2021)	• Coordination/collaboration • Organization and maturity • Individual professionalism • Digitalisation • Adaptability • Commitment • Design for vulnerabilities
Scala & Lindsay (2021)	• Improving visibility in the supply chain network • Collaboration among the key stakeholders

	• Redundancy in the supply chain
Bag et al. (2021)	• Big data analytics capability • Innovative leadership • Supply chain innovation • Responsive supply chain
Senna et al. (2021)	• Buffer inventory • Multisourcing • Agility • Effective communication • Crisis respondent team • Employees cross-training • Supply chain risk culture • Alternative modes of transportation
Chakraborty (2018)	• Trust • Communication

	• Interdependence • Transparency • Co-creation activities
Mandal et al. (2017b)	• Organisational culture • Technology orientation

Based on the review of articles, I classify the enablers of the healthcare supply chain based on the Resource-Capability (R-C) framework (see Kamoche, 1996, p. 214). The resource-capability framework has been developed by combining the resource-based view (Barney, 1991) and the dynamic capability view (Teece et al., 1997) (see Figure 2.3, p. 56).

2.3.1 Resource-Capability (R-C) Framework

The R-C framework is a practical approach that organisations can use to manage their resources and capabilities. It involves mapping out a company's resources and the corresponding capabilities that these resources can enable. The framework helps organisations identify gaps in their resource and capability allocation and make informed decisions on allocating resources effectively to achieve strategic goals. By leveraging the resource capability framework, companies can optimise their resource utilisation, minimise waste, and enhance their overall organisational performance. Next, we discuss the importance of the resources and capabilities essential for building resilience in the healthcare supply chain using three popular views: *resource-based view (RBV), dynamic capability view (DCV) and resource dependence theory (RDT)*.

2.3.1.1 Resource-Based View (RBV)

The R-C framework discusses different resources and capabilities (R-C) that help organisations gain a competitive advantage (Hall, 1993). This section delves into the resource-based perspective (RBV) concept and its significance in creating a competitive advantage (Barney, 1991; Peteraf, 1993). RBV is a widely used approach that explains how an organisation’s resources and capabilities can be leveraged to achieve a sustainable competitive advantage (Hitt et al., 2016). According to Barney's (1991) framework, a resource can be defined as any tangible or intangible asset that enables a firm to improve its efficiency, effectiveness, or both. On the other hand, capabilities are the firm's ability to coordinate, integrate, and deploy resources to achieve a desired outcome (Ravichandran et al., 2005). By analysing their resources and capabilities, firms can identify the sources of their competitive advantage and

develop strategies to enhance their value proposition. This, in turn, helps them to stay ahead of their competitors and maintain their market position.

Healthcare resilience is the ability of healthcare systems to withstand and recover from shocks or disruptions while continuing to provide essential services (Hanefeld et al., 2018). It is developed through a combination of resources and capabilities, which include adequate staffing, infrastructure, medical supplies, technology, and financial resources. (Behrens et al., 2022). A resilient healthcare system can adapt to changing circumstances, maintain quality of care, and effectively respond to emergencies and crises (Taherkhani et al., 2022). In this section, I provide a comprehensive and detailed classification of the various types of resources that are of utmost importance for building a resilient healthcare supply chain. These resources can be broadly classified into two major categories, tangible and intangible. The tangible resources refer to the physical assets such as medical equipment, vehicles, warehouses, distribution centres, etc., which are crucial in ensuring the smooth and uninterrupted flow of medical supplies across the supply chain. On the other hand, intangible resources, including information sharing, communication, trust, training, and commitment, are essential for ensuring the resilience of the healthcare supply chain in the face of unforeseen challenges and disruptions.

"*Capabilities*" are about a more complex and advanced concept that is not just a simple combination of resources (Brandon-Jones et al., 2014). Capabilities are developed by combining and integrating different resources, such as skills, knowledge, technologies, systems, and processes, to create an organisation's unique and valuable advantage (Lichtenthaler & Lichtenthaler, 2009). Capabilities are about having the resources and knowing how to achieve specific goals and outcomes effectively (Gold et al., 2001). Therefore, developing capabilities requires deeper strategic thinking, planning, and execution than acquiring or utilising individual resources. Building a resilient supply chain is of utmost

importance in the healthcare industry. To achieve this, three key factors are considered crucial: supply chain visibility, digital technologies, and alliance management capability (Harland et al., 2021; Spieske et al., 2022).

Supply chain visibility refers to tracking and monitoring the movement of goods and materials through the supply chain (Barratt & Oke, 2007; Brandon-Jones et al., 2014)). This allows healthcare organisations to identify and proactively prevent potential disruptions (Harland et al., 2021). Organisations can make informed decisions and respond quickly to changes by clearly viewing the supply chain.

Digital technologies play a significant role in enhancing the efficiency and effectiveness of the healthcare supply chain (Furstenau et al., 2022). Through technologies such as automation, artificial intelligence, and the Internet of Things (IoT), healthcare organisations can streamline their supply chain processes, reduce errors, and improve overall supply chain performance.

Alliance management capability refers to collaborating and managing relationships with suppliers, distributors, and other partners in the supply chain (Spekman et al., 1998; Schreiner et al., 2009; Dubey et al., 2021a). By building strong alliances and partnerships, healthcare organisations can ensure a reliable and resilient supply chain that can withstand unexpected disruptions. Therefore, healthcare organisations need to prioritise these three factors to build a resilient and sustainable supply chain that can meet the needs of patients and healthcare providers.

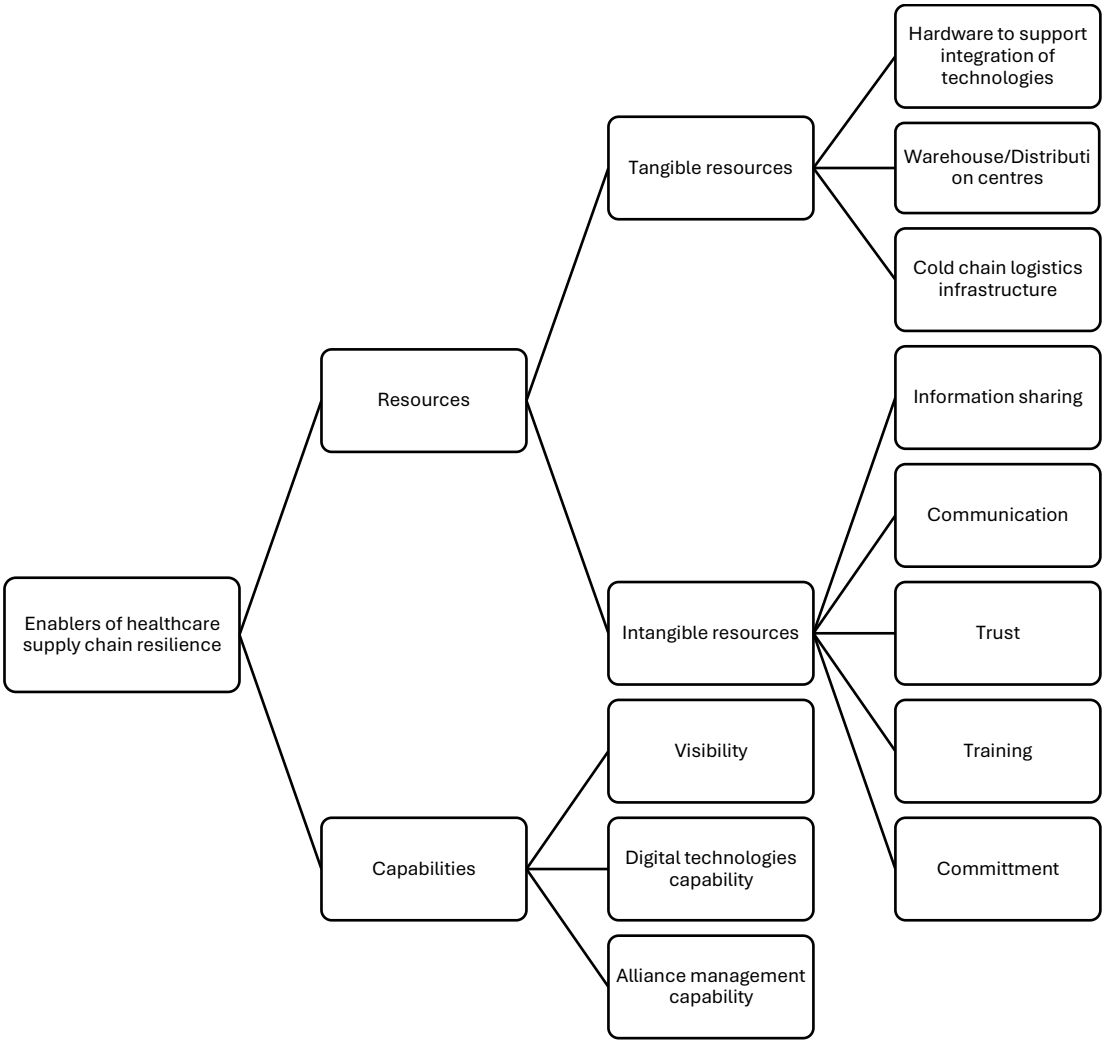


Figure 2.3: Resource-Capability framework of the enablers of Healthcare Supply Chain Resilience (Source: Author's work)

2.3.1.2 Dynamic Capability View (DCV)

In this section, I will discuss the concept of dynamic capability, which refers to the ability of an organisation to adapt to changing environments (Teece et al., 1997; Teece, 2007). The dynamic capability view is a theoretical framework that suggests organisations can develop and leverage their dynamic capabilities to achieve a competitive edge in the market (Eisenhardt & Martin, 2000). This approach involves identifying and cultivating dynamic capabilities, an organisation's ability to adapt and respond to changing market conditions and customer needs (Schilke et al., 2018). Building dynamic capabilities requires a combination of resources,

processes, and knowledge, all of which can be developed over time (Salvato & Vassolo, 2018). Once these capabilities are in place, organisations can improve their performance and gain an advantage over their competitors (Teece, 2007). By leveraging their dynamic capabilities, organisations can respond quickly to changes in the market, innovate to meet emerging customer needs and sustain their competitive edge over the long term (Salunke et al., 2011). I will specifically focus on classifying resources and organisational capabilities during turbulent times. According to Teece (2007), organisations must sense opportunities or threats and transform their existing resources and capabilities to build resilience in the healthcare supply chain. This means that healthcare organisations need to be able to identify potential challenges and opportunities in their environment and then restructure their resources and capabilities to address those challenges and capitalise on those opportunities.

In the healthcare industry, this could mean identifying new technologies or approaches to patient care or developing new partnerships and collaborations to improve supply chain resilience (Mandal, 2017b). By doing so, healthcare organisations can better prepare themselves for the unexpected and ensure the continued provision of high-quality patient care (Junaid et al., 2023). In summary, classifying resources and organisational capabilities and transforming them in response to changing environments is crucial to organisational resilience in the healthcare industry.

2.3.1.3 Resource Dependence View

Recently, resource dependence has been the topic of significant interest and discussion, particularly in the ongoing crisis (Craighead et al., 2020; Nandi et al., 2021). This concept refers to the extent to which an individual, organisation, or country relies on external resources to meet their needs and achieve their goals (Pfeffer, 1987; Hillman et al., 2009). Resource dependence can take many forms, including dependence on strategic resources for economic growth, dependence on foreign markets for trade, or dependence on technology for innovation

(Schuster & Holtbrügge, 2014). The current crisis has highlighted the vulnerability of resource-dependent systems and the need for diversification and resilience in the face of unexpected shocks (Yuan et al., 2022). As such, resource dependence has become a critical study area for policymakers, academics, and practitioners alike.

During a crisis, public healthcare decision-makers and healthcare providers often face challenges in meeting the demands of the healthcare supply chain (Sengupta et al., 2021). To address this, they form alliances and work together to strengthen the resilience of the healthcare supply chain (Friday et al., 2021; Spieske et al., 2022). This collaboration involves adopting a resource-dependence perspective, identifying critical resources and dependencies, building redundancy, and developing contingency plans to mitigate risks (Gebhardt et al., 2022). By working together, public healthcare officials and healthcare providers can improve the efficiency and effectiveness of the healthcare supply chain, ensuring that critical resources are available when they are most needed (Chen et al., 2023).

To summarise, I discussed three well-known theoretical lenses that can be utilised to comprehend the role of the resource and capability framework in understanding healthcare supply chain resilience. This framework is crucial in ensuring that the healthcare supply chain can withstand and recover from disruptions caused by unforeseen events or disasters. With the help of these theoretical lenses, we can gain a deeper understanding of the various resources and capabilities necessary to maintain the resilience of the healthcare supply chain. By doing so, we can ensure the uninterrupted supply of essential healthcare products and services, even in the face of unforeseen events.

2.3.2 Healthcare Resilience from Engineering Perspective

The supply chain view is a comprehensive approach that organisations can adopt to understand better their interactions with external members (Wieland & Durach, 2021). This approach

allows organisations to gain insights into how they relate to their suppliers, distributors, and other partners in the supply chain (Spekman et al., 1998). By analysing these connections, organisations can identify areas where they can improve their processes, reduce costs, and enhance their overall performance (Nyaga et al., 2010).

The supply chain view offers a unique perspective that organisations may not have previously considered (Omar et al., 2012). Traditionally, many organisations have focused primarily on their internal processes without paying much attention to their external partners (Robinson & Malhotra, 2005). However, by adopting a supply chain view, organisations can see how their actions and decisions affect other supply chain members (Martin & Patterson, 2009). This can help them make more informed decisions that benefit themselves and their partners.

Overall, the supply chain view is an influential tool that organisations can use to gain a competitive advantage in today's complex and interconnected business environment (Surana et al., 2005; Allred et al., 2011). By understanding their interactions with external members, organisations can optimise their operations, improve their relationships with their partners, and ultimately enhance their bottom line (Hollos et al., 2012).

The supply chain is a crucial aspect of any organisation's operations, as it involves the flow of goods and services from suppliers to customers. However, this process can also expose organisations to a wide range of risks from different sources (Chopra & Sodhi, 2004). These risks may include supplier bankruptcies, supply disruptions, quality issues, and reputational damage (Juttner et al., 2003). In addition, natural disasters, geopolitical events, and regulatory changes can also impact the supply chain and increase the risks (Hu et al., 2013). Therefore, organisations must identify and mitigate these risks to ensure their supply chain's smooth functioning and maintain their reputation and profitability (Dhingra & Krishnan, 2021).

Supply chain resilience has historically been viewed primarily as an engineering discipline (Wieland & Durach, 2021). This approach focuses on designing and implementing solutions to mitigate risks and vulnerabilities in the supply chain (Pavlov et al., 2017; Ivanov et al., 2021). The engineering view of supply chain resilience is an approach that seeks to identify and address the factors that can cause disruptions in the supply chain (Spiegler et al., 2012). This perspective emphasises the controllable factors that can impact critical inflows of the supply chain, such as inventory, transportation, and production (Pettit et al., 2019). By analysing these factors, managers can help businesses develop strategies to mitigate potential disruptions, such as implementing redundant systems or diversifying suppliers (Soni et al., 2014). Furthermore, this approach recognises that disruptions in one area of the supply chain can have a ripple effect throughout the entire system and, therefore, seeks to identify and address those interdependencies (Ivanov et al., 2014; Dolgui et al., 2018). Overall, the engineering perspective on supply chain resilience is valuable for businesses looking to safeguard their operations against unexpected disruptions (Aldrighetti et al., 2021). When we examine the healthcare supply chain through the lens of engineering, there are a plethora of fascinating insights that can be gleaned (Dobrzykowski et al., 2014). For instance, we can delve into the underlying mechanisms that enable the supply chain to remain resilient and robust despite external shocks and disruptions (Devi et al., 2023). We can also explore the various stakeholders involved, their roles and responsibilities, and how they interact with each other to keep the healthcare supply chain functioning smoothly (Khan et al., 2018; Tseng et al., 2022). By analysing the healthcare supply chain's resilience from an engineering perspective, we can identify potential areas for improvement and optimisation, leading to a more efficient and effective system overall (Tavana et al., 2021; Zamiela et al., 2022).

However, recent research has shown that factors beyond engineering can impact supply chain resilience, such as organisational culture, communication, and collaboration (Wieland &

Durach, 2021; Wieland, 2021; Ivanov, 2023; Peters et al., 2023). Therefore, scholars are now exploring other approaches beyond engineering to build more comprehensive and effective supply chain resilience strategies. Organisations can better anticipate and respond to disruptions by considering broader factors, improving their overall supply chain performance and competitiveness.

2.3.3 Healthcare Supply Chain Resilience from Social-Ecological Perspective

Holling (1973) argues that systems have two distinct features that play a critical role in their functioning: resilience and stability. Resilience is a fundamental aspect of any system, which enables it to absorb changes and remain functional despite the disturbances (Ponomarov & Holcomb, 2009). This means a resilient system can withstand shocks and stresses and maintain its functions and structures. On the other hand, stability refers to the characteristics of the system that enable it to return to its original state of equilibrium after facing an initial disturbance (Ponomarov & Holcomb, 2009). Stability is essential in ensuring that the system remains balanced and predictable in the long run, even when it experiences some fluctuations in the short term. In summary, resilience and stability are two complementary properties of a system essential for optimal performance and sustainability. Since the pioneering work of Holling (1973), the concept of resilience has evolved significantly. Several perspectives of ecological resilience have been captured by Westman (1986), including *elasticity*, *amplitude*, *hysteresis*, *malleability,* and *damping* (Ponomarov & Holcomb, 2009, p. 126).

The ecological perspective of resilience focuses on the interdependent relationship between various components of an ecosystem and how they contribute to the system's ability to adapt and recover from disturbances or changes (Westman, 1986; Gunderson, 2000). This perspective emphasises the importance of understanding the complex interactions between organisms, environments, and natural resources in promoting resilience and sustainability (Wieland & Durach, 2021). In an ecosystem, resilience can be viewed as the ability of the

system to maintain its structure and function in the face of disturbances, such as natural disasters, climate change, or human activities (Ungar, 2018). This ability is closely linked to the ecosystem components' diversity, connectivity, and flexibility (Ponomarov & Holcomb, 2009). For example, a diverse ecosystem that includes a variety of species and habitats is more likely to be resilient to stressors, as it can draw on a range of resources and adapt to changing conditions (Allen & Holling, 2010). Similarly, a well-connected ecosystem, with robust networks of interactions between different organisms, can more easily recover from disturbances by sharing resources and information (Seidl et al., 2016). In contrast, ecosystems that lack diversity or connectivity may be more vulnerable to collapse or irreversible damage when faced with stressors (Davoudi et al., 2013). This highlights the importance of promoting resilience at all levels of the ecosystem, from individual species to entire landscapes, to enhance the sustainability and well-being of our planet.

The ecological perspective is a theoretical framework that emphasises the importance of understanding complex systems (Ponomarov & Holcomb, 2009; Wieland & Durach, 2021; Statsenko et al., 2024). When applied to healthcare supply chains, this perspective highlights the interconnectedness of the various components that make up the system, including suppliers, manufacturers, distributors, and healthcare providers (Zamiela et al., 2022). By considering the system, rather than focusing solely on individual components, we can gain a deeper understanding of the factors that contribute to the resilience of the healthcare supply chain (Friday et al., 2021). This includes redundancy, diversity, and adaptability, which can help mitigate disruptions and ensure a reliable supply of critical healthcare products and services (Azadegan & Dooley, 2021). Overall, the ecological perspective offers a valuable lens through which to view the healthcare supply chain and can help us to develop more effective strategies for managing and improving this vital system.

2.3.3.1 Healthcare Supply Chain Resilience from Organisational Perspective

Organisational resilience can be understood as a company's ability to withstand and adapt to changes in its capacities or abilities (Ponomarov & Holcomb, 2009). In other words, resilient organisations can adjust to changing circumstances and adapt their operations accordingly (Chowdhury & Quaddus, 2017). This type of adaptability can be seen as a critical component of organisational success in today's dynamic and ever-changing business environment. By developing and maintaining a resilient organisational perspective, companies can position themselves to better weather challenges and capitalise on opportunities (Burnard & Bhamra, 2011; Hillmann & Guenther, 2021).

In times of crisis, such as a pandemic or natural disaster, the supply chain's resilience becomes critical (Ivanov & Dolgui, 2020). From an organisational perspective, this resilience can be viewed as a dynamic capability that enables healthcare providers to adapt to unforeseen challenges and rapidly respond to emerging needs (Barasa et al., 2018). This capability involves various factors, including quickly identifying and assessing risks, implementing effective contingency plans, and maintaining open communication channels with key stakeholders (Turenne et al., 2019). By developing and refining these capabilities over time, healthcare organisations can enhance their ability to deal with unprecedented crises and ensure that critical medical supplies and services continue to reach those who need them most (Friday et al., 2021).

2.3.3.2 Healthcare Supply Chain Resilience as an Emerging Interdisciplinary Research Stream

Considering recent health crises that have rocked the world, healthcare supply chain resilience has become critical (Spieske et al., 2022). It is essential to ensure that critical medical supplies, equipment, and pharmaceuticals are available when needed, even in times of crisis (Scala & Lindsay, 2021). This requires a comprehensive and interdisciplinary approach involving

stakeholders across the supply chain, including manufacturers, distributors, healthcare providers, and government agencies (Govindan et al., 2020). Effective supply chain management ensures that healthcare systems can respond quickly to crises, minimise disruptions, and continue to provide essential services to patients. In summary, healthcare supply chain resilience is a complex and multifaceted issue requiring careful attention and collaboration from all stakeholders (Zamiela et al., 2022).

Throughout history, scholars have attempted to study resilience from physical and social science perspectives (Ponomarov & Holcomb, 2009). Physical sciences such as biology, chemistry, and physics have explored how resilience manifests in living organisms and how it can be measured and studied (Chave, 2013; Doring et al., 2015). On the other hand, social sciences such as psychology, sociology, and anthropology have focused on how resilience manifests in human behaviour and how social, cultural, and economic factors influence it (Panter-Brick, 2014; Dagdeviren et al., 2016). Despite the different approaches, all these attempts have contributed to a better understanding of resilience and its importance in various fields (Wieland & Durach, 2021).

2.4 Theoretical discussion on enablers of healthcare supply chain resilience

The primary focus of the study is to examine the various factors that contribute to enhancing resilience in the healthcare supply chain, particularly in minimising disruptions caused by the ongoing pandemic. The study explores how these enablers play a critical role in fostering resilience and aims to identify the specific conditions under which these enablers yield varying results. Several scholars, including Harland et al. (2021), Scala & Lindsay (2021), and Spieske et al. (2022), have highlighted the significance of factors such as visibility, trust, leadership, and organisational culture in significantly bolstering resilience within the healthcare supply chain. Furthermore, other scholars have emphasised factors like swift trust, information

visibility, collaborative efforts, and effective leadership during humanitarian or health crises (Prasanna & Haavisto, 2018; Kovacs & Sigala, 2021).

In the healthcare crisis caused by COVID-19, swift trust becomes particularly crucial (Dirani et al., 2020; Kovacs & Sigala, 2021). Unlike in previous disasters, the healthcare staff may not have had the opportunity to build strong relationships with one another (Jewett et al., 2021). This lack of familiarity makes developing swift trust especially important to effectively collaborate and address the challenges posed by the current crisis (Zafari et al., 2020). Swift trust becomes crucial when disaster relief teams are formed voluntarily with no prior acquaintance (Tatham & Kovacs, 2010). This term refers to the rapid establishment of trust among team members despite their lack of familiarity with each other. This trust is essential for effective collaboration and coordination in high-stress and time-sensitive disaster relief efforts (Dubey et al., 2019). To establish trust rapidly, it is essential to prioritise information visibility, particularly during periods of crisis (Mutch, 2015). When individuals have access to accurate and timely information, they are more likely to feel confident and secure in their decision-making (Sadeghi et al., 2024). This visibility fosters a sense of transparency and openness and helps build and maintain trust between all parties involved (Chakraborty et al., 2021; Dubey et al., 2021 b). In summary, it can be argued that the establishment of swift trust, which is the initial trust formed between individuals or organisations without prior experience, plays a crucial role in building resilience in the healthcare supply chain (Schiffling et al., 2020; Bag et al., 2021; Sangal et al., 2024). Additionally, ensuring high information visibility within the supply chain is vital for enhancing its resilience (Brandon-Jones et al., 2014; Sa et al., 2020). These elements contribute to the overall ability of the healthcare supply chain to respond to unexpected disruptions and challenges effectively, ultimately ensuring the continued delivery of essential medical supplies and services (Scala & Lindsay, 2021; Friday et al., 2021; Finkenstadt & Handfield, 2021a).

During times of crisis, collaboration emerges as a direct result of swiftly established trust and transparent sharing of critical information (Wang et al., 2021). Extensive literature has consistently shown an empirical relationship between collaboration and the ability to rebound from challenges (Razak et al., 2023). Collaboration plays a vital role, and the lack of effective collaboration among partners often leads to failures in the supply chain (Mandal & Jha, 2018; Duong & Chong, 2020; Kovacs & Sigala, 2021). In recent years, collaboration within the supply chain industry has become increasingly vital for ensuring efficient and effective operations (Cao & Zhang, 2011; Zhang & Cao, 2018). This shift in focus towards collaboration has been driven by recognising the interconnected nature of supply chain activities and the need for seamless coordination among various stakeholders (Gabler et al., 2017; Min et al., 2019). As a result, companies are emphasising building strong partnerships, sharing information and resources, and working closely with suppliers and distributors to streamline processes and enhance overall supply chain performance (Liu et al., 2020). Hence, it can be argued that collaboration among healthcare partners plays a critical role in strengthening the resilience of the healthcare sector. By working together effectively, healthcare providers, organisations, and institutions can better prepare for and respond to challenges such as pandemics, natural disasters, and other emergencies (Kovacs & Sigala, 2021). This collaboration involves sharing resources, expertise, and information and developing coordinated strategies to ensure a unified and effective response to various healthcare challenges (Gooding et al., 2022). Strong partnerships and collaboration within the healthcare sector are essential for building a resilient and robust healthcare system (Corbett et al., 2022).

During times of crisis, effective leadership is essential for guiding and inspiring individuals and organisations through challenges (Dirani et al., 2020). Strong leadership can significantly affect how well a crisis is managed and overcome (Holge-Hazelton et al., 2021). Effective leadership is critical in guiding organisations and communities through challenges (Caringal-

Go et al., 2021). Crisis leadership involves making quick, informed decisions, maintaining open communication channels, and supporting those affected (Haslam et al., 2021). Effective crisis leaders inspire confidence, display empathy, and demonstrate resilience, ultimately significantly impacting the crisis outcome (Collins et al., 2023). In summary, fostering collaboration among stakeholders and implementing strong crisis leadership are crucial factors in enhancing the resilience of the healthcare supply chain during crises. These efforts ensure the continued delivery of essential medical supplies and services to those in need.

2.5 Comparison of the studies based on the enablers of healthcare supply chain resilience

Healthcare supply chain resilience has gained significant attention in the last decade. However, the COVID-19 crisis has further reinvigorated interest within the operations and supply chain management community (Flynn et al., 2021). Despite a considerable increase in the number of research publications, it is evident that there is a lack of consensus among scholars regarding the key variables that contribute to the resilience of the healthcare supply chain. To provide better clarity, I present an extensive discussion based on literature. In the realm of scholarly research, it is evident that while there are commonalities among scholars in the variables they employ, their approaches to analysing the relationships between these variables show substantial divergence. This divergence encompasses a wide spectrum of differences, ranging from how the variables are categorised and grouped to the theoretical models utilised, contextual considerations, and the various methodological approaches adopted in interpreting and presenting the findings. These aspects will be thoroughly examined and discussed in the subsequent sections.

2.5.1 Resolving Issues Related to Model Development

2.5.1.1 Which variables?

Based on the review, I found a lack of consensus about which variables or enablers should be considered for building the healthcare supply chain resilience. This becomes apparent after reviewing recent studies published in scholarly peer-reviewed journals (Table 2.3). The enablers influencing the healthcare supply chain resilience vary significantly. The enablers identified were *trust*, *visibility*, *leadership*, *culture*, *collaboration/coordination*, *commitment*, *and digitalisation* (Harland et al., 2021; Spieske et al., 2022). On the other hand, Zamiela et al. (2022) found *redundancy, robustness, supply chain design, collaboration, communication capabilities, and supply chain risk management* as the key enablers of healthcare supply chain resilience. Senna et al. (2023) conducted a comprehensive analysis that revealed the critical components of healthcare supply chain management. They emphasised the significance of identifying, assessing, and mitigating risks within the healthcare supply chain. Furthermore, they highlighted the pivotal role of integrating these risk management strategies to develop healthcare supply chain 4.0. This advanced approach is instrumental in enhancing the overall performance of the healthcare supply chain, significantly contributing to the holistic healthcare supply chain resilience framework. After conducting a comprehensive assessment, it is irrefutable that the COVID-19 pandemic has given rise to a multifaceted and intricate healthcare crisis (Kovacs & Sigala, 2021). Effectively managing this situation demands a comprehensive strategy considering the diverse humanitarian needs of affected populations and the intricate dynamics of commercial supply chains, including procuring and distributing essential medical supplies, equipment, and pharmaceuticals (Gotz et al., 2024). In times like a pandemic, it becomes crucial to establish swift trust among collaborators and ensure information visibility (Kovacs & Siagala, 2021). This is essential for facilitating effective and efficient collaboration and ensuring the smooth distribution of necessary healthcare items (Friday et al., 2021). Furthermore, it is essential to recognise that during times of crisis, having

robust and capable leadership is vital to effectively leverage collaboration and ensure the supply chain's resilience (Collins et al., 2023).

2.5.1.2 Guiding Theories

Over the years, scholars have explored a range of organisational theories to analyse the resilience of supply chains. For example, Brandon-Jones et al. (2014) delved into the contingent resource-based view (C-RBV) to investigate how various resources (both tangible and intangible) and capabilities (such as visibility) interact with supply-based complexity to influence the resilience and robustness of supply chains. The contingent resource-based view is a strategic management framework that integrates the resource-based view and contingency theory (Aragon-Correa & Sharma, 2003; Brandon-Jones et al., 2014; Eckstein et al., 2015). This approach seeks to understand how a firm's unique resources and capabilities interact with external environmental factors to achieve a competitive advantage (Aragon-Correa & Sharma, 2003; Tiwari et al., 2024). Despite its widespread popularity, scholars have identified certain limitations associated with this view (Priem & Butler, 2001; Lavie, 2006; Newbert, 2007). These limitations include the theory's tendency to overlook contextual variations and its static nature, which may not fully capture the dynamic nature of competitive environments (Sirmon et al., 2010; Barney et al., 2011). While utilising C-RBV as a theoretical lens, the commercial sector needs to prioritise investments in enhancing visibility, a crucial aspect of building resilience (Brandon-Jones et al., 2014). However, it is worth noting that applying this concept to understand resilience in the humanitarian or healthcare sectors presents significant challenges and necessitates a different perspective (Kovacs & Spens, 2009; Tabaklar et al., 2015; Dubey et al., 2022).

Wieland & Wallenburg (2013) assert that the organisation's ability to effectively communicate, collaborate, and integrate is crucial in establishing resilience within the supply chain. The term "*relational competencies*" encompasses the soft skills and interpersonal abilities that are

essential for establishing and nurturing trust and strong connections among the various partners within the supply chain management process (Wieland & Wallenburg, 2013; Akrout & Diallo, 2017; Durach & Machucha, 2018). These competencies include effective communication, active listening, conflict resolution, empathy, and collaboration (Aggarwal et al., 2005). Clear and open communication is particularly vital in this context, as it facilitates understanding, alignment of goals, and the successful coordination of activities among the partners involved in the supply chain (Lee, 2004). The Wieland & Wallenburg (2013) supply chain resilience framework is based on the relational view (RV). The relational view was introduced by Dyer & Singh (1998) as an extension of RBV, arguing that relational competencies can help organisations gain a competitive advantage. The theory expands the scope of the RBV to include multiple firms engaging in collaborative relationships.

The RV theory suggests that firms' critical and strategic resources may go beyond their boundaries and be part of interfirm resources and routines. Dyer & Singh (1998, p.660), argues that the "*competitive advantage requires focusing on the relationship between firms and identifying four potential sources of inter-organizational competitive advantage: (1) specific assets for a particular relationship, (2) routines for sharing knowledge, (3) complementary resources and capabilities, and (4) effective governance".* The RV offers a unique vantage point for comprehending how different organisations work together during times of crisis to strengthen the resilience of the entire supply chain.

Dickens et al. (2023) delve into an in-depth analysis of the rebound effect within supply chains. They propose a comprehensive approach combining transaction cost economics (TCE) theory and Panarchy theory to illuminate this complex phenomenon. The TCE is an economic framework that seeks to understand the costs associated with transactions between individuals and organisations (Williamson, 2008; Wever et al., 2012). It focuses on the costs incurred in exchanging goods, services, and resources, considering factors such as information asymmetry,

opportunistic behaviour, and the costs of enforcing contracts (Ketokivi & Mahoney, 2020). The theory aims to provide insights into how transaction costs influence the structure of economic systems, firms' boundaries, and the markets' organisation (Bakshi & Kleindorfer, 2009). The Panarchy theory concept is based on the idea that complex systems, such as ecosystems or social systems, are characterised by interconnectedness and interdependence (Dickens et al., 2023). This theory suggests that these systems undergo adaptive growth, accumulation, reorganisation, and renewal cycles. It emphasises the importance of understanding the dynamics of change and resilience within these systems (Holling, 2001; Adobor, 2020). Transaction cost economics and Panarchy theory offer valuable perspectives for analysing how supply chains recover from significant disruptions (Mirzabeiki & Aitken, 2023). Transaction cost economics focuses on the costs associated with making economic exchanges, while Panarchy theory examines the interconnections and dynamics of complex systems (Yin et al., 2024). By applying these theories, we can gain insights into the mechanisms and factors that contribute to the resilience and adaptability of supply chains in the face of severe disruptions. This deeper understanding can inform strategies for mitigating the impacts of disruptions and building more robust supply chain networks.

Chowdhury & Quaddus (2017) provided a thorough understanding of supply chain resilience, emphasising the concept from a dynamic capability perspective. This perspective has gained widespread acceptance among scholars eager to delve into the intricate mechanisms and strategies for fortifying supply chain resilience. Notable contributors to this field include Lee and Rha (2016), Mandal (2017), Yu et al. (2019), Sabahi and Parast (2020), and Ye et al. (2024). The dynamic capability perspective enables organisations to cultivate a keen ability to sense internal and external changes that could disrupt the supply chain. This heightened awareness empowers organisations to prepare for such disruptions proactively. Subsequently,

organisations invest in the capacity to leverage dynamic capabilities to seize opportunities and adapt existing resources and capabilities to respond to unforeseen events effectively.

In our analysis, I found that dynamic capability, resource-based, contingency and relational views have been the primary theories utilised extensively to comprehend the development of resilience in supply chains. In the wake of the COVID-19 crisis, the healthcare supply chain presents a distinctive challenge that compels us to explore beyond the traditional resource or capability framework, which typically focuses on competitive advantage. As a result, in line with Craighead et al. (2020), we should consider delving into other theories, such as resource dependence theory or strategic choice theory, as they might provide valuable insights.

My current study will utilise the relational view and the upper-echelon theory. Previous research utilising the relational view has failed to explain how relational competencies enhance organisational resilience adequately. Consequently, I propose exploring the role of the upper-echelon theory, which emphasises the significant influence of leadership on organisations' overall performance and effectiveness. The Upper-echelon theory, proposed by Hambrick and Mason (1984), posits that an organisation's strategic choices and behaviours are heavily influenced by its top executives' backgrounds, values, and cognitive processes. This theory contends that the highest-ranking managers' vision and perspectives shape the organisation's direction and decisions, ultimately impacting its performance and outcomes.

2.5.1.3 Methodological approaches

The current body of literature shows a noticeable divergence in the methods and approaches employed for data collection. A comprehensive review of existing studies reveals a diverse array of approaches spanning traditional analytical techniques (see Ivanov et al., 2018; Sazvar et al., 2021; Tippong et al., 2022; Yilmaz et al., 2023; Shiri et al., 2024), Multi-Criteria Decision Making (MCDM) methodologies (Zamiela et al., 2022; Lagana & Colapinto, 2022;

Sotoudeh-Anvari, 2022; Pamucar et al., 2023) and Qualitative interview-based approach (see Scala & Lindsay, 2021; Yaroson et al., 2021; Friday et al., 2021; Lusiantoro & Pradiptyo, 2022; Furstenau et al., 2022; Tortorella et al., 2022; Shen & Sun, 2023; Li et al., 2023; Bastani et al., 2023). Qualitative research systematically uses multiple case studies or grounded theory methodology to analyse qualitative data and develop new theoretical frameworks or research hypotheses. The case study offers valuable insights into the intricacies of the healthcare supply chain that were not fully captured by using quantitative modelling approaches. This in-depth analysis sheds light on the complexities and nuances of the supply chain, allowing for a more comprehensive understanding of its operations and potential areas for improvement. In recent years, there has been a notable surge in academic research employing survey-based methodologies in addition to traditional quantitative and qualitative approaches (see Mandal, 2017a,b; Bag et al., 2021; Queiroz et al., 2022; Munir et al., 2022; Senna et al., 2023). This trend reflects a growing recognition of the value of gathering direct input from survey respondents to complement and enrich data analysis and interpretation. Despite the numerous advantages of survey-based research, such as the ability to yield reasonable results with minimal resources (Flynn et al., 1990; Malhotra & Grover, 1998; Forza, 2002; Rungtusanatham et al., 2003), this method has encountered several criticisms. These include concerns about common method bias (CMB), which refers to the potential for systematic error due to the data collection method, and the challenge of establishing causality in survey-based studies (Guide Jr. & Ketokivi, 2015). In considering future approaches, it is essential to recognise each method's unique strengths and limitations. According to Boyer & Swink (2008), a more comprehensive and insightful perspective can be achieved by employing a combination of methods to mitigate the deficiencies inherent in each approach. This approach allows for a more holistic view that is often absent when relying solely on a single method. I have dedicated significant effort to conducting a comprehensive critical analysis of a carefully selected set of

recent studies about healthcare supply chain resilience (see Table 2.5). My primary focus has been identifying and understanding the state-of-the-art methodologies employed in these studies and discerning any existing gaps. This scrutiny has been instrumental in formulating specific research areas that warrant further attention and investigation. The study findings have brought to light a variety of perspectives that offer valuable insights for shaping my research design. These perspectives give me a clear direction on framing my research and effectively addressing the research questions outlined in the next section.

Table 2.5: Methods Used

Reference	Method	Objectives of the study	Findings of the Study	Limitations
Pamucar et al. (2023)	The study uses a mixed-method approach involving qualitative judgment and fuzzy theory to develop a novel decision-making model.	To present a decision-making model for addressing uncertainties leading to acute shortages of face masks and other essential healthcare items.	The study develops a Measuring Attractiveness through a Categorical-Based Evaluation Technique (MACBETH) and a new combinative distance-based assessment method to address the supplier selection problem during the COVID-19 pandemic.	The proposed method's validity is not sufficiently discussed, necessitating validation using a robust approach.
Yılmaz et al. (2023)	Analytical method (two-stage stochastic optimisation model)	To build resilience in medical supply during disruptions	The study aims to create a probabilistic model to understand how organisations can proactively prepare for disruptions.	The study is based on assumptions that may be effective in some cases. It does not explain how the medical supply chain can be resilient during an unprecedented, long-term crisis.

Sazvar et al. (2021)	Case study approach using robust fuzzy optimisation method	To design a sustainable and resilient supply chain for the vaccine distribution	The study proposes a trade-off model between sustainability and resilience, helping managers make decisions in situations where resilience and sustainability act as a double-edged sword.	This study is based on assumptions that may not be applicable to addressing a global phenomenon like pandemics.
Zamiela et al. (2021)	Case study (multiple)	To identify the enablers of resilience in the healthcare supply chain	The study findings suggest that redundancy, collaboration among the key stakeholders, and robustness are the most critical dimensions of resilience.	The study findings are based on the opinions of the selected healthcare professionals drawn from the various organisations that provided medical supplies to hospitals during the COVID-19 crisis. The sample size is low, and the MCDM technique limits the study's generalizability.
Abdolazimi et al. (2021)	Analytical method	To evaluate the impact of the COVID-19	The model developed by the authors was quite effective in	Despite some good results, the study's findings cannot be easily

		outbreak on the healthcare and non-cold pharmaceutical care distribution channels.	reducing the cost and the lead time. Further, the model reduced carbon emissions.	translated to other settings. The study does not provide many insights into how COVID-19 has affected the health staff and how the mortality rate could be reduced.
Hossain et al. (2023)	Interpretive logic	To identify the enablers of the healthcare supply chain and further understand how these enablers are interrelated.	The study found that government intervention and legal dimensions significantly shaped effective healthcare supply chains during the COVID-19 crisis.	The study has its limitations. First, it does not provide many details on how the enablers were identified. Second, the findings are based on a limited response, which limits the scope of the findings.
Govindan et al. (2020)	Analytics method	To develop a decision-support system for healthcare staff under immense stress due to	The findings of the study help tackle different cases based on their severity. In this way, the healthcare staff could reduce the severity of	To categorise the patients, the study only considered fever, tiredness, and dry cough. Secondly, the study adopted expert opinion. However,

		the rapid rise in the cases of COVID-19.	the problem by addressing the patient who needs immediate attention.	expert judgment might lead to cognitive biases.
Tortorella et al. (2022)	Multiple case study approach	To understand the role of digitalisation on the resilience of healthcare organisations.	The study's findings indicate that the supply chain of critical items and patient diagnosis are the most important enablers of healthcare organisations' resilience.	The study suggests some propositions that need to be validated using data. The generalizability of the research findings might limit the scope of the study.
Harland et al. (2021)	This qualitative study is based on interviews with 58 senior public procurement practitioners drawn from central and regional	To understand procurement professionals' main challenges during the COVID-19 crisis to support healthcare organisations.	The study used the Awareness-Motivation-Capability (A-M-C) framework to classify the factors. Based on the interviews, the authors have identified the role of awareness, the level of motivation of the practitioners, and the	The study proposes a framework based on the interviews. However, the model needs to be tested using data to establish further the validity of the constructs and causality of the model.

	governments, NGOs, and professional organisations.		capabilities needed to be developed to tackle such unprecedented crises.	
Sriyanto et al. (2021)	Empirical study	To examine the relationship between the healthcare logistics performance index (HLPI) and COVID-19 cases.	The study found N shaped relationship between the HLPI and the number of COVID-19 cases.	
Ash et al. (2022)	Analytical method	To develop an analytical model to enhance the resilience of the healthcare supply chain in the context of the PPE	The study offers a unique solution for developing procurement strategies for PPE that minimise costs without compromising the service level.	The study has limitations, as it fails to account for the role of other factors, such as trade wars and other government policies, in the supply of PPE.

		shortages caused by the pandemic.		
Mandal (2017)	Empirical method	To develop a theory to explain resilience in the healthcare supply chain.	The study found that the organisational culture under the moderating effect of technological orientation significantly affects the resilience of the healthcare supply chain.	The study utilises cross-sectional data using survey-based instruments. Like any other survey-based study, the study has its limitations.

2.5.2 Research gaps

The current focus of research has been on building supply chain resilience to address challenges arising from man-made or natural disasters. However, the present pandemic is unprecedented, emphasising the necessity for a comprehensive theory to understand healthcare supply chain resilience during pandemics. Such a theory could ensure that the healthcare supply chain is resilient enough to handle future disruptions caused by pandemics. Therefore, it is crucial to conduct more in-depth research to gain insights into the mechanisms of healthcare supply chain resilience during pandemics. This information would be invaluable for developing and implementing strategies to mitigate the impact of pandemics on healthcare supply chains. Craighead et al. (2020) have also highlighted the need for theory-focused research to explore supply chain management issues arising from pandemics like COVID-19. I have identified several research gaps that are worth investigating. The research gaps identified are:

Firstly, the healthcare supply chain relies heavily on trust and visibility to build resilience. While there is broad agreement on this, the existing literature does not delve into how information visibility and swift trust enhance resilience within the healthcare supply chain. This gap in understanding leaves a significant area for further research and exploration.

Secondly, the importance of crisis leadership in leveraging information visibility and swift trust to build resilience in the healthcare supply chain is poorly understood. Although leadership is acknowledged as a key factor in enhancing healthcare supply chain resilience, existing literature does not delve into the specific leadership characteristics involved. Prior studies have examined the direct impact of collaboration and visibility on an individual or organisation's ability to bounce back from adversity. However, there is still a lack of clarity on how these capabilities promote resilience, especially during crises. This underscores the need for further investigation into how and when collaboration and visibility contribute to the cultivation of resilience during challenging circumstances.

The micro-foundation of healthcare supply chain resilience is not well understood. The concept of micro-foundation offers a framework that empowers managers and scholars to effectively navigate and resolve the inherent tension between resilience and sustainability. It provides a nuanced approach to understanding the interplay between these two crucial concepts. It enables stakeholders to make informed decisions and implement strategies that promote long-term viability and adaptability while considering the environmental and social impact. The theory of micro-foundations delves into the intricate details of individual behaviours and decisions within the healthcare supply chain, offering valuable insights into the factors that contribute to its resilience.

Finally, there is a lack of research using a mixed-method approach to enhance the theoretical understanding of healthcare supply chain resilience. Many studies rely on anecdotal evidence, multiple-criteria decision-making tools, or qualitative methods. In the preceding section, we highlighted that the absence of multiple methods frequently limits a comprehensive understanding of intricate subjects such as healthcare supply chain resilience.

I have conducted a thorough critical literature review using the problematisation theory proposed by Alvesson & Sandberg (2020) to identify specific research gaps. These gaps are crucial as they form the cornerstone of my research. Furthermore, I have meticulously refined my research questions by drawing on the framework established by Alvesson and Sandberg (2011). In this process, I conducted a critical evaluation of each assumption that underpins my study. This involved analysing how these assumptions influence the research design and outcomes, ensuring a more robust and comprehensive approach to my investigation. In the following section, I will elaborate on my research objectives and provide the guiding research questions that will shape the direction of my study.

2.6 Refining Research Questions through Problematisation

The pandemic has disrupted the global supply chain, particularly in the healthcare industry. As a result, there is a pressing need to determine the risks associated with the healthcare supply chain and identify methods and insights that can help supply chain managers navigate this new environment. The motivation for this study stems from this need for rapid response. I aim to provide a comprehensive analysis of the risks involved in the healthcare supply chain and identify effective strategies to mitigate these risks. The study will also explore the impact of the pandemic on the supply chain and the measures that supply chain managers can take to ensure the continued delivery of essential healthcare supplies. Literature on epidemics and humanitarian disasters with supply chain and logistics context delivers a rich body of inspiring methods and outcomes (Craighead et al., 2020; Fosso Wamba et al., 2021; Queiroz et al., 2022; Spieske et al., 2022). Hence, the main objectives of this thesis are:

(a) To provide operational definitions of healthcare supply chain management and resilience.

To achieve this objective, I am using an exploratory approach to better understand the various factors that could influence healthcare resilience. To accomplish the first goal, I propose two research questions:

RQ1: What are the enablers of healthcare supply chain resilience?

To effectively address RQ1, I employed a qualitative research approach that specifically focused on identifying the key enablers relevant to the study (Mandal & Deshmukh, 1994). To gather this information, I utilised the DELPHI method, which is a structured technique for collecting expert opinions through multiple rounds of questioning (Durugbo et al., 2021). This approach allowed for a comprehensive exploration of the factors that facilitate the outcomes of interest, ensuring that diverse perspectives were considered in the analysis. The DELPHI study approach, which is a method of forecasting and decision-making based on the input of a panel

of experts (Melnyk et al., 2009; Kwak et al., 2018; Bond et al., 2020; Hohn & Durach, 2021; Bianco et al., 2023). By employing this approach, I aim to develop a comprehensive framework using interpretive methods (see Meredith et al., 1989, p. 309) to establish associations between variables that have not been extensively explored or understood in the existing literature on healthcare resilience. I have provided an in-depth analysis of the DELPHI study in the thesis. This analysis has resulted in the development of a hierarchical framework that offers a detailed micro-foundation for enhancing the resilience of the healthcare supply chain. This framework is thoroughly elaborated in the subsequent chapters, providing a comprehensive understanding of its structure and implications for supply chain management in the healthcare industry.

RQ2: How are these enablers interlinked?

To better understand the interconnections among various enablers, several techniques based on interpretive logic, often referred to as cognitive modelling, can be employed (Irani et al., 2009; Sharma & Kumar, 2023). Notable methods that utilize a graph-theoretic approach include Graph Theoretic Matrix Approximation (Santos et al., 2023), Interpretive Structural Modeling (Warfield, 1974; Farris & Sage, 1975; Mandal & Deshmukh, 1994), Total Interpretive Structural Equation Modeling (Sushil, 2012; Dubey et al., 2017), and DEMATEL (Bai & Sarkis, 2013). I have chosen to adopt Interpretive Structural Modeling (ISM), as it requires fewer iterations compared to other techniques and provides a more effective framework (Pfohl et al., 2011; Yadav & Barve, 2015). However, I acknowledge that the ISM method has its own limitations, which I address in the conclusion section.

(b) To develop and validate a theoretical model to explain how to build resilience in the healthcare supply chain during pandemics.

The second objective that I am referring to is a significant and valuable addition to my current research. The theoretical model I am using is based on the influential work of Sutton & Staw

(1995), which offers valuable insights into model development. As I discussed in the preceding sections, I use the relational view (RV) (Dyer & Singh, 1998) to explain how relational competencies such as information visibility and swift trust among the partners in the supply chain help build effective and efficient collaboration among the partners, further contributing to healthcare resilience. In this case, I build on the Wieland & Wallenburg (2013) study with modifications following the context in which the healthcare supply chain operates. In addition to the gaps I have noted, which is a useful contribution to the relational view, previous studies, including Wieland & Wallenburg (2013), do not explain how these relational competencies will translate into healthcare supply chain resilience. Hence, in such a case, following the argument of upper echelon theory (Hambrick & Mason, 1984), I have introduced crisis leadership as a moderating construct, which I will delve into in the subsequent chapters. I have formulated three specific research questions based on the insights presented by Whetten (1989). These questions are intended to help achieve the second objective of my study, which is to develop a theoretical model to explain healthcare supply chain resilience.

RQ1': What are the distinct effects of information visibility and swift trust on collaboration?

During times of crisis, such as a public health emergency or natural disaster, the ability of partners in the healthcare supply chain to collaborate effectively relies heavily on two key competencies: information visibility and swift trust (Dubey et al., 2021b; Kovacs & Sigala, 2021). Information visibility refers to the accessibility and transparency of crucial data and insights throughout the supply chain (Srinivasan & Swink, 2018). This includes real-time information on inventory levels, demand forecasts, and logistical challenges. When all partners have access to this information, they can make informed decisions and coordinate their efforts more effectively (Barratt & Oke, 2007; Wang & Wei, 2007; Dubey et al., 2021b). Swift trust, on the other hand, pertains to the willingness of partners to trust each other and collaborate quickly, even in the absence of a longstanding relationship (Tatham & Kovacs, 2010). This

type of trust is essential during crises when rapid decisions and actions are necessary, and there may not be time to build traditional trust through repeated interactions (Schiffling et al., 2020). In summary, the healthcare supply chain's ability to respond to crises seems to be greatly influenced by the presence of information visibility and the existence of swift trust among its partners.

RQ2': How can collaboration among partners in the healthcare supply chain enhance supply chain resilience?

During crises, it is crucial for partners to work together to minimise risks and strengthen resilience in the healthcare supply chain (Spieske et al., 2022). Collaborative efforts can include sharing resources, coordinating logistics, and implementing contingency plans to ensure the continued delivery of essential medical supplies and services (Dasaklis et al., 2012; Bealt et al., 2016). By fostering open communication and mutual support, partners can effectively navigate disruptions and maintain the stability of the healthcare supply chain, ultimately benefiting the well-being of patients and healthcare providers (Brodie et al., 2021; Raassens et al., 2022). The establishment of robust healthcare supply chain resilience heavily depends on effective collaboration. Despite the existence of a substantial body of literature on this topic, there still remains a lack of comprehensive understanding within the healthcare industry and this study aims to address this gap.

RQ3': How does crisis leadership influence the link between collaboration and resilience of the healthcare supply chain?

In the previous section, I emphasized the critical role of crisis leadership in managing challenging situations. The third research question seeks to explore the theoretical boundaries of the relational view and its implications. As previously discussed, there is a noticeable gap in the literature regarding the explanation of how relational competencies specifically contribute

to enhancing resilience. In these instances, the significance of crisis leadership becomes even more pronounced. The three research questions collectively contribute to fulfilling the second objective of the study.

2.7 Chapter Summary

I have devoted this chapter to outlining the meticulous approach I employed for conducting a critical review of the literature, utilising a prominent database. Within this chapter, I meticulously categorised the literature into distinct sections, delving into discussions surrounding the underlying theories that significantly contribute to the central debate of healthcare supply chain resilience. Furthermore, I thoroughly examined the theoretical debates pertaining to the study's variables, the theory utilised for analysing complex resilience, and the methodologies employed in previous studies. In addition to this, I meticulously identified potential research gaps and formulated the guiding research questions that underpin the foundation of my study. The subsequent chapter provides a comprehensive overview of the research methodology, wherein I will expound upon the philosophical assumptions that have shaped my study, and deliberate upon the intricacies of my questionnaire design, the identification of experts for the pre-testing of the instrument, and the detailed discussion of the DELPHI study.

CHAPTER 3: RESEARCH METHODOLOGY

This chapter describes the research methodology used in this thesis, following the research onion structure proposed by Saunders et al. (2019) (see Fig 3.1). The research onion is a helpful way to approach methods as it involves various philosophical and practical decisions. The five layers of the research onion discussed are research philosophy, research approach, strategies, data collection, and data analysis. Additionally, the chapter will cover research quality assurance and ethical considerations. Section 3.1 will briefly discuss philosophical stances and research paradigms in business research, followed by the philosophical stance chosen for this thesis. Section 3.2 will justify the chosen research approach. Section 3.3 will explain different research strategies and multi-methods suitability for achieving the objectives. Section 3.4 describes the data collection and analysis. Section 3.5 covers the description of research quality. Section 3.6 presents the ethical considerations of the study. Section 3.7 presents a summary of the chapter.

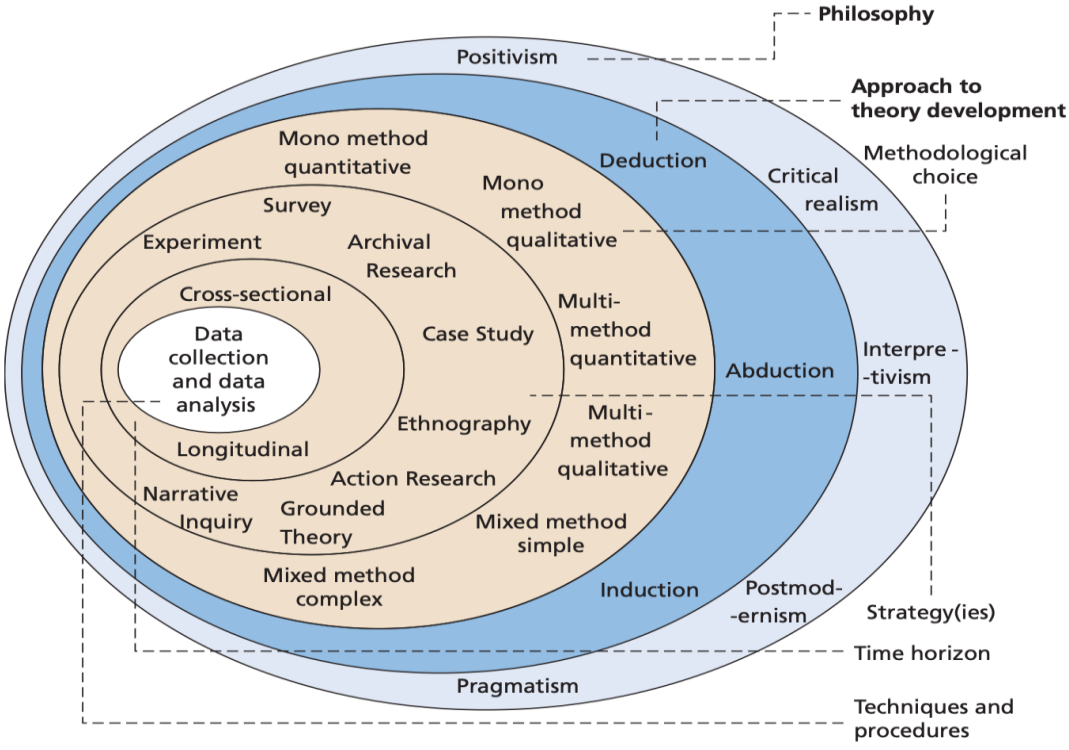


Figure 3.1: Research Onion Framework
(Source: Saunders *et al,* 2015, p. 130).

3.1 Research Philosophy

The research philosophy is "*a system of beliefs and assumptions about knowledge development*" (Saunders et al., 2019, p. 130). Research philosophy is a fundamental aspect of any research project. The assumptions, beliefs, and principles guide a researcher's understanding of complex phenomena. The researcher's philosophical stance shapes their understanding of the research problem and determines the methods they use to investigate it. By comparing different philosophical positions, researchers can gain a deeper insight into the nature of the phenomenon they are studying. Ultimately, the research philosophy provides the foundation for the entire research process, influencing everything from the research question to the data analysis and interpretation.

Saunders et al. (2019, p. 133) identify ontological, epistemological, and axiological assumptions. The *ontological* assumptions shape the way we see and study objects. In my case, the COVID-19 crisis has significantly impacted my way of thinking. Particularly in India during the second wave when I saw most people lose their lives due to the shortages of adequate health infrastructure. This event has significantly influenced me, and I decided to undertake my research to understand how to improve the healthcare supply chain resilience in countries like India and other developing countries where more than 50 per cent of the population still cannot afford or have access to minimum health services.

Epistemological refers to the assumptions about knowledge (Saunders et al., 2019, p. 133) that are valid, acceptable, and legitimate and how one can share or communicate with others. In my context, I relied upon the published data, visual data, narratives, and stories presented by various local and international agencies, which can be considered legitimate. Thus, the epistemological assumptions further reinforce my ontological assumptions.

Axiology assumptions shape the researcher's ethics and values. The axiological assumptions played a significant role in shaping my choice of topic and data. The healthcare supply chain topic has received relatively less attention from the academic community within developing economies as, in recent times, researchers often shy away from such topics that may attract criticisms from one section of society. However, as a researcher, I am responsible for understanding the causes of many disruptions in the healthcare supply chain and how these issues can be sorted out through scientific research. In totality, three philosophical assumptions embrace those concerning the nature of realities (ontology), human knowledge (epistemology), and the role of values and ethics (axiology). To ensure a robust research design, I have tried to explore and understand the appropriate research philosophy by reflecting on my own beliefs, values, and actions to derive a well-organized and consistent set of assumptions (see Alvesson and Sandberg, 2011; Haynes, 2012), and further trying to understand the different philosophical stances to enhance my creativity to address the research questions that shape my research scientifically.

The choice of the philosophical stance is the most critical aspect as it affects all steps of the research, from the choice of research topics, the formation of research questions and objectives, the approach to theoretical development, and the choice of research methodology research outcomes (Alvesson & Sandberg, 2011; Saunders et al., 2019). Hence, it is essential to be familiar with different philosophical stances and their assumptions (see Table 3.1).

Table 3 1: Different Philosophical Stances (adapted from Saunders et al. 2019, p. 144-145)

Philosophical stance	Ontology (what is the nature of reality)	Epistemology (what constitutes acceptable knowledge)	Axiology (views on the role of values and ethics)	Typical Methods
Positivism (naïve/ direct realism)	One universal truth/reality	Observable and measurable facts with law-like generalisations	Value-free Researcher has an objective stance	Deductive quantitative on a large sample.
Critical Realism	Stratified reality (the empirical, the actual and the real)	Epistemological relativism Facts are socially constructed	Value-laden with acknowledgement of the researcher's bias	Any methods to analyse reproductive and historically situated problems
Interpretivism	Socially constructed reality	Narratives, stories, perceptions, and interpretations are legitimate knowledge.	Value-bound to the researcher. Interpretation of the researcher is the key	Inductive Small sample, in-depth interviews

Postmodernism	Socially constructed reality through power relations; others dominate or silence some realities.	'Knowledge' or 'truth' is determined by dominant ideologies; it is necessary to challenge dominant views to awaken silenced and oppressed ones.	Value-constituted, influenced by the power relation between the researcher and participants	In-depth investigations of anomalies, silences, absences
Pragmatism	Reality is the practical consequences of ideas	'Knowledge' or 'truth' are those that enable successfully action	Value-driven research is instigated and sustained by researchers.	Depending on the research problem and questions, different methods are used.

3.2 Research Approach

I combined qualitative and quantitative research methods (mixed methods) to effectively address the research questions. The research has been designed to achieve two key objectives. The primary objective is to develop a comprehensive theoretical understanding of the resilience of the healthcare supply chain, and for this, I intend to employ the inductive method. The secondary objective involves testing a specific theory within the given context, which will require the using the deductive method to gather and analyse data. This approach will allow for a thorough investigation and in-depth exploration of the research topic to provide valuable insights and contribute to the existing body of knowledge (Saunders et al., 2019).

Boyer and Swink (2008, p. 343) argue that "a body of research made up of a variety of research methodologies is not unlike a diversified portfolio of financial holdings. The collection is more likely to yield highly productive outputs with lowered risks (in this case, lowered risk of biased findings)". As per the findings of Boyer & Swink (2008), it is essential to incorporate mixed methods in research, especially when developing a survey-based instrument to reduce biases. In this context, the qualitative approach is used to operationalise the constructs and ensure that the survey is comprehensive and covers all the necessary aspects. By doing so, researchers can obtain a broader perspective on their research problem and gain insights into the different dimensions of the phenomenon under investigation (Flynn et al., 1990).

Moreover, the study adopts cross-sectional data to further validate the theoretical model and research hypotheses (Flynn et al., 1990; Gupta et al., 2006; Boyer & Swink, 2008). Cross-sectional data is observational data collected at a specific time, allowing researchers to examine the relationships among variables at a given time (Boyer & Swink, 2008). By using cross-sectional data, researchers can test the theoretical framework and hypotheses and determine whether there are any significant associations among the variables being studied. Overall,

combining mixed methods and cross-sectional data helps ensure that the research is comprehensive and reliable and that the results are valid and relevant to the research problem.

In this study, I propose two research objectives (Figure 3.2). The first objective is to develop a comprehensive view of healthcare supply chain resilience following the COVID-19 pandemic. To achieve this, I conducted an extensive literature review to understand healthcare supply chain resilience. However, I found a gap in the literature that did not provide a holistic view of this topic. I utilised the DELPHI study approach to gain a comprehensive understanding of the factors that influence the resilience of healthcare supply chains. This approach involved three distinct phases. During the first phase, I distributed a questionnaire to experts to evaluate the importance of various factors. The questionnaire was designed to identify the most significant factors, and their rankings were determined based on the collective responses of the experts.

The DELPHI approach is regarded as reliable for achieving consensus among experts using questionnaires and controlled feedback (McKenna, 1994; Melnyk et al., 2009). A Delphi study effectively enhances group communication processes (Akkermans et al., 2003; Melnyk et al., 2009; Kembro et al., 2017). This method encourages structured interaction among experts, allowing them to tackle complex problems collaboratively (Akkermans et al., 2003). By employing iterative rounds of questionnaires and feedback, participants can refine their opinions and gradually reach a consensus (Melnyk et al., 2009). This approach not only capitalises on the diverse expertise within the group but also promotes a more comprehensive understanding of intricate issues (Kembro et al., 2017). Ultimately, the Delphi method ensures that various viewpoints are considered, leading to well-rounded solutions (Remus & Weiner, 2010). Therefore, in my study aimed at gaining insights into the relationship among the enablers of healthcare supply chain resilience, the DELPHI approach stands out as one of the best methodologies (Melnyk et al., 2009).

However, the DELPHI technique does have its limitations. One significant challenge is controlling biases, and the divergence in expert opinions can also be a major hurdle—especially in my study (Demlehner et al., 2021). Although I implemented measures to minimise these limitations, they remain substantial and significantly impact the reliability and validity of the research.

I used a structural self-interaction matrix to capture the experts' opinions in the second phase. This matrix allowed the experts to evaluate the relationships between the identified factors and provide a more detailed understanding of how these factors interact with one another. Finally, I conducted in-depth qualitative interviews with experts in the third phase. These interviews gave me a deeper understanding of the factors that influence the resilience of healthcare supply chains and allowed me to triangulate the data with information from relevant literature and expert opinions. The fourth chapter of my research report provides a detailed analysis of the findings from the DELPHI study. This analysis includes a comprehensive overview of the factors that were identified as being most significant and a detailed examination of the relationships between these factors. By utilising the DELPHI study approach, I was able to provide a thorough analysis of the factors that influence the resilience of healthcare supply chains.

To address the second research objective, I conducted a critical review of various organisational theories to determine which theory is best suited to explain the context. I came across influential literature utilising the relational perspective to elucidate supply chain resilience (Wieland & Wallenburg, 2013). However, the study did not explain how communication, cooperation, and integration can influence agility and resilience at the same level. Furthermore, while relational competencies are a source of competitive advantage, the literature did not explain how the leadership component affects the impact of collaboration on resilience, which was a notable gap. I proposed a theoretical model based on a relational view

and the upper-echelon theory to address these gaps. To validate the theoretical model and test the research hypotheses, I chose to use a survey-based approach as it is more convenient in terms of time and accessibility of information.

Overall, this approach enabled me to understand the factors contributing to healthcare supply chain resilience, which is critical for ensuring that healthcare systems can continue operating effectively under challenging circumstances.

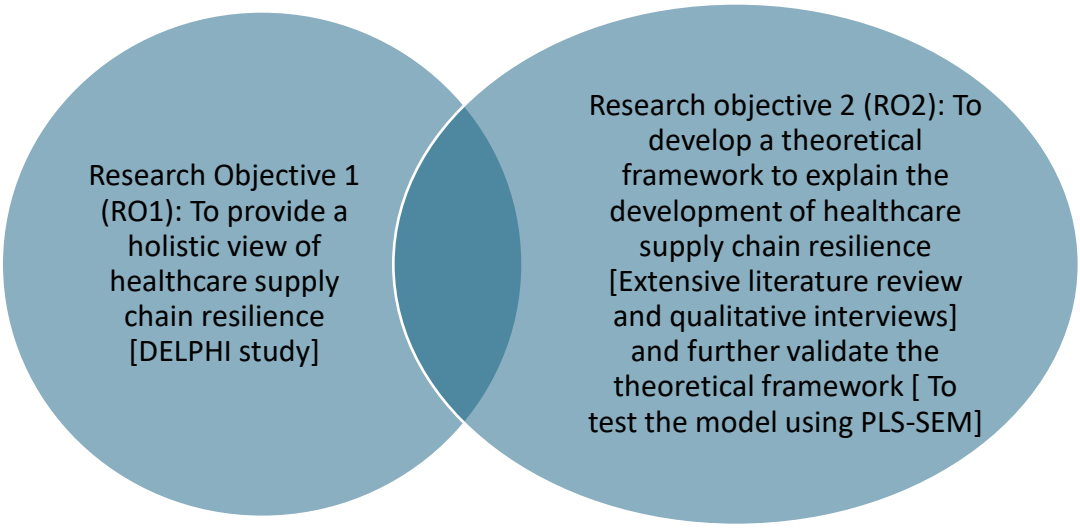


Figure 3.2: Research Approach
(Source: Author's work)

3.3 Research Strategies

When conducting management research, choosing the right research method is important. Saunders and Bezzina (2015) discuss various research methods. I have developed a guide, Figure 3.3, presented on page 99, based on Whetten's (1989) model that incorporates the 5 Ws and 1 H to help researchers choose an appropriate method based on their research questions.

To answer the question "*what*," an extensive literature review should be conducted to identify the variables and constructs used in developing a theoretical model. Exploratory research

methods like in-depth qualitative interviews with experts, focus group interviews, and the Delphi approach can also be used (refer to Whetten, 1989).

When addressing "*why*", it is crucial to understand a few critical things about the study; firstly, why I chose this topic; in the previous section, I explained how my topic was shaped by four philosophical assumptions, namely ontological, epistemological, axiological, and methodological assumptions. The COVID-19 health crisis triggered my interest in the healthcare sector, significantly shaping the developing country's economy particularly focussing on India. However, developing countries like India have healthcare sectors that differ greatly from state to state. For instance, the eastern part of India needs a better healthcare infrastructure than the southern and western parts. These challenges are primarily attributed to poor governance and a fragile healthcare supply chain. Secondly, the literature published about the healthcare supply chain needs to include comprehensive work that helps to understand the challenges faced by the healthcare supply chain in developing countries. Even during COVID-19, there was a significant rise in the literature, but most of the studies offered anecdotal evidence or lacked theory-focused studies. Thirdly, my motivation to undertake this study was further shaped by its potential impact. The study has significant social and economic implications, which further directed me towards the study. Finally, most of the studies in this field were either based on case studies or survey-based studies, with the multi-method perspective needing to be revised. Therefore, based on these aspects, I chose to undertake a study grounded in the relational view, upper echelon theory, and contingency theory. Following Alvesson and Sandberg's (2011) suggestions, I critically challenged the assumptions made in the existing body of knowledge. For example, one assumption is about the translation of relational competencies into resilience, which is a topic that requires further investigation. Despite having similar infrastructure, some states have significantly different mortality rates, raising questions about the factors contributing to healthcare supply chain resilience. To

address these limitations in the existing literature, a critical approach was adopted to carefully debate each argument and gain a deeper understanding of the factors contributing to the resilience of the healthcare supply chain. The aim was to thoroughly examine the existing literature and identify gaps in knowledge, which would then be used to develop a more comprehensive study model.

To provide a more detailed response to the question of "*when*", it is necessary to explore deeper into the previous arguments about the specific conditions that allow relational competencies to enhance the resilience of the healthcare supply chain. This perspective is based on the contingency theory, which posits that the effectiveness of relational competencies is contingent upon several factors unique to the healthcare industry. These factors include but are not limited to the nature of the healthcare supply chain, the types of organisations involved, and the cultural and political context in which healthcare is delivered (Sousa & Voss, 2008). By considering these factors, we can better understand relational competencies' role in building healthcare supply chain resilience and identify the most effective strategies for leveraging these competencies to improve patient healthcare outcomes.

To provide a more comprehensive understanding, let us look at my study's key participants (*Who*). The healthcare sector is a complex, multifaceted network of actors with distinct roles and responsibilities. Healthcare staff are crucial in providing medical care and patient support, whereas pharmaceutical companies are responsible for developing and manufacturing drugs and medications. In addition, healthcare item manufacturers, including producers of personal protective equipment (PPE) and oxygen cylinders, play a critical role in ensuring the safety and well-being of healthcare workers and patients. Distributors and retailers help distribute and supply these essential items. Government organisations and professional bodies work to regulate and oversee the healthcare sector, ensuring that patients receive the highest standard of care. Finally, patients are key participants in the healthcare sector, as they are the ultimate

beneficiaries of medical care and support. By understanding these key participants' roles and responsibilities, we can better understand the healthcare sector and the factors contributing to its overall success. In the present study, I researched healthcare staff working in various hospitals. The study sample comprises doctors, nurses, OPD (Outpatient Department) staff, and purchasing managers responsible for procuring healthcare items in the hospital. These individuals have been on the frontlines of the COVID-19 crisis and have played a key role in mitigating its impact on the healthcare system. They have witnessed first-hand the challenges posed by the pandemic and how it has affected their work and colleagues. During the study, I had the opportunity to interact with these healthcare staff and gain insights into their experiences. They shared their thoughts on how the COVID-19 crisis created panic among the team and how they overcame it with time. They also spoke about the various measures implemented by hospitals to ensure the safety of both patients and healthcare workers, as well as the challenges faced in procuring essential healthcare items during the pandemic. Overall, the study illuminates the experiences of healthcare staff during the COVID-19 crisis and provides valuable insights into the pandemic's impact on the healthcare system.

The subsequent question (*Where*) pertains to selecting samples for the study and its underlying rationale. I have chosen experts from hospitals in the USA, UK, France, and India for the qualitative interviews and focus group. The decision to select these countries was based on the study conducted by Filip et al. (2022), which recommended one of these four nations as a relevant source for the study. Moreover, I selected experts from these countries based on their availability, although it is essential to note that this selection criterion may limit the broader generalisation of the study's findings. For the survey-based data, I selected India as the country of focus. The rationale behind this decision was that India is a large and diverse nation with a unique healthcare practice and outcome perspective. Therefore, the samples from India can provide a better understanding of the research question. It is essential to mention that the

selection of India as the focus country does not imply that other countries are irrelevant but that India is particularly relevant to our study.

To validate the model theoretically, the researchers must choose suitable statistical tools based on the nature of the data. This relates to the third research question, which is "*How*." In my study, there are two stages. One of my research objective is to comprehensively understand the various factors that contribute to the resilience of the healthcare supply chain. To achieve this, I explored how these factors are interconnected and establish the nature of their interdependent relationship. The reason for this investigation is that the existing literature on this topic needs to provide more insights into the interconnectedness of these factors. Therefore, by gaining a more detailed understanding of the interdependency of these factors, we can develop more effective strategies to enhance the resilience of the healthcare supply chain, especially in the face of unexpected disruptions or crises. To achieve this, I adopted a graph theoretic approach known as Interpretive Structural Modelling (Warfield, 1974; Janes, 1988; Attri et al., 2013). Secondly, to further validate the model and test the research hypotheses, I used variance-based structural equation modelling (PLS-SEM) (Peng & Lai, 2012; Sarstedt et al., 2020; Sarstedt et al., 2022). In the next section, I will discuss the reasons for choosing PLS-SEM over other methods in depth.

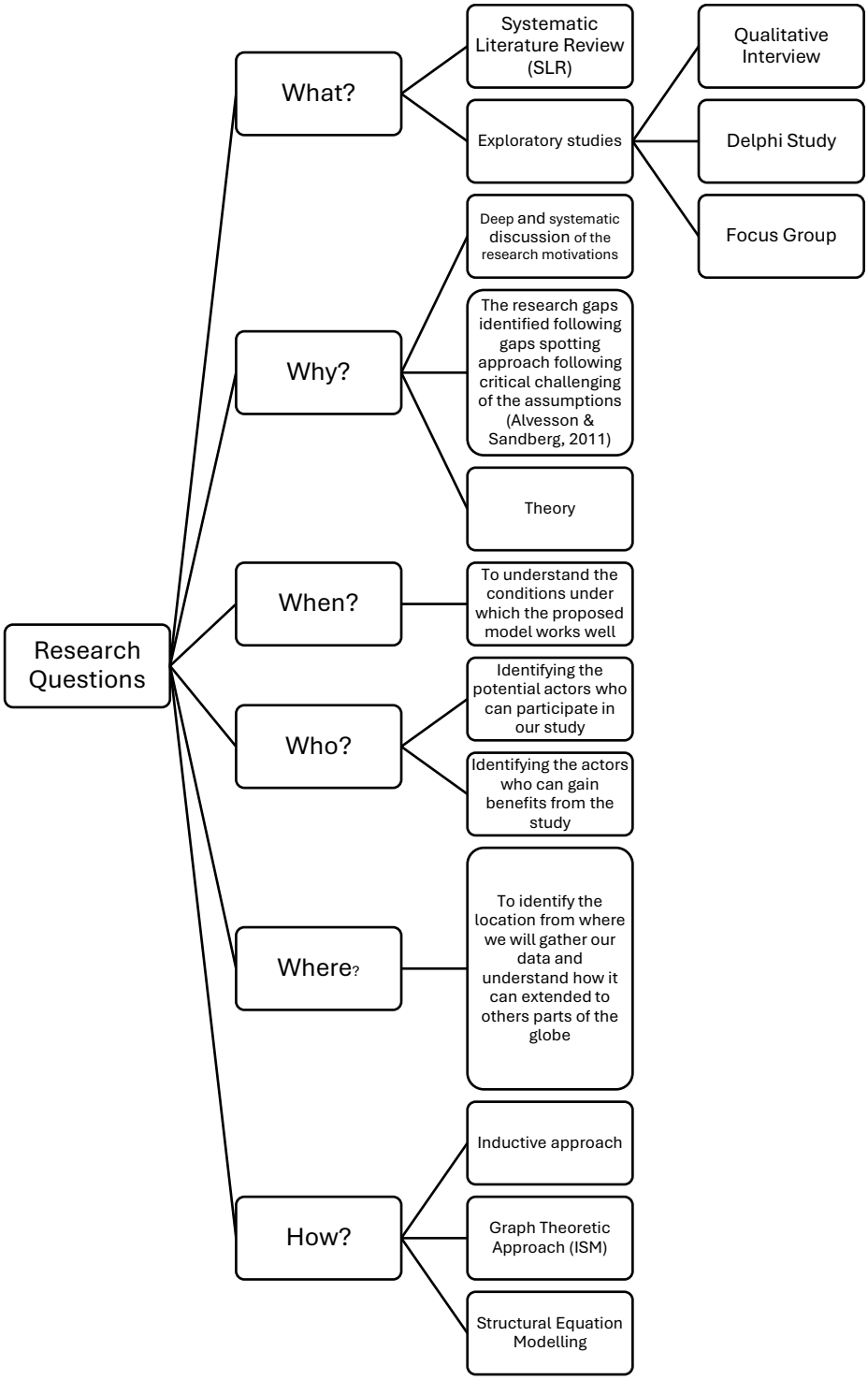


Figure 3.3: Research Strategies
(Source: Author's work)

Table 3.2: A summary of theories used in the healthcare supply chain management literature to examine the enablers

Theory	Scope of application	Unit of analysis	Example articles
Organisational Information Processing Theory (OIPT) (Galbraith, 1974)	Firms must organise and use information effectively, especially when they execute tasks involving high uncertainty levels.	Firm	Bag et al. (2021)
Dynamic Capability View (DCV) (Teece et al., 1997)	Dynamic capabilities thus reflect an organisation's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions.	Firm	Mandal (2017)
RBV (Barney, 1991)	To underline VRIN resources (e.g., collaboration, employee skills) as facilitators of circular economy achievement.	Firm	Mandal (2018)
Relational View (Dyer & Singh, 1998)	It argues how a group of firms or networks can sustain a competitive advantage through collaborative efforts.	Intra-organisational relationship (multiple firms or networks)	Chen et al. (2013); Dobrzykowski et al. (2015) ; Mandal & Jha (2018)

Upper echelon theory (Hambrick & Mason, 1984)	The role of top managers or leaders in shaping business strategies.	Firm or Intra firm	Bag et al. (2021)
Contingency theory (Donaldson, 2006; Sousa & Voss, 2008)	Contingency theory holds that organisations adapt their structures to fit changing contextual factors to attain high performance.	Firm	Zheng et al. (2006) ; Tortorella et al. (2022)

3.4 Data Collection and Data Analysis

At the beginning of my research, I mentioned using three stages to gather data to address the research objectives (see Figure 3.4). To fulfil the first objective, which was to provide a comprehensive and all-inclusive view of the healthcare supply chain resilience, I believe the COVID-19 pandemic offers a unique and fresh perspective to revisit previous healthcare supply chain resilience studies. To achieve this, I conducted an exploratory research study to identify the enablers of healthcare supply chain resilience and further understand their interconnections. To tackle the situation at hand, I employed a methodology known as the DELPHI study. This approach is often considered one of the best ways to gather expert input regarding a particular issue (Mitchell, 1991). The DELPHI study involves multiple rounds of anonymous surveys and feedback, during which experts provide their opinions and insights on the studied topic. This approach ensures that the research findings are informed by the collective knowledge and expertise of the participants, leading to a more comprehensive and accurate understanding of the issue. As part of this round, I administered a comprehensive questionnaire to gather insights into the healthcare supply chain resilience during the COVID-19 crisis. The questionnaire included questions related to the enablers of the healthcare supply chain, and participants were asked to rank these enablers based on their personal experience. The goal of this exercise was to gain a better understanding of the factors that contributed to the resilience of the healthcare supply chain during the pandemic.

In the second stage of my research, I conducted field interviews with senior-level experts from the healthcare sector and senior-level academics with expertise in healthcare supply chain resilience. Each interview lasted between 60 to 90 minutes, providing ample time to dive deep into the topic. In the first part of the interview, I asked the managers to share their views on the relevance of enablers. The experts shared their in-depth views on the relevance of each variable, providing valuable insights into the subject matter. They provided their opinions on the various

enablers, including *trust, information sharing, top management support, use of digital technologies, adaptability, transparency, alignment, awareness, inventory management, agility, accessibility, mutual respect, interdependence, government support, affordability, information visibility, family support, and financial support.*

In the second part of the interview, I scrutinised the study's research hypotheses by asking the experts how critical these variables are for building healthcare supply chain resilience, both in general situations and during the pandemic. I found that the experts had a wealth of knowledge and experience in this area, and they provided detailed and comprehensive responses to my questions. There was considerable agreement on most of the variables. However, in some cases, we found that experts from developed and developing countries had different opinions, which provided exciting insights into our study.

In the third part, I asked the experts to fill out the questionnaire to eliminate ambiguity or double-barrelled questions. This stage helped me to clarify any doubts I had and provided me with additional data to complement the previous interview responses. Overall, the second stage of the research was a critical step in my journey to understanding healthcare supply chain resilience.

In the third stage of my research, I adopted Dillman's (2007) total design test method to collect data and test my research hypotheses. The study population comprised healthcare staff from various departments, including the OPD division, procurement and materials management division, and senior management staff. The study was conducted in privately and publicly owned hospitals across India to test the hypotheses in developing countries. The study's primary objective was to understand how the relational components contribute to the healthcare supply chain resilience, including information visibility, swift trust, collaboration, and crisis leadership. To achieve this, I collected data from a sample of hospitals of different sizes across

India. The sample covered a range of hospitals, from small clinics to large multi-speciality hospitals, to ensure the results represented the entire population.

To collect the data, I used an online survey. I ensured that the questions were clear and concise and that the participants understood them fully. In addition, I followed a rigorous data validation process to ensure the accuracy and reliability of the data collected. Overall, the study provides valuable insights into the healthcare supply chain resilience in India, a developing country.

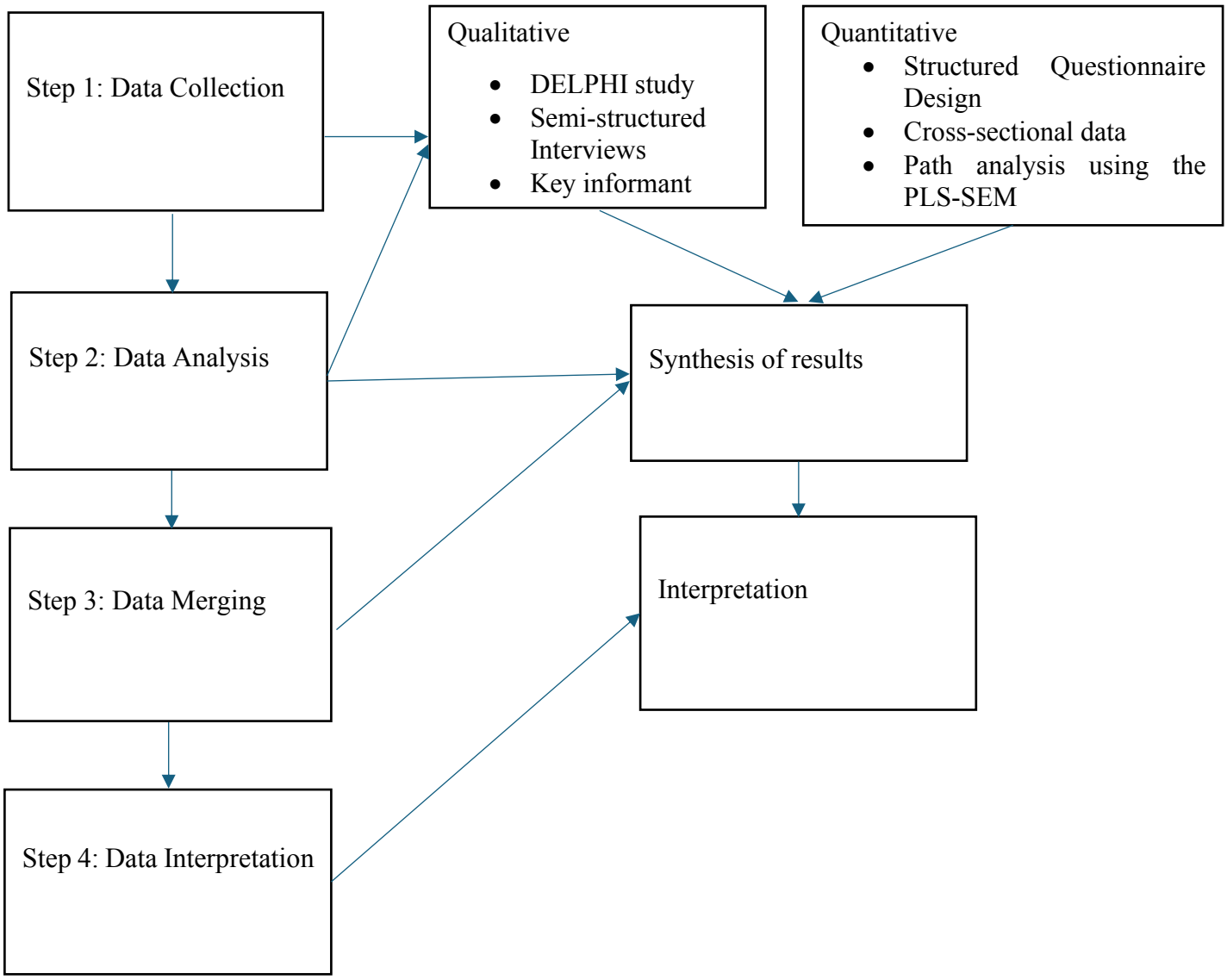


Figure 3.4: Flowchart of a Mixed Methods Research Design
(Source: Author's work)

3.5 Research Quality

Yin (2013) suggests that research quality can be evaluated based on four essential dimensions: construct validity, internal validity, external validity, and reliability. Construct validity refers to how well a study measures and examines the specific constructs or concepts it claims to investigate. Internal validity pertains to the extent to which a study supports a causal relationship between the independent and dependent variables. External validity, on the other hand, refers to the generalisability of the study findings to the broader population or other settings. Finally, reliability ensures that the research results are consistent and dependable over time. By considering these four dimensions, researchers can better assess their studies' quality and rigour and improve their findings' validity and reliability. I have created a tabulated format to comprehensively understand the subject matter to present a detailed overview of the four criteria. This format can be found in Table 3.3. By utilising this method of presentation, the information is presented in a clear and easy-to-understand manner that allows for a quick reference to the key points of the criteria.

Table 3.3: Assessment of the empirical validity of the Interpretive Structural Equation Modelling (Chapter 4) and Structural Equation Modelling Chapter 5)

Criterion	**Aims from Yin (2013)**	**Applied in this thesis**	**Measures**	**Research phases**
Construct validity	Use valid constructs to measure the concept.	Establish a chain of evidence linking the objectives to the protocol, findings, and literature review.	Multiple sources of evidence/ data triangulation.	Data collection Data analysis

Internal validity	Establish an appropriate causal relationship or make a valid inference	The research built on recognised principles of Healthcare supply chain and related literature, acting as a foundation to identify critical enablers of the healthcare supply chain resilience	In-depth, semi-structured qualitative interviews with the key informants followed the DELPHI study.	Interpretive structural equation modelling and structural equation modelling using the variance-based tool.
External validity	Ensure the analytic generalisation of the findings	Thesis objectives drive the design of the thesis. The theoretical sampling aligned with the scope of the study to create a coherent sample.	Choose an appropriate theory. Select initial RQs with how and why. Theoretical replication logic.	A hypothesis-driven study with the model firmly grounded in theory and the constructs validated by experts further.
Reliability	The same results are arrived at if a later researcher follows the same process specified by the earlier one to do the same case again.	A DELPHI study protocol is developed and validated to ensure reliable results and remove bias or errors.	Retrievable data organisation. Formalised coding.	Data collection Data analysis

3.5.1 Construct validity

When evaluating the quality of research, it is important to consider the construct validity of the study. Construct validity refers to how well a research study measures what it intends to measure (Borsboom et al., 2004). It is a crucial aspect of any research study as it ensures that the research is accurate and reliable regarding its results (MacKenzie et al., 2011). By assessing the construct validity of a study, researchers can determine whether the study's design and methods are appropriate for measuring the variables of interest. In essence, construct validity helps researchers to have confidence in the conclusions drawn from their research.

In my thesis, I have presented a detailed account of the measures I adopted to establish the construct validity of the variables used in the study. Firstly, in the case of interpretive structural modelling, I analysed data from multiple sources until the data converged on a specific variable or construct. This helped me triangulate the data and ensure the accuracy of the results. I also ensured the data was reliable and consistent by cross-checking it with other sources, including secondary data and existing seminal works that used similar constructs.

Secondly, I asked vital informants to review the case reports and transcripts and provide detailed feedback. This feedback helped me identify any discrepancies or errors in the data and allowed me to make the necessary corrections. This also helped me ensure that the data was comprehensive and covered all the essential aspects of the study.

Finally, for the survey-based study, I used a quantitative approach. Following Fornell & Larcker's (1981) methodology, I performed confirmatory factor analysis to establish the convergent and discriminant validity of the reflective constructs used in the study. This helped me ensure that the survey questions were measuring what they were intended to measure and that there was no overlap between different constructs. Overall, these measures helped me

establish the validity of the variables used in the study and ensured that the results were accurate and reliable.

3.5.2 Internal validity

The internal validity of any research is a fundamental and critical aspect that should be considered. Therefore, I made sure to establish that the study variables were adequately strong to establish a clear cause-and-effect relationship. To achieve this, for the interpretive structural modelling, I conducted a DELPHI study to gather expert opinions and viewpoints from knowledgeable sources. This was then followed up with in-depth, semi-structured, and qualitative interviews with key informants to further refine and validate the digraph and MICMAC analysis (Kwak et al., 2018).

For the survey-based study, I conducted a rigorous and critical review of existing literature on healthcare supply chain resilience. I then conducted qualitative interviews with experts to further scrutinise the hypotheses and variables used. This helped me gain a more comprehensive understanding of the subject matter and ensure that the study variables were robust enough to establish a conclusive cause-and-effect relationship (Malhotra & Grover, 1998; Forza, 2002).

3.5.3 External validity

To ensure that my study's findings are applicable in different settings, I paid close attention to external validity (Im & Straub, 2015). I employed multiple approaches to achieve this goal (see, Malhotra & Grover, 1998; Forza, 2002). Firstly, I conducted a DELPHI study, which is a structured communication technique that involves a series of questionnaires to establish a contextual relationship among the enablers of healthcare supply chain resilience. This allowed me to gather expert opinions and identify the key factors that contribute to supply chain resilience in the healthcare industry.

Secondly, I conducted qualitative semi-structured interviews with individuals who have experience in healthcare supply chain management. This approach helped me gain a deeper understanding of how the Digraph and the MICMAC analysis reflect real-life situations. The interviews allowed me to explore the perceptions of the interviewees regarding the factors identified in the DELPHI study and the extent to which they influence supply chain resilience in their specific contexts.

Finally, I compared the findings of the structural equation modelling with similar studies in the literature to strengthen the external validity of my study. I also noted the limitations of the study to caution readers while interpreting the results. This approach allowed me to identify potential areas for improvement and future research. Overall, these approaches helped me ensure that my study possesses high external validity and can be replicated in different settings.

3.5.4 Reliability

Maintaining the reliability of research involves using accurate, consistent, and sound methods to collect and analyse data. It also requires minimising the possibility of errors or biases that may affect the results (Flynn et al., 1990). Ensuring research reliability is crucial because it strengthens the validity of the study's findings and enhances confidence in the conclusions drawn from the data (Forza, 2002). It also helps to ensure that the research is replicable, meaning that other researchers can obtain similar results when they follow the same procedures.

In this study, I used two approaches to ensure the final digraph accurately reflects the experiences of the key informants. First, I conducted semi-structured qualitative interviews with them to gather detailed and nuanced information regarding their experiences and perspectives. I aimed to comprehensively understand their insights, which could be incorporated into the final interpretive structural model. The interviews were conducted professionally and respectfully,

ensuring the key informants felt comfortable and at ease sharing their valuable insights with me.

Secondly, I assessed the construct reliability based on the suggestions of Fornell & Larcker (1981), who recommended using confirmatory factor analysis. This method allowed me to test the validity of my assumptions about the underlying factors of the constructs I intended to measure. I carefully selected the cutoff values for each factor loading and measurement error to ensure they were as small as possible. During data collection, I took several measures to ensure the accuracy and reliability of the results. For example, I carefully designed and pre-tested the questionnaire to identify any potential issues with the questions. I also used multiple methods to recruit participants and ensured that the sample size was adequate for statistical analyses.

Overall, I am confident that my approach for establishing reliability was rigorous and will produce robust results.

3.6 Ethical Considerations

"Research ethics is a term most typically applied to rules for "proper" behaviour during the thinking and action processes of research and particularly to the protection of human subjects", Depoy & Gitlin (2016, p. 24). In the field of social science, ethics are a crucial aspect of conducting research that is fair, transparent, and respectful of the rights and dignity of all individuals involved (Saunders et al., 2019). Researchers are guided by ethical principles that require them to obtain informed consent from participants, ensure that participants are not harmed by the research, and protect their privacy and confidentiality (Wiles et al., 2006). In recent years, ethical considerations have become even more important in social science research (Davies, 2020). This is due in part to the increasing complexity of studies and the potential for unintended consequences (Sutrop et al., 2020). Ethical considerations help ensure that research

is conducted in a way that is not only legally compliant but also socially responsible and beneficial (Hall & Martin, 2019). Moreover, ethical considerations help establish trust between the researchers, participants, stakeholders, and the wider community (Isbell et al., 2022). This trust is essential for building relationships and collaborations that can result in meaningful and positive social change (Ryan & Tipu, 2022). Overall, ethical considerations play a critical role in shaping the way social science research is conducted. By adhering to ethical principles and guidelines, researchers can ensure that their work is rigorous, scientifically valid, socially responsible, and impactful.

The Liverpool John Moores University (LJMU) is known for its high standards of research ethics. Before starting any research project, the university provides comprehensive training to its students on ethical considerations. I had the opportunity to attend one such training program before embarking on my research journey with LJMU. The training proved highly informative and helped me understand the importance of ethical considerations in research. In addition to the training, my supervisors at LJMU have played an instrumental role in shaping my ethical behaviour throughout my research journey. They have guided me on the ethical implications of my research and helped me navigate any ethical challenges that arose during my research. Their support has been invaluable and helped me conduct my research with integrity. Overall, LJMU's emphasis on ethical considerations has been a significant factor in the success of my research journey.

3.6.1 Philosophical foundation of research ethics

As a researcher, I have invested considerable effort to ensure that my understanding of research ethics is comprehensive and precise. It is vital to acknowledge that research ethics is shaped by four philosophical understandings: utilitarianism, deontology, virtue, and contractarianism (Comstock, 2012). Utilitarianism, also called outcome-based ethics, emphasises that the ethical values of research are determined by their usefulness in promoting the greatest good for the

most significant number of individuals. Deontology, conversely, is duty-based, meaning that ethical values are determined by adherence to moral principles and obligations. As the name suggests, virtue ethics emphasises the importance of cultivating virtues, such as honesty, integrity, and compassion, to promote ethical research practices. Finally, contractarianism emphasises the importance of contracts and agreements in determining ethical values, particularly regarding the expectations and obligations of researchers and research participants.

The ethical framework that guides my research is based on the principles of deontology philosophy. This philosophy was founded by the eminent philosopher Immanuel Kant, who lived from 1724 to 1804. In deontology, the moral worth of an action is determined by its adherence to a set of universal ethical principles rather than the outcome of the action itself. In the context of research ethics, a research study's ethicality is evaluated based on whether it conforms to a set of fundamental ethical principles, such as respect for autonomy, beneficence, non-maleficence, and justice. By following this ethical framework, I strive to conduct research that is both scientifically rigorous and morally sound.

3.6.2 Ethical issues in data collection

In any research study, it is essential to consider ethical considerations while collecting data. The methods employed for data collection, such as interviews, questionnaires, surveys, and observations, can raise various ethical issues. Therefore, it is imperative to follow ethical guidelines to ensure that the data collection process is conducted responsibly and ethically. For this study, interviews, observations, and secondary data were used for collecting data. To ensure that ethical considerations were considered while collecting data, I followed the guidelines provided by Murphy & Dingwall (2007). These guidelines include measures such as obtaining informed consent from participants, ensuring that the data collected is kept confidential, and taking steps to protect the privacy and anonymity of participants. Moreover, the researchers ensured that the participants were not coerced or manipulated into providing information and

were free to withdraw from the study at any time. I have taken steps to ensure that I adhere to the ethics guidelines set by Liverpool John Moores University.

Firstly, I obtained written informed consent from all participants before collecting data. The full consent forms were submitted to and approved by the university's ethics committee.

Secondly, I invited participants to choose dates and times that were convenient for them.

Thirdly, before conducting the interviews, I sent the guide and requested permission to record. Participants were given the right to turn off the recording at any time.

Fourthly, I conducted the interviews professionally and ensured that participants were not physically, emotionally, socially, or economically harmed or uncomfortable. Participants had the right to withdraw their consent at any point and refuse to answer any questions they were unsure about. I provided multiple contact points, including my research supervisor's and my details. Additionally, I ensured no discrimination in the research process based on gender, race, social class, or age.

Fifthly, I took necessary measures to ensure that the participants' anonymity and confidentiality were fully maintained throughout the entire process. I avoided mentioning any names or details that could potentially disclose their identity. Furthermore, I took extra care to protect their privacy by using secure methods to store and handle any sensitive information related to the study. This way, the participants could have confidence in providing their honest and genuine feedback without any fear of their personal information being compromised.

Finally, once I completed the interview process, I shared the transcripts with the study participants to ensure the accuracy and reliability of the collected data. Participants were given the opportunity to review the transcripts and provide feedback or suggest any necessary changes. This step was crucial in ensuring the data analysis was based on accurate and reliable data. Once any amendments were made, the transcripts were finalised and ready for analysis.

3.6.3 Ethical issues in data analysis and thesis writing

When conducting data analysis and drafting a thesis, it is essential to ensure research objectivity and integrity to produce accurate research outcomes (Saunders et al., 2019). Research objectivity refers to presenting data unbiasedly without any distortion of the outcomes. This can be achieved by carefully selecting data sources, using appropriate research methods, and accurately presenting the findings. Furthermore, ensuring that the research is based on relevant and reliable sources is crucial to strengthen its objectivity. Research integrity, on the other hand, involves upholding ethical standards and preventing any misconduct that could affect the trustworthiness of the thesis. This includes avoiding fabrication, falsification, and misrepresentation of data and ensuring that all research participants are treated ethically and respectfully (Saunders et al., 2019).

Throughout the study, I was mindful of the ethical challenges of maintaining confidentiality and anonymity. To ensure confidentiality and anonymity, I took various measures, such as obtaining informed consent from participants, protecting their identities, and storing data securely. Additionally, my supervisors provided regular mentoring and guidance on ethical issues to ensure the research was conducted with integrity and objectivity. In summary, maintaining research objectivity and integrity is crucial for producing accurate research outcomes and upholding ethical standards. By selecting reliable data sources, using appropriate research methods, and treating participants ethically, I ensured that my thesis was trustworthy and meaningful to the readers.

3.7 Chapter Summary

This chapter aims to provide a comprehensive understanding of the research methodology used in this study. I elaborated on the reasons behind using multiple methods to address the research objectives and answer the research questions. I have also presented a detailed account of the philosophical stance that has shaped my study, which includes my beliefs, values, and

assumptions about the world and the nature of research. Furthermore, I have provided an in-depth description of the research process, including the steps taken to collect and analyse data, the research strategies employed, and the dimensions of research quality. I have also discussed the ethical considerations involved in conducting this research, including confidentiality, informed consent, and participant safety issues.

In the next chapter, I will present the DELPHI study, a structured method for collecting and analysing expert opinions. I will also describe the interpretive structural model, which provides a holistic view of healthcare supply chain resilience. This model helps to identify the key enablers of the healthcare supply chain resilience and provides insights into the interrelationships between different factors. By using the DELPHI study and interpretive structural model, I aim to provide a comprehensive understanding of healthcare supply chain resilience, which can be used to inform future research, policy, and practice.

CHAPTER 4: CONCEPTUAL MODEL DEVELOPMENT FOR THE HEALTHCARE SUPPLY CHAIN RESILIENCE

This chapter will discuss the factors contributing to healthcare supply chain resilience and how they interact. I will be using Interpretive Structural Modelling (ISM), which is a powerful tool for gaining a better understanding of what we know and what we do not know. ISM is a process designed to help humans better understand their beliefs and recognise what they are unaware of (Attri et al., 2013). In simple terms, ISM is a process based on graph theory that helps to transform unclear mental models of systems into clear and well-defined models. The aim is to develop a comprehensive view of healthcare supply chain resilience based on the experiences of healthcare staff, ranging from the strategic to the tactical level, during the pandemic. Despite a substantial body of literature on healthcare supply chain resilience, my goal was to identify other factors that have yet to be fully understood from a broader perspective. To achieve this, I conducted an in-depth DELPHI study to determine the factors that enable healthcare supply chain resilience and then validated these findings using the existing literature. I used these factors to understand how they interact with each other. I developed a hierarchical model and classified these factors into four distinct categories. Section 4.1 provides an overview of an ISM method. Section 4.2 presents a detailed overview of the ISM method and the steps involved. Section 4.3 presents the MICMAC analysis. Section 4.4 presents the synthesis of the ISM and MICMAC analysis. Section 4.5 presents a summary of the chapter.

4.1 Interpretive Structural Modelling (ISM)

The ISM method, a powerful tool deeply rooted in graph theory and discrete or finite mathematics developed by Warfield (1973, 1974, 1976), provides a fascinating approach to structuring complex problems. It creates a structural model that aids in understanding and analysing complex relationships and interactions within a system (Janes, 1988). ISM allows for

a systematic analysis and representation of the interdependencies among various elements, making it an invaluable tool for decision-making and problem-solving in diverse fields such as engineering, management, and social sciences (Janes, 1988; Sushil, 2012).

In recent years, the ISM technique has gained significant importance in management for its effectiveness in analysing complex business problems (Malone, 1975; Mandal & Deshmukh, 1994; Agarwal et al., 2007; Sorooshian et al., 2023). ISM provides a systematic approach to understanding the interrelationships among various problem components, allowing for a comprehensive analysis of the factors at play (Raj et al., 2008; Kwak et al., 2018). This method has proven valuable in identifying key drivers and dependencies within complex business scenarios, enabling managers to make more informed decisions and develop effective strategies (Singh & Gupta, 2020). However, I must acknowledge that other methods can be used for understanding complex inter-relationships that have roots in the graph-theoretic approach (Sushil, 2012; Sushil, 2019). The graph theory approach is a fundamental method employed by mathematicians and computer science scholars to analyse and understand complex relationships between different variables (Wagner & Neshat, 2010; Sushil & Dinesh, 2022). This approach utilises graphs, which are composed of nodes (also known as vertices) and edges (lines or arcs that connect the nodes) (Kim et al., 2016). Several techniques have been widely employed to analyse and comprehend the intricate interrelationships within complex systems. Notable among these is graph theoretic matrix approximation (Santos et al., 2023), which allows for the efficient representation and analysis of relationships through vertices and edges. Another method is total interpretive structural modelling (TISM), which systematically maps out the relationships between different elements in a system to identify their hierarchical structure and influence (Sushil, 2012). Additionally, the Decision-Making Trial Laboratory (DEMATEL) technique is instrumental in developing a deep understanding of causal relationships by visualising how factors influence one another (Bai & Sarkis, 2013). Each of these approaches

offers valuable insights, helping researchers and decision-makers navigate the complexities inherent in various domains. In my current study, I have chosen to use the Interpretive Structural Modelling (ISM) approach. I find this method to be particularly effective due to its straightforward nature, which allows for a clearer understanding of complex relationships (Mandal & Deshmukh, 1994). Furthermore, ISM requires fewer iterations compared to alternative approaches, making it a more efficient option (Yadav & Barve, 2015). The efficiency of the Interpretive Structural Modelling (ISM) method is essential for my research, as it optimises the analytical process, allowing me to quickly and effectively analyse complex data sets. This efficiency not only saves time but also provides valuable insights into the relationships and structures within the data, thereby enhancing the overall understanding of the subject matter. However, it is important to acknowledge that the ISM method has its own limitations. For instance, while it effectively illustrates interrelationships, it may not capture the full complexity of dynamic systems or account for all variables involved (Sushil, 2012). Gaining a thorough understanding of these limitations is crucial, as it enables me to refine my approach and ultimately advance scientific inquiry in this area. I have engaged in comprehensive research to gain a deeper understanding of how the ISM method is utilised within the realms of operations and supply chain management. This method offers a systematic approach to identifying and analysing the relationships between various components in these fields. For a more thorough examination of my findings, I have compiled the key details and insights into Table 4.1. Table 4.1 provides detailed information on how the Interpretive Structural Modelling (ISM) method is used in operations and supply chain management.

Table 4.1: Applications of the ISM Method in the Field of Operations and Supply Chain Management

Source	**Objective**
Mandal & Deshmukh (1994)	The authors have developed a vendor selection model using the Interpretive Structural Modelling (ISM) method. This study identifies various factors crucial for vendor selection. Based on expert opinion, the authors created an ISM model that illustrates the hierarchical classification of factors. This model helps organisations prioritise factors with high driving power and low dependence.
Agarwal et al. (2007)	The researchers employed the ISM method to gain insight into the specific drivers that enhance agility within supply chain networks. This involved a comprehensive analysis of the intricate interrelationships among these drivers, leading to a deeper understanding of their combined impact on supply chain agility.
Vivek et al. (2008)	The authors of this study employed the ISM method to develop a comprehensive model to gain insights into the complex interplay among core, transactional, and relational specificity constructs within the offshore business context. This model seeks to provide a deeper understanding of the dynamics involved in offshore business operations and relationships.
Raj et al. (2008)	The authors conducted a comprehensive study to analyse the various factors contributing to implementing flexible manufacturing processes. They employed the ISM method better to understand these contributing factors' complex interactions and interdependencies. This approach allowed them to assess the intricate relationships and hierarchies within

	the enablers of flexible manufacturing, providing valuable insights for enhancing operational efficiency and adaptability in manufacturing processes.
Alawamleh & Popplewell (2011)	Supply chain collaboration is a critical determinant of success for firms navigating complex business environments. Due to their potential impact, virtual organisations have garnered significant attention in the third industrial revolution era. However, despite their numerous advantages, virtual organisations are susceptible to a myriad of risks arising from various sources. In this study, the authors employed the ISM method to identify the diverse sources of risk meticulously. Furthermore, they conducted an in-depth analysis of the intricate interactions among these factors to develop a comprehensive framework for managing supply chain risks.
Diabat et al. (2012)	The authors of this study aimed to comprehend the food sector's supply chain risk management strategy. They used the ISM method to identify the different sources of supply chain risk and understand the complex relationships among these sources. This understanding is crucial for developing an effective risk mitigation strategy.
Purohit et al. (2016)	The authors of this study have conducted an in-depth analysis to identify the various factors that play a crucial role in enabling mass customisation within the Indian footwear manufacturing sector. They have meticulously developed an ISM model to understand the intricate interactions among these factors better. This model serves as a valuable tool for comprehensively examining the complex relationships and dependencies among the identified factors, thereby providing valuable insights for the footwear manufacturing industry in India.

Jain et al. (2017)	Supply chain resilience has garnered considerable attention from industry practitioners and academic scholars. Despite a substantial body of literature on the subject, achieving it remains a significant challenge, mainly because the field is still in its early stages of development. The authors have utilised the ISM method to enrich the supply chain resilience theoretical understanding. This method allows for a comprehensive exploration of supply chain resilience and facilitates the identification of the various factors that contribute to its successful implementation.
Kwak et al. (2018)	The complexity of global supply chains poses a persistent challenge for international logistics professionals as they grapple with the multifaceted issue of supply chain risk. Despite its critical importance, understanding the diverse sources of risk and their interconnectedness remains limited. The authors employed the ISM model to address this knowledge gap and enhance the supply chain risk management theoretical framework in international logistics. This strategic approach offers a comprehensive method for analysing and prioritising the various factors contributing to supply chain risk, thereby providing valuable insights for effective risk management strategies in the international logistics domain.
Mathivathanan et al. (2021)	Blockchain technology has gained significant attention from all sectors. There is a significant rise in consensus among industry professionals to adopt blockchain technology in the supply chain network to enhance trust, collaboration, and risk. However, despite several benefits, managers face challenges in adopting blockchain technology. In this study, the authors have identified the barriers and further analysed their interaction using an extended version of the ISM method.

I have thoroughly reviewed selected studies published in reputable outlets, explicitly focusing on Table 4.1. This review illustrates the prominence of the ISM method and its significant utility in comprehending the enablers or barriers and gaining deeper insights into complex interactions that are not well understood. The ISM method is an invaluable exploratory tool, facilitating the translation of human perception, also called expert input, by utilising discrete mathematics and the graph theory perspective to develop a comprehensive and intricate model.

4.2 ISM Method and Steps Involved

I have identified eight steps (see Figure 4.1) based on previous studies, including research by Mandal & Deshmukh (1994), Faisal et al. (2006), and Kwak et al. (2018). However, other research suggests that additional steps may be necessary depending on the approach to ensure the study's robustness (Diabat et al., 2012; Govindan et al., 2012).

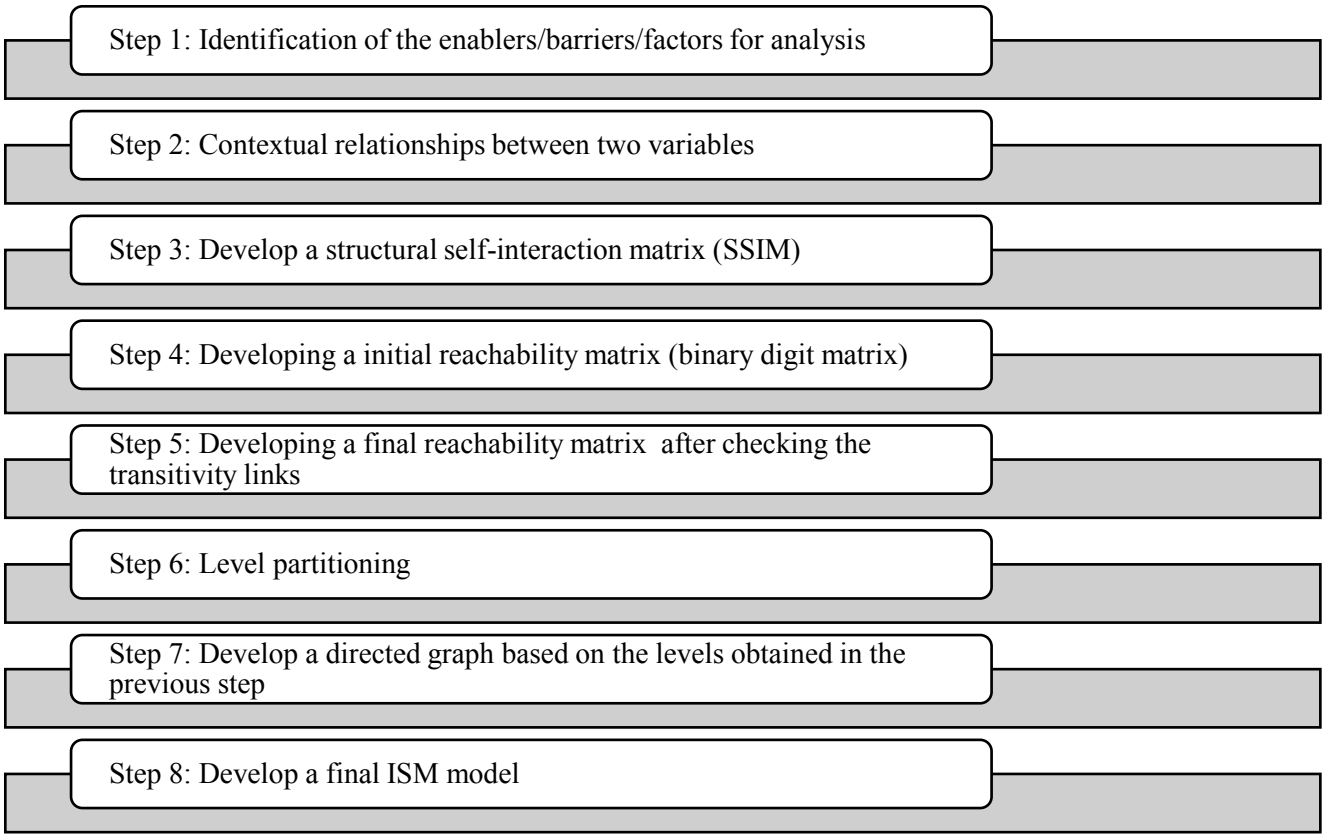


Figure 4.1: Steps involved in the ISM method
(Source: Author's work)

4.2.1 Identification of the enablers of healthcare supply chain resilience

In the initial phase of my research utilising the ISM method, I embarked on a comprehensive study to identify the key enablers of healthcare supply chain resilience (HSCR). To achieve this, I adopted two distinct approaches. Firstly, I conducted an in-depth critical analysis of relevant academic literature, drawing insights from the works of Mandal & Deshmukh (1994), Faisal et al. (2006), and Govindan et al. (2012). This process facilitated identifying and extracting pivotal enablers, and the detailed findings are presented in Chapter 2 of the study.

In the second approach, I employed the DELPHI study method to identify enablers further (see Appendix A). This involved an initial comprehensive literature review to pinpoint potential enablers. I developed a comprehensive questionnaire aimed at gathering insights from 40 experts in the healthcare field. Each expert was asked to rank a series of enablers based on their professional knowledge and personal experiences during the COVID-19 crisis. The group of experts was carefully selected to include a diverse range of healthcare professionals. This included frontline healthcare staff who had firsthand experience managing resources in hospitals and healthcare centres throughout the pandemic. Among them, outpatient department (OPD) staff were particularly vital; they played a crucial role in handling the surge of patients as hospitals grappled with severe shortages of beds and medical infrastructure to accommodate the overwhelming number of COVID-19 cases. In addition, I included pharmacists who were actively involved in procuring essential medical supplies during this challenging period. Their responsibilities encompassed securing not only crucial medications but also personal protective equipment (PPE), hand sanitisers, face masks, and vaccines. Furthermore, I sought input from suppliers of PPE, who played a significant role in ensuring that healthcare facilities had the necessary protective gear to safeguard both staff and patients. By enlisting a wide range of expertise, I aimed to gather a well-rounded understanding of the key enablers that contributed to effective resource management during the pandemic. Among the 40 respondents surveyed, a

significant portion, 22 individuals, reported having more than 5 years of professional experience in their respective fields. In contrast, 18 respondents indicated that they had less than 5 years of experience. This distribution highlights a diverse range of expertise within the group. In the analysis, I carefully ranked the eighteen variables based on their respective mean scores, arranging them from the highest to the lowest. This ranking system allowed me to identify variables that are more significant in contributing to supply chain resilience within the healthcare sector.

This process allowed for a thorough and diverse assessment of the identified enablers, providing valuable and nuanced insights for the study (see Table 4.2). In their study, Kwak et al. (2018) conducted focus group interviews to identify the enablers. I think using the DELPHI study approach, followed by in-depth qualitative interviews, is the right approach for my case. This is because my experts are available in different time zones, and having them all converge for a focus group discussion was not feasible.

Table 4.2: Enablers of the Healthcare Supply Chain Resilience

Serial Number	**Enabler**
VAR1	Trust
VAR2	Information sharing among stakeholders
VAR3	Top management support
VAR4	Use of digital technologies
VAR5	Adaptability
VAR6	Transparency in the process and communication
VAR7	Alignment

VAR8	Awareness
VAR9	Inventory management
VAR10	Agility
VAR11	Accessibility
VAR12	Mutual respect
VAR13	Interdependence
VAR14	Government support
VAR15	Affordability
VAR16	Visibility of Information related to supply and demand
VAR17	Family support
VAR18	Financial support

I will provide detailed explanations for each enabler (see Table 4.3) to ensure a thorough understanding of our study.

Table 4 3: Definition of Enablers in the Supply Chain Context

Enabler	**Definition**
Trust (Morgan & Hunt, 1994; Sahay, 2003; Capaldo & Giannoccaro, 2015; Scala & Lindsay, 2021)	To achieve effective collaboration, it is crucial to establish and maintain a high level of trust among all partners involved. Trust is the foundation for successful collaboration, fostering open communication, mutual respect, and a shared sense of purpose. This trust allows partners to work together seamlessly, leveraging each other's strengths and expertise to achieve common goals. Trust is critical in strengthening the healthcare supply chain's ability to withstand and recover from disruptions. Building strong relationships among stakeholders, fostering collaboration, and ensuring the smooth flow of vital medical supplies and services is essential. Trust also contributes to effective communication and decision-making, critical elements in resilience when facing challenges.
Information sharing among stakeholders (Brandon-Jones et al., 2014)	Information sharing encompasses exchanging intangible resources related to shared information, such as knowledge, expertise, and insights. This includes the timely and appropriate dissemination of information among partners involved in the supply chain. Information sharing is essential for maintaining a resilient healthcare supply chain. It facilitates the timely and accurate data exchange between various stakeholders, including manufacturers, distributors, and healthcare providers. This,

	in turn, enables better coordination of supply and demand, improved inventory management, and enhanced responsiveness to disruptions. Effective information sharing also supports collaborative problem-solving and decision-making, ultimately contributing to a more robust and reliable healthcare supply chain.
Top management support (Hambrick & Mason, 1984; Villena et al., 2018)	The support of top management during crises is crucial for an organisation's success. An organisation's decisions directly reflect its top management's values and cognitive foundations. Therefore, it is essential for top management to demonstrate strong support and leadership during challenging times to steer the organisation in the right direction. The success of an organisation's supply chain heavily relies on the belief and active involvement of top management. When top management believes in the importance of the supply chain and actively participates in its development and implementation, they set a strong example for the rest of the organisation. This involvement can lead to better decision-making, improved resource allocation, and a more cohesive and efficient supply chain process. Hence, top management support is vital to healthcare supply chain resilience.
Use of digital technologies (Birkel et al., 2023)	Integrating digital technologies, such as advanced inventory management systems, real-time tracking tools, and data analytics platforms, has significantly enhanced resilience within the healthcare supply chain. These technological advancements have enabled better coordination, visibility, and decision-

	making, ultimately improving the overall efficiency and responsiveness of the healthcare supply chain in the face of various challenges and disruptions.
Adaptability (Spieske et al., 2022)	The ability to be adaptable is of utmost importance for the healthcare supply chain. It allows the healthcare sector to respond and adjust to various changing circumstances, such as fluctuations in demand, supply chain disruptions, or unforeseen events. This adaptability is essential for ensuring that the healthcare system can function effectively and provide necessary patient care, even in challenging and unpredictable conditions.
Transparency in the process and communication (Wadhwa et al., 2010; Spieske et al., 2022; Morgan et al., 2023)	Transparency in the process and open communication are crucial in supply chain networks involving multiple partners. These factors are critical during health crises as they help establish trust and facilitate stakeholder collaboration. In essence, transparency contributes to building better resilience in healthcare supply chains.
Alignment (Spieske et al., 2022)	Establishing a strong and resilient healthcare supply chain requires close alignment and collaboration among all partners, suppliers, distributors, and healthcare providers. This entails ensuring that all parties share a common understanding of goals, objectives, and strategies and maintaining effective communication and coordination throughout the supply chain network. By fostering alignment among

	partners, the healthcare industry can better anticipate and respond to disruptions, mitigate risks, and ensure the consistent availability of essential medical supplies and services.
Awareness (Hossain et al., 2022)	When establishing resilience in the healthcare supply chain, it is vital to deeply understand the current and potential future situations and challenges that could impact it. This includes being aware of factors such as demand fluctuations, supply chain vulnerabilities, regulatory changes, and external risks.
Inventory management (Friday et al., 2021)	Effective inventory management plays a crucial role in maintaining supply chain resilience in the healthcare industry. During times of crisis, such as pandemics, shortages of critical items can lead to significant disruptions in the delivery of healthcare services. Proper inventory management practices, including accurate forecasting, efficient procurement, and strategic stockpiling, ensure that healthcare facilities are well-prepared to address unexpected challenges and maintain continuity of care.
Agility (Spieske et al., 2022)	During times of crisis, agility becomes a crucial ability for the healthcare sector. The ability to swiftly adapt and respond to unexpected challenges is essential for anticipating and mitigating the impact of supply chain disruptions. This agility enables healthcare providers to proactively address issues and ensure that essential supplies and services remain available to those in need.
Accessibility (Haldane et al., 2021; Friday et al., 2021)	To ensure resilience in the healthcare supply chain, it is crucial to have easy access to key resources such as medical supplies, equipment, and personnel. This accessibility plays a vital role in maintaining

	a consistent and efficient flow of healthcare products and services, especially during times of crisis or high demand.
Mutual respect (Wu et al., 2014)	Maintaining mutual respect among partners and staff members during a crisis is crucial for success. This mutual respect fosters an environment of trust and cooperation, leading to more effective collaboration. Ultimately, this approach plays a significant role in strengthening the resilience of the healthcare supply chain, ensuring that it can effectively adapt to and overcome challenges during difficult times.
Interdependence (Spieske et al., 2022; Harland, 2021)	The interdependence among various stakeholders within the healthcare sector, including hospitals, suppliers, manufacturers, and distributors, plays a critical role in minimising disruptions within the supply chain. This close collaboration and coordination are essential for ensuring the smooth and uninterrupted flow of essential medical supplies, equipment, and pharmaceuticals, especially during times of crisis or high demand. By working together and establishing robust relationships, the healthcare sector can effectively address challenges such as shortages, delays, and logistical obstacles, ultimately ensuring that patients receive the care they need when they need it.
Government support (Dobrzykowski, 2019; Harland et al., 2021)	Government support plays a critical role in the development of a resilient healthcare supply chain. By providing funding, regulations, and strategic guidance, governments can help ensure that healthcare

	systems are equipped to withstand disruptions and meet the needs of the population, especially during times of crisis. Additionally, government support can facilitate collaboration among various stakeholders, such as healthcare providers, suppliers, and logistics partners, to improve the efficiency and effectiveness of the supply chain.
Affordability (Friday et al., 2021)	During times of crisis, ensuring that essential resources are affordable is essential for strengthening the resilience of the healthcare supply chain. Access to affordable medical supplies, equipment, and medication plays a critical role in maintaining the stability and effectiveness of healthcare systems when they are under strain. By addressing affordability, healthcare organisations can better prepare for and respond to emergencies, safeguarding the continuity of care for patients in need.
Visibility of Information related to supply and demand (Brandon-Jones et al., 2014)	Visibility within the supply chain encompasses the capacity to minimise the adverse effects of disruptions by effectively capturing and analysing material and information flows. This comprehensive understanding of the supply chain facilitates enhanced stakeholder collaboration, leading to more informed and effective decision-making processes. Having clear visibility into every aspect of the healthcare supply chain, from sourcing raw materials to delivering finished products, is crucial for building resilience. This visibility enables better forecasting, identification of potential

	risks, and the ability to quickly adapt to disruptions, ultimately leading to a more robust and reliable healthcare supply chain.
Family support (Lusiantoro & Pradiptyo, 2022)	It is crucial to have the support of family members during times of crisis. This support plays a significant role in influencing the level of trust and collaboration among the partners involved in the supply chain. When individuals feel supported by their families, they are better equipped to work together effectively and build strong, cooperative relationships within the supply chain.
Financial support (Zamiela et al., 2022)	During crises, providing financial support is essential for maintaining the resilience of healthcare supply chains. This support enables the healthcare system to procure necessary equipment, maintain infrastructure, and ensure the availability of essential supplies. By bolstering the financial aspect of the supply chain, healthcare organisations can better respond to and recover from crises, ultimately improving overall healthcare delivery and outcomes.

4.2.2 Establishing Contextual Relationships

In step 2, we examined the contextual relationships between the HSCR enablers to determine their pairwise relationships. We followed a two-stage process in which we selected five participants from the initial group of forty experts involved in identifying and ranking the eighteen HSCR enablers based on their roles and responsibilities (Kwak et al., 2018). I asked each participant to simultaneously decide on the contextual relationships between two enablers. Each discussion lasted over three hours as each expert had 153 suggestions for the eighteen enablers for pairwise relationships. Finally, after eliminating discrepancies during multiple iterations, I conducted a DELPHI study to arrive at a common matrix.

In the study, it was essential to consider the possibility of common method bias (CMB), as the practitioners participated in both stages of the two-stage research approach while representing their organisation and its supply chain. This dual participation could have influenced the results due to the practitioners' perceptions. I employed a triangulation approach to mitigate this bias from a single informant study. This involved using multiple data sources and methods to cross-validate the findings, thereby reducing the impact of common method bias on the study results.

4.2.3 Developing a structural self-interaction matrix (SSIM)

In the context of the relationships between each element, experts investigate a specific relation R between any two elements (i and j). This examination aims to understand the complex interplay and interactions between these elements. Four distinct symbols (Table 4.4) represent the various relations between the two enablers under consideration. These symbols categorise and elucidate the nature of the connections and dependencies between the elements, contributing to a comprehensive understanding of their interrelations.

Table 4.4: Symbols used to establish contextual relationships between two enablers (Sushil, 2012, p. 89)

Symbol	Relation
V	When element i leads to element j and not j leads to i (i →j; j ↛i)
A	When element j leads to element i and not i leads to j (j →i; i ↛j)
X	When both direction relations from element i to j and j to i exist (i→j; j→i)
O	If the relations do not exist between to enablers (i↛j; j↛i)

The expert's perception is encoded using a structural self-interaction matrix (SSIM) based on four specific symbols. I have presented the SSIM matrix of my study (see Table 4.5).

Table 4.5: Structural self-interaction matrix (SSIM)

	VAR18	VAR17	VAR16	VAR15	VAR14	VAR13	VAR12	VAR11	VAR10	VAR9	VAR8	VAR7	VAR6	VAR5	VAR4	VAR3	VAR2	VAR1
VAR1	A	X	A	O	A	V	V	O	A	V	V	V	A	V	A	A	A	
VAR2	O	O	V	O	O	X	V	V	V	A	V	V	X	X	A	X		
VAR3	V	O	V	V	X	O	V	V	V	V	V	V	V	V	V			
VAR4	A	O	V	A	A	X	O	A	V	V	X	X	V	V				
VAR5	A	A	A	A	A	A	A	A	O	O	A	A	A					
VAR6	A	A	A	A	A	V	V	V	V	V	V	V						
VAR7	A	A	A	A	A	A	A	A	X	A	A							
VAR8	O	O	A	V	A	V	A	V	V	V								
VAR9	A	O	A	O	A	V	A	X	A									
VAR10	A	A	A	A	A	A	A	A										
VAR11	A	A	A	X	A	X	V											
VAR12	A	A	A	O	O	X												
VAR13	A	V	A	V	X													
VAR14	V	O	V	V														
VAR15	A	O	O															
VAR16	X	V																
VAR17	X																	
VAR18																		

4.2.4 Initial reachability matrix

I converted the SSIM matrix into an initial reachability matrix in this step. The initial reachability matrix is prepared by substituting the four symbols (V, A, X, O) into 1 and 0. For instance, the (VAR1, VAR18) entry, as shown in Table 4.5, has "A" as an entry. Hence, I can argue that VAR 18 (financial support) does not influence VAR1 (trust). However, VAR1 (trust) influences VAR 18 (financial support). Therefore, entry (VAR1, VAR18) will be captured with "0", and entry (VAR18, VAR 1) will be captured with "1". Based on this approach, I have obtained the initial reachability matrix (Table 4.6).

Table 4.6: Initial Reachability Matrix

	VAR1	VAR2	VAR3	VAR4	VAR5	VAR6	VAR7	VAR8	VAR9	VAR10	VAR11	VAR12	VAR13	VAR14	VAR15	VAR16	VAR17	VAR18
VAR 1	1	0	0	0	1	0	1	1	1	0	0	1	1	0	0	0	1	0
VAR2	1	1	1	0	1	1	1	1	0	1	1	1	1	0	0	1	0	0
VAR3	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1
VAR4	1	1	0	1	1	1	1	1	1	1	0	0	1	0	0	1	0	0
VAR5	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
VAR6	1	1	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0
VAR7	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0
VAR8	0	0	0	1	1	0	1	1	1	1	1	0	1	0	1	0	0	0
VAR9	0	1	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0
VAR10	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0
VAR11	0	0	0	1	1	0	1	0	1	1	1	1	1	0	1	0	0	0
VAR12	0	0	0	0	1	0	1	1	1	1	0	1	1	0	0	0	0	0
VAR13	0	1	0	1	1	0	1	0	0	1	1	1	1	1	1	0	1	0
VAR14	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1
VAR15	0	0	0	1	1	1	1	0	0	1	1	0	0	0	1	0	0	0
VAR16	1	0	0	0	1	1	1	1	1	1	1	1	1	0	0	1	1	1
VAR17	1	0	0	0	1	1	1	0	0	1	1	1	0	0	0	0	1	1
VAR18	1	0	0	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1

4.2.5 Final reachability matrix

Once I had derived the initial reachability matrix, I meticulously analysed the interconnections between variables to identify transitive relationships. Let us consider a scenario where we have three variables - A, B, and C. If A is linked to B, and B is linked to C, according to the transitive property, it implies that A is also linked to C. Taking this into account, I conducted a thorough evaluation of these transitive relationships, ultimately resulting in the derivation of the final reachability matrix, which is presented in Table 4.7 for reference.

Table 4.7: Final Reachability Matrix

	VAR1	VAR2	VAR3	VAR4	VAR5	VAR6	VAR7	VAR8	VAR9	VAR10	VAR11	VAR12	VAR13	VAR14	VAR15	VAR16	VAR17	VAR18
VAR 1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
VAR2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
VAR3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
VAR4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
VAR5	1	1	1	0	1	1	1	1	0	1	1	1	1	0	0	1	0	0
VAR6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
VAR7	1	1	0	1	1	1	1	1	1	1	0	0	1	0	0	1	0	0
VAR8	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
VAR9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
VAR10	1	1	0	1	1	0	1	1	1	1	1	1	1	0	0	0	1	0
VAR11	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
VAR12	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	0	1	0
VAR13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
VAR14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
VAR15	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0
VAR16	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
VAR17	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
VAR18	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

4.2.6 Level partitioning

To obtain the reachability set (RS) and the antecedent set (AS) for each enabler, we start with the final reachability matrix. The RS includes the enabler and any other enablers it may influence, while the AS comprises the enabler and any other enablers that may influence it. We then find the intersection set (RS ∩ AS). If the intersection of RS and AS generates the same set as RS, then the enabler occupies the top level in the ISM hierarchy. This process continues until all the enablers have been assigned a level.

After following the specified process, I carried out the necessary operations and repeated them for four iterations. As a result, I acquired all the levels that will be utilised in creating the diagram and the final ISM (see Table 4.8-Table 4.11).

Table 4.8: Level partitioning (Iteration 1)

Variables	RS	AS	RS ∩ AS	Level
VAR 1	1,2,4,5,6,7,8,9,10,11,12,13,14,15,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,4,5,6,7,8,9,10,11,12,13,14,15,17,18	I
VAR2	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	I
VAR3	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	2,3,4,5,6,9,13,14	2,3,4,5,6,9,13,14	
VAR4	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18	
VAR5	1,2,3,5,6,7,8,10,11,12,13,16	1,2,4,5,6,7,8,9,10,11,12,13,14,15,17,18	1,2,3,5,6,7,8,10,11,12,13,16	I
VAR6	1,2,4,5,6,7,8,9,10,11,12,13,14,15,17	1,2,4,5,6,7,8,9,11,13,14,15,17,18	1,2,4,5,6,7,8,9,11,13,14,15,17	
VAR7	1,2,4,5,6,7,8,9,10,16,13	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,4,5,6,7,8,9,10,16,13	I
VAR8	1,2,4,5,6,7,8,9,10,11,12,13,14,15,16,17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,4,5,6,7,8,9,10,11,12,13,14,15,16,17	I
VAR9	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17	
VAR10	1,2,4,5,7,8,9,10,11,12,13,17	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,4,5,7,8,9,10,11,12,13,17	I
VAR11	1,2,4,5,6,7,8,9,10,11,12,13,14,15,16,17	1,2,3,4,5,6,8,9,10,11,12,13,14,15,16,17,18	1,2,4,5,6,8,9,10,11,12,13,14,15,16,17	
VAR12	1,2,4,5,7,8,9,10,11,12,13,14,15,17	1,2,3,4,5,6,8,9,10,11,12,13,14,15,16,17,18	1,2,4,5,8,9,10,11,12,13,14,15,17	

VAR13	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	I
VAR14	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,6,8,9,11,12,13,14,16,18	1,2,3,4,6,8,9,11,12,13,14,16,18	
VAR15	1,2,4,5,6,7,8,9,10,11,12,13,15,16	1,2,3,4,6,8,9,11,12,13,14,15,16,17,18	1,2,4,6,8,9,11,12,13,15,16	
VAR16	1,2,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	2,3,4,5,6,7,8,9,11,13,14,15,16,17,18	2,4,5,6,7,8,9,11,13,14,15,16,17,18	
VAR17	1,2,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,6,8,9,10,11,12,13,14,16,17,18	1,2,4,6,8,9,10,11,12,13,16,17,18	
VAR18	1,2,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,13,14,16,17,18	1,2,4,13,14,16,17,18	

The results from the first iteration (see Table 4.8) reveal that VAR1, VAR2, VAR5, VAR7, VAR8, VAR10, and VAR13 have reached the highest levels of measurement (Level I). This finding suggests that these enablers serve as significant outcome variables characterised by a strong dependence on other enablers while demonstrating relatively low driving power in influencing changes within the system. Although they are crucial in understanding the outcomes, they do not have a substantial impact on driving those outcomes themselves.

Table 4.9: Level partitioning (Iteration 2)

Variables	RS	AS	RS ∩ AS	Level
VAR3	3,4,6,9,11,12,14,15,16,17,18	3,4,6,9,14	3,4,6,9,14	
VAR4	3,4,6,9,11,12,14,15,16,17,18	3,4,6,9,11,12,14,15,16,17,18	3,4,6,9,11,12,14,15,16,17,18	II
VAR6	4,6,9,11,12,14,15,17	4,6,9,11,14,15,17,18	4,6,9,11,14,15,17	II
VAR9	3,4,6,9,11,12,14,15,16,17	3,4,6,9,11,12,14,15,16,17,18	3,4,6,9,11,12,14,15,16,17	II
VAR11	4,6,9,11,12,14,15,16,17	3,4,6,9,11,12,14,15,16,17,18	4,6,9,11,12,14,15,16,17	II
VAR12	4,9,11,12,14,15,17	3,4,6,9,11,12,14,15,16,17,18	4,9,11,12,14,15,17	II

VAR14	3,4,6,8,9,11,12,14,15,16,17,18	3,4,6,9,11,12,14,16,18	3,4,6,9,11,12,14,16,18	
VAR15	4,6,9,11,12,15,16	3,4,6,9,11,12,14,15,16,17,18	4,6,9,11,12,15,16	II
VAR16	4,6,9,11,12,14,15,16,17,18	3,4,6,9,11,14,15,16,17,18	4,6,9,11,14,15,16,17,18	
VAR17	4,6,9,11,12,15,16,17,18	3,4,6,9,11,12,14,16,17,18	4,6,9,11,12,16,17,18	
VAR18	4,6,9,11,12,14,15,16,17,18	3,4,14,16,17,18	4,14,16,17,18	

The results obtained from iteration 2 (Table 4.9), provide valuable insights into the enablers identified in the analysis. Specifically, the enablers VAR4, VAR6, VAR9, VAR11, VAR12, and VAR15 are classified as belonging to level II. This classification suggests that the dependence power of these level II enablers is slightly lower than that of the level 1 enablers, indicating a diminished capacity for influence or reliance. However, their dependence power is greater than that of the level III variables, highlighting their significance within the overall framework. Moreover, when examining the driving power of these enablers, it is found to be slightly higher than the driving power of level I enablers, yet lower than that of level II enablers. This nuanced positioning underscores the role of these enablers as intermediaries or connecting enablers between different levels of influence within the model. As such, these level II enablers are often referred to as connecting enablers, as they facilitate relationships and interactions between the more strongly dependent level I and the weaker dependent level III enablers.

Table 4.10: Level partitioning (Iteration 3)

Variables	RS	AS	RS ∩ AS	Level
VAR3	3,14,16,17,18	3,14	3,14	
VAR14	3,8,14,16,17,18	3,14,16,18	3,14,16,18	
VAR16	14,16,17,18	3,14,16,17,18	14,16,17,18	III
VAR17	16,17,18	3,11,14,16,17,18	16,17,18	III
VAR18	14,16,17,18	3,14,16,17,18	14,16,17,18	III

The findings from iteration 3, as presented in Table 4.10, reveal that VAR16, VAR17, and VAR18 are categorised as Level III enablers. This classification is significant because it suggests that these enablers possess a higher driving power than those in Levels I and II. However, it is important to note that while they have greater influence, their dependence on other factors is lower compared to the enablers in the lower levels. This distinction highlights the unique role that Level III variables play in the overall system, balancing influence with a lower degree of reliance on other enablers.

Table 4.11: Level partitioning (Iteration 4)

Variables	RS	AS	RS ∩ AS	Level
VAR3	3,14	3,14	3,14	IV
VAR14	3,8,14	3,14	3,14	V

In the final iteration, iteration 4, we identified two distinct categories labelled Level IV and Level V. Within these classifications, VAR3 is assigned to Level IV, whereas VAR14 is

categorised under Level V. Notably, VAR14 exhibits the highest driving power among the enablers, demonstrating its significant influence on the system. Additionally, VAR14 has the least dependence on other enablers, which underscores its role as a crucial driver that affects the behaviour of other enablers within this framework. This suggests that understanding VAR14's characteristics and dynamics is essential for fully grasping the overall system dynamics.

4.2.7 Directed graph

Based on the reachability matrix's conical form, the digraph (Figure 4.2) is generated by nodes and lines of edges (Attri et al., 2013). Based on this, I have developed the ISM model (Figure 4.3, p. 145) further by replacing the nodes of the enablers.

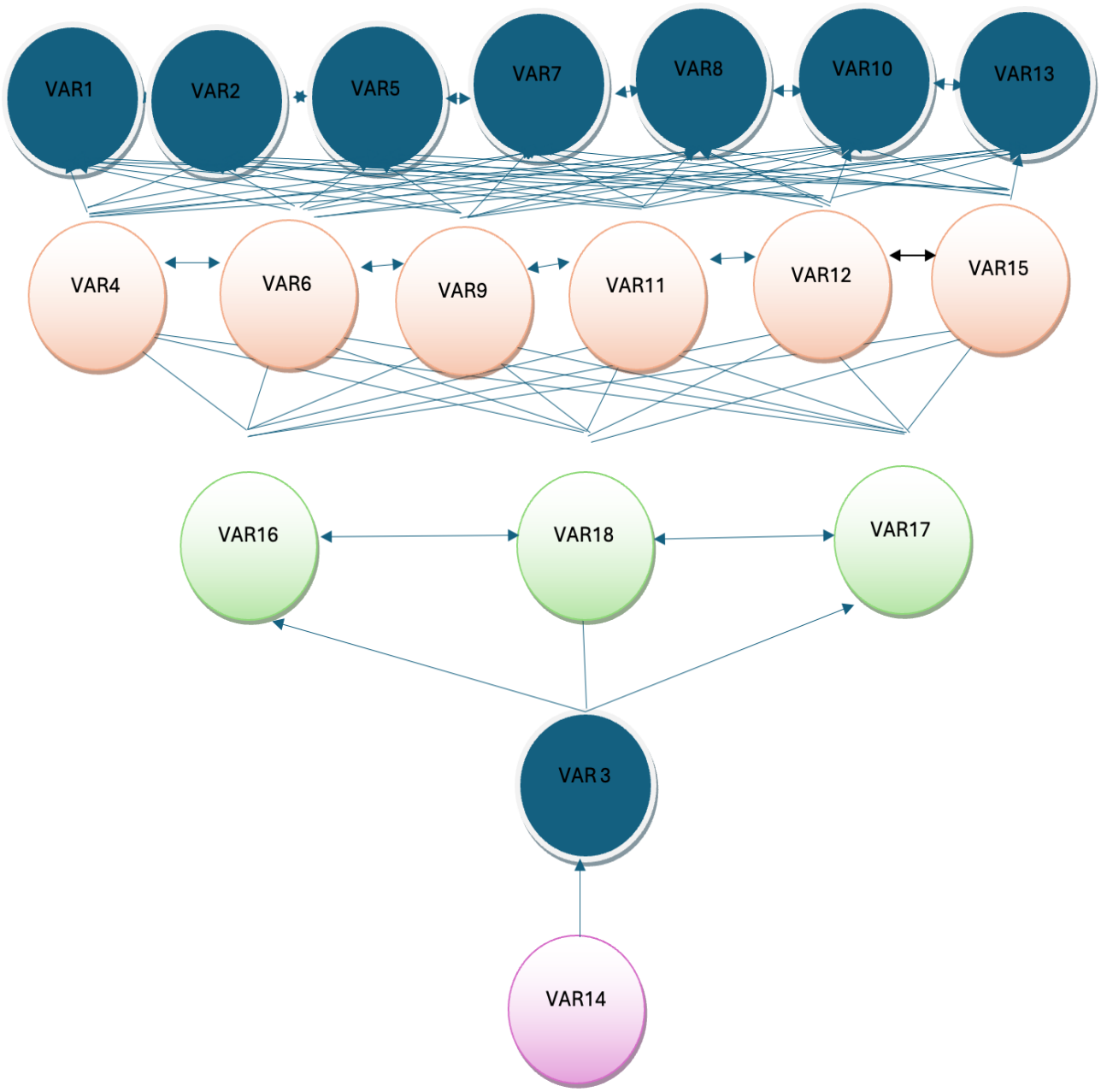


Figure 4.2: Digraph (Source: Author's work)

4.2.8 ISM model

After conducting a comprehensive analysis using the ISM model, the findings indicate that government support exhibits strong driving power and low dependence among the eighteen enablers. This suggests that government support plays a pivotal role and is considered the most crucial factor during the pandemic crisis, significantly influencing the resilience of healthcare supply chains. The government's support plays a crucial role in influencing top management's

support during supply chain disruptions resulting from the pandemic. This support could come in the form of policy measures, financial aid, or regulatory adjustments, all of which can significantly impact the ability of top management to navigate and mitigate the challenges posed by the disruptions. The support of top management plays a crucial role in influencing information visibility, financial support, and family support. It encourages information visibility, significantly impacting how supply chain partners communicate during a crisis to minimise the negative effects of disruptions. In times of crisis, it is crucial to have clear visibility of information to address the situation effectively. Furthermore, the backing of top management offers crucial financial assistance and provides valuable guidance and direction. Family support is also pivotal in navigating challenging times and offering emotional and practical assistance to those affected.

Various factors profoundly impact the utilisation of digital technologies during a crisis. First, financial support is crucial in enabling organisations to invest in and adopt digital solutions. Information visibility is also essential, as it ensures that relevant data is shared effectively among supply chain partners within the healthcare sector. Additionally, family support can influence individuals' ability to engage with digital technologies during challenging times. Furthermore, the implementation of digital technologies can greatly enhance transparency in terms of information sharing among supply chain partners in the healthcare sector. This can lead to improved inventory management practices, allowing for more efficient planning of healthcare items based on demand and supply situations. Moreover, accessibility, mutual respect, and affordability also play significant roles in determining the successful adoption and utilisation of digital technologies during crises.

In the healthcare sector, digital technology is crucial in enhancing process transparency. Moreover, effective inventory management systems ensure that necessary supplies are readily available, promoting accessibility and timely delivery of healthcare services. Establishing

mutual respect and affordability further strengthens supply chain partners' relationships, fostering trust and cooperation. This environment of trust encourages information sharing and promotes adaptability, alignment, awareness, agility, and interdependence, ultimately leading to a more efficient and effective healthcare supply chain.

Upon careful examination, it can be inferred that the resilience of the healthcare supply chain is a multifaceted and intricate concept that warrants significant focus. Notably, government and management support emerge as pivotal drivers with high driving value and minimal dependence. Conversely, the enablers, including trust, information sharing, adaptability, alignment, awareness, agility, and interdependence, exhibit low driving power but high dependence, signifying their critical role in bolstering the resilience of the healthcare supply chain.

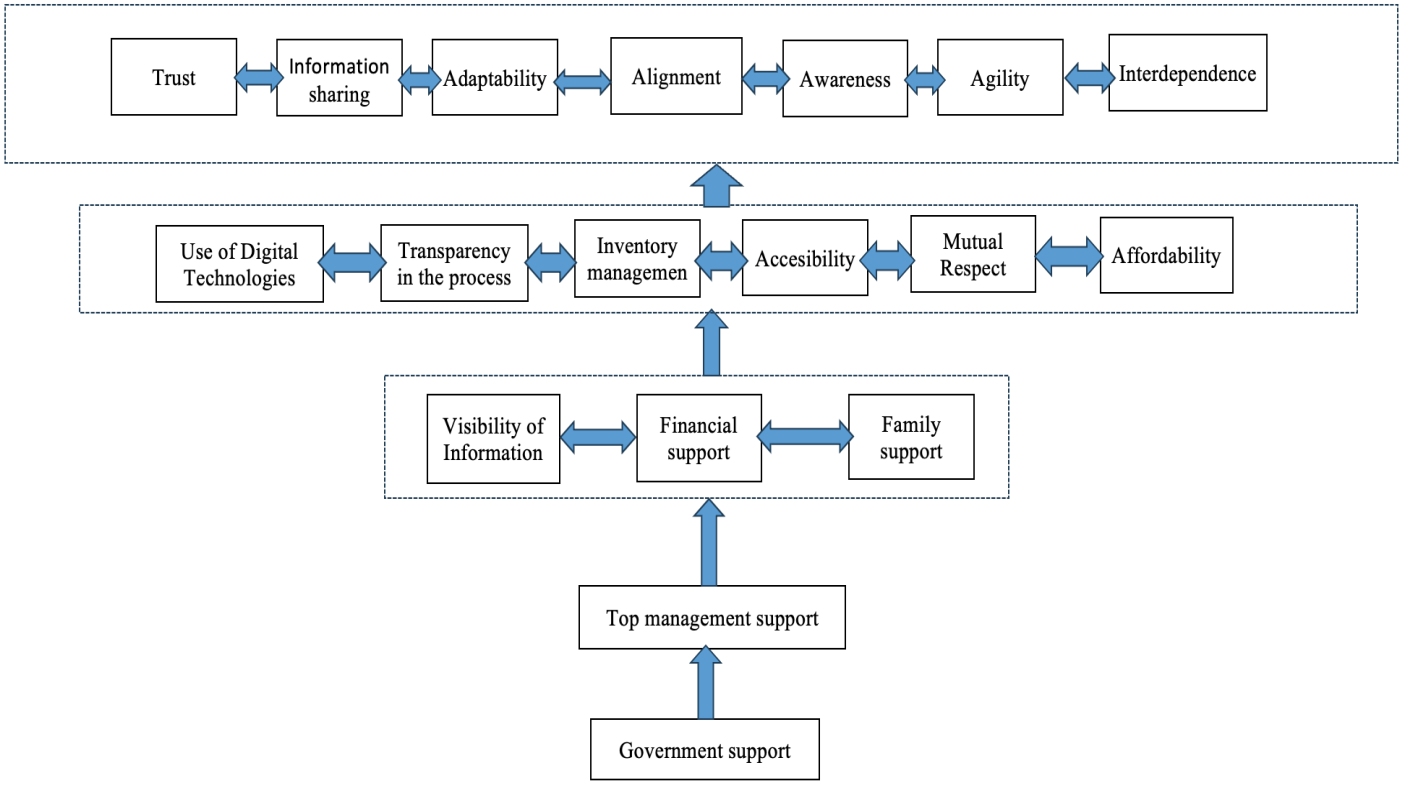


Figure 4.3: ISM Model
(Source: Author's work)

4.3 MIC-MAC (Matrice d'Impact Croisés – Multiplication Appliqueé à un Classement) analysis

The objective of the MICMAC analysis is to classify the enablers into four categories further. Category 1 represents variables with weak driving power and weak dependence, meaning these enablers are not closely related to other enablers. Our analysis suggests two scenarios. First, the classification of the enablers is based on the initial reachability matrix (Figure 4.4, where the X-axis represents Dependence and the Y-axis represents Driving power), and second, it is based on the final reachability matrix (Figure 4.5). After thorough consideration, I have analysed both scenarios to gain a deeper understanding of how the nature of the enablers evolves when the initial reachability matrix is modified using the transitivity links. This analysis aims to illuminate the specific changes and impacts that occur because of these modifications.

I have acquired information based on the MICMAC analysis that provides additional insight into the nature of enablers. The four quadrants help understand the relationship between dependence and the driving power of enablers.

The first quadrant (autonomous enablers) is characterised by enablers with weak dependence and weak driving power. For example, VAR 15 (affordability) falls into this quadrant, which is known as an autonomous enabler. These autonomous enablers have weak associations with other variables and do not exert strong influence. This understanding can be valuable for assessing the impact of various enablers on the overall system.

In the second quadrant (dependence enablers), variables or enablers have weak driving power but high dependence. This study identified enablers (VAR1, VAR12, VAR9, VAR7, VAR10, and VAR5) falling into the dependence enablers quadrant. Therefore, trust, mutual respect, inventory management, alignment, agility, and adaptability are represented in this quadrant and have high dependence and weak driving power. Hence, these are the outcomes which rely on the driving enablers.

The third quadrant (linkage enablers) represents those enablers or variables with medium driving power and dependence. Therefore, these enablers serve as mediating variables between driving and dependence variables. In this study, VAR4, VAR6, VAR8, VAR13, and VAR11 are enablers with medium dependence and driving power. The utilisation of digital technologies (VAR4), transparency (VAR6), increased awareness (VAR8), interdependence (VAR13), and accessibility (VAR11) play a crucial role as effective facilitators that mediate between the driving variables and the dependence enablers. These factors act as key components in supporting and bridging the gap between the primary influencing elements and the dependent factors.

The fourth quadrant (driving enablers) represents those enablers who have high driving power and weak dependence. In this study, enablers VAR3 (top management support), VAR14 (government support), VAR18 (financial support), VAR16 (information visibility), VAR2 (information sharing), and VAR17 (family support) are identified as the driving enablers. Top management support, government support, financial support, information visibility, information sharing, and family support are strong drivers determining how the healthcare sector recognises these enablers. These factors lead to essential effects such as trust, mutual respect, inventory management, alignment, agility, and adaptability.

Figure 4.4 has been updated after the incorporation of a transitive check. The results indicate that top management and financial support are enablers with strong driving power. After analysing the data presented in Figures 4.3 and 4.4, it is evident that government support, top management support, and financial backing play pivotal roles as enablers in developing robust and resilient healthcare supply chain systems. These factors are essential in ensuring the efficiency and effectiveness of the healthcare supply chain, particularly in times of crises and disruptions.

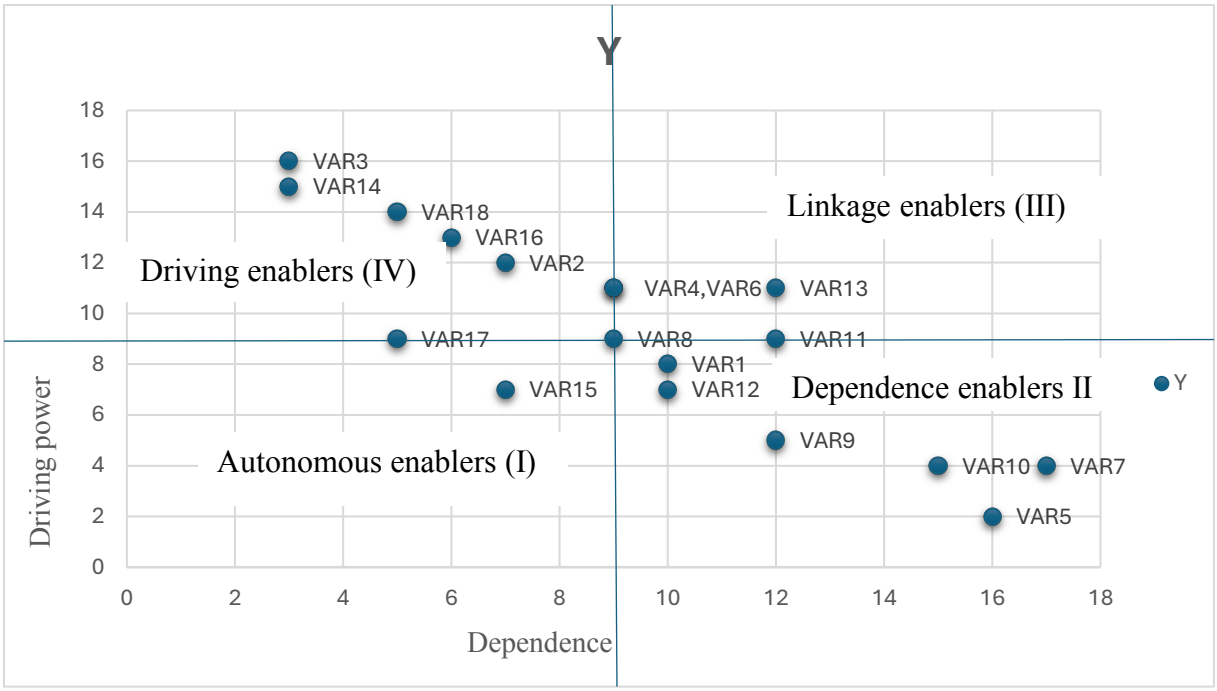


Figure 4.4: Driving power and Dependence diagram of enablers of HSCR based on the Initial Reachability Matrix
(Source: Author's work)

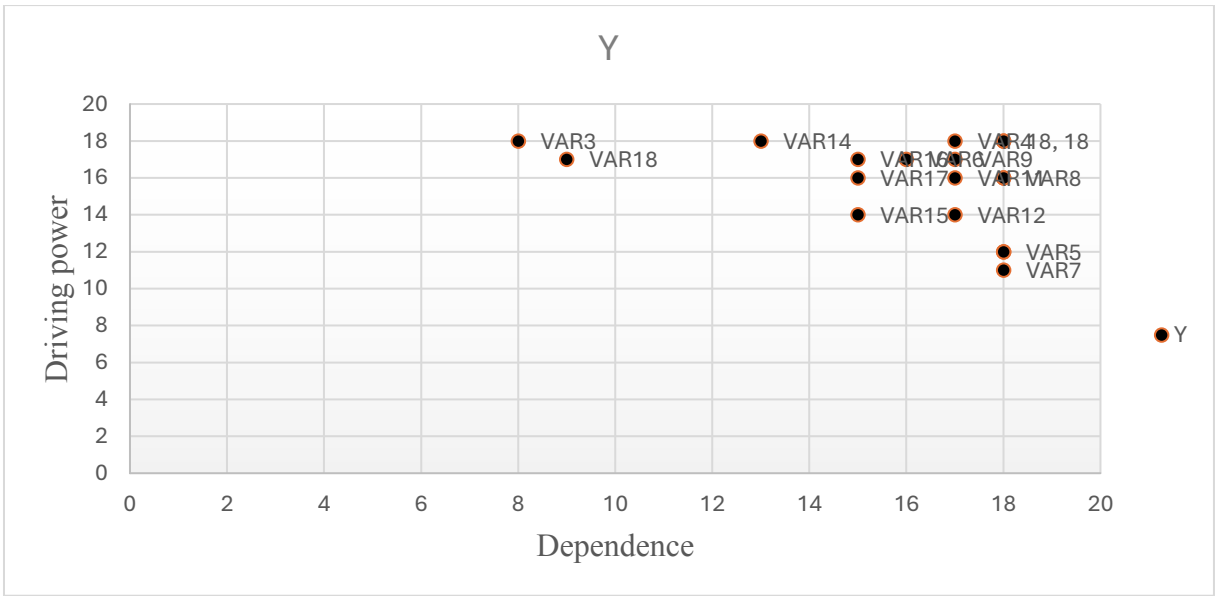


Figure 4.5: Driving power and Dependence diagram of enablers of HSCR based on the Final Reachability Matrix
(Source: Author's work)

4.4 Synthesis of ISM and MICMAC Output

After conducting a comprehensive analysis of the output of the ISM and MICMAC methods, I have identified several key inferences that warrant a thorough investigation.

4.4.1 Government support and top management support

Government support is essential during crises to shape the beliefs and attitudes of top management. This support encourages and empowers top managers to actively address the issues arising from the crisis, particularly those affecting the supply of healthcare items. Government involvement can provide the necessary resources and guidance to help ensure that the healthcare system can effectively meet the demand during a crisis.

4.4.2 Government support, top management support and financial support

The support provided by the government during a crisis proves to be effective in several ways. The financial package helps hospitals and healthcare centres build necessary capabilities and allows them to recruit additional staff to handle emergencies during a health crisis. In addition, top management's decision to provide additional incentives to the healthcare staff working extra hours in a highly uncertain and stressful environment, away from their families, proves to be highly beneficial. Government and top management support are pivotal elements that drive financial support, which enables organisations to acquire necessary resources and build capabilities. This financial backing is significant in empowering organisations to effectively navigate and address high uncertainties within their operational environment.

4.4.3 Family support, financial support and top management support

During times of crisis, the support of healthcare staff's families plays a crucial role in maintaining the well-being and effectiveness of the healthcare workers. The emotional and practical support provided by family members can significantly impact the mental and physical resilience of the staff, ultimately influencing their performance and ability to provide quality

care to patients. Furthermore, top management's involvement in fostering an environment that values and supports the families of healthcare staff can have far-reaching benefits. By recognising the importance of family support, top management can implement policies and initiatives that enhance the well-being of healthcare workers and their families. Extending this support to supply chain partners can create a more cohesive and resilient healthcare ecosystem, benefiting patient care and overall operational effectiveness.

4.4.4 Digital technologies, increased awareness, interdependence, and accessibility as mediating variables

The effective utilisation of digital technologies, including but not limited to electronic health records, telemedicine platforms, and supply chain management systems, is pivotal in enhancing coordination and communication among healthcare supply chain partners. This, in turn, plays a significant role in harnessing the support from government agencies, top management, and family members. By leveraging these digital tools, healthcare supply chain partners can achieve desired outcomes such as improved trust, mutual respect, inventory management, alignment, agility, and adaptability to changing circumstances. Furthermore, the accessibility of resources, including financial support, skilled workforce, and technological infrastructure, is a critical enabling factor in a developing economy, ensuring that the healthcare supply chain functions optimally and delivers high-quality patient care.

Hence, based on synthesis, we develop a framework that helps us understand how social support theory during a crisis triggers support mechanisms that further enhance the desired outcome (see Figure 4.5).

4.4.5 Social Support System and Healthcare Resilience

A strong social support system encompassing family, friends, and community has played a crucial role in enhancing an individual's ability to cope with health challenges and bounce back

from adversity. This support network can provide emotional, practical, and informational assistance, contributing to overall healthcare resilience. Integrating ISM and MICMAC analysis provides a valuable contribution to understanding social support theory. This combined approach helps elucidate the intricate ways the social support system functions during times of crisis and its pivotal role in bolstering the resilience of healthcare supply chains.

Dunkel-Schetter et al. (1987) highlighted the crucial role of a strong social support system in aiding individuals in managing and coping with stress and adversity. They underscored that a network of supportive relationships can provide emotional, informational, and practical assistance, which can help individuals navigate and overcome challenging circumstances. Drawing from the social support theory, I posit that during a crisis, an effective support system is crucial in bolstering the resilience of the healthcare supply chain. By providing the necessary support, such as logistical assistance, resource allocation, and communication facilitation, the support system can significantly contribute to maintaining the functionality and effectiveness of the healthcare supply chain, ultimately ensuring that critical medical resources reach those in need during challenging times. Aside from the crucial support provided by families, the backing of top-level management within healthcare organisations and government support at the local, regional, and national levels play a pivotal role in fortifying the fragile healthcare system during times of crisis. Their combined efforts can ensure that the system is well-equipped to handle the challenges posed by emergencies and maintain the delivery of high-quality care to those in need. Figure 4.6 significantly enhances social support theory by extending its boundaries to elucidate the healthcare supply chain resilience concept.

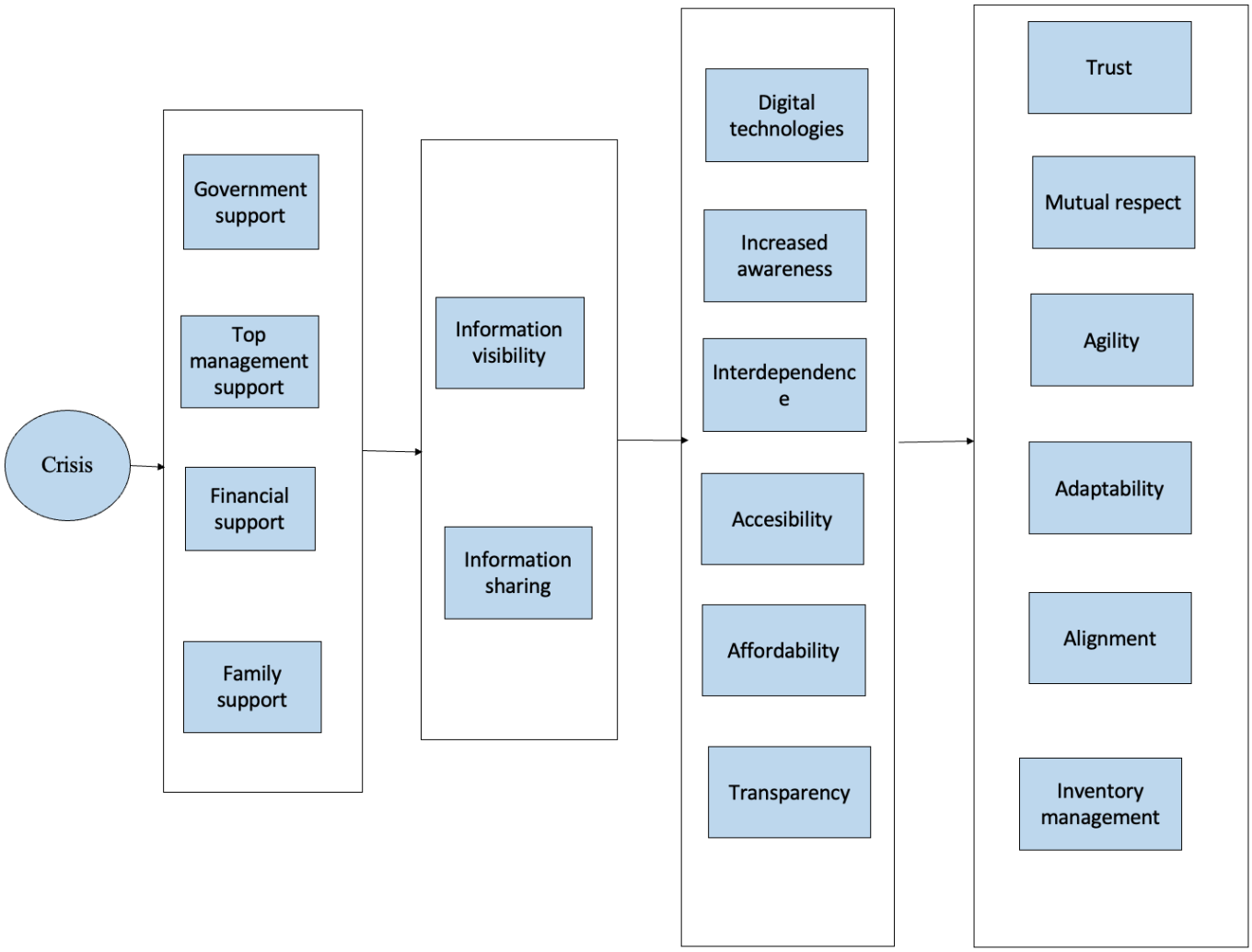


Figure 4.6: Social Support System for Resilient Healthcare Systems
(Source: Author's work)

4.5 Chapter Summary

This chapter comprehensively discusses the ISM method and its applications in healthcare supply chain management. I also delve into the detailed use of the DELPHI approach, focusing on its role in identifying and analysing the key enablers of resilience within the healthcare supply chain. The chapter establishes a contextual relationship among these enablers, providing insights into their interdependencies and impact on overall supply chain resilience. In addition to the ISM method, I have performed the MICMAC analysis, which further classifies the enablers into four categories based on their dependence and driving power. I have synthesised the outcome of these analyses and developed a framework (Figure 4.5) to expand the boundary

of social support theory in explaining healthcare supply chain resilience. It is important to note that the model I developed is in its early stages. As with any inductive approach, the model presents a series of research propositions that require empirical validation through rigorous testing and analysis. This process is crucial for ensuring the accuracy and reliability of the model's findings and conclusions.

I have enumerated certain limitations of the ISM model to provide readers with a comprehensive understanding of its strengths and weaknesses. This approach allows for a more nuanced evaluation of the model's effectiveness and applicability. The ISM method relies on experts' interpretation to analyse complex relationships between different variables. To ensure the reliability and accuracy of the findings, I made a conscientious effort to minimise the common method bias using triangulation, which involves cross-verifying information from multiple sources or methods. This approach helps to strengthen the validity of the results by reducing the potential impact of any single method's inherent limitations or biases.

Sushil (2012) argues that the ISM method is carefully designed to streamline the presentation of intricate systems. It achieves this by deciphering embedded objects and converting ambiguous, poorly articulated mental models into visible, well-defined models. This approach is instrumental in addressing theoretical inquiries about "what" and "how" in theory building. It expedites the identification of the structure within a system, thereby offering a comprehensive understanding of its components and relationships. However, the ISM technique is intended for individuals who deeply understand its principles and have received training in data interpretation. Access to computer resources is essential for successfully applying this technique, and its implementation may be hindered without such facilities. It is crucial to recognise that the interpretation of links within the model is partial, allowing for diverse interpretations by the user. Additionally, it is essential to note that ISM does not address the causality of links, thereby limiting its ability to explain "why" in theory building.

Therefore, it is highly recommended that structural equation modelling be employed to conduct further empirical validation of the ISM model. This will help solidify the model's validity and reliability, ensuring it accurately represents the underlying relationships and constructs being studied.

CHAPTER 5: THEORETICAL MODEL DEVELOPMENT, RESEARCH HYPOTHESES AND DATA ANALYSIS

In the next section, I will tackle the second research objective of my thesis, which is to present a comprehensive theoretical model based on organisational theories and pivotal research hypotheses. This chapter will exemplify my positivistic approach to address the second research objective and answer the guiding research questions. I will provide a detailed overview of the theory and the model development, which is the very essence of this study. Additionally, I will delve into each research hypothesis, underscoring its importance and the meticulousness of the questionnaire development and sampling design for data collection. I will then elucidate the data collection strategy and the meticulous data gathering from the target respondents. Following the data collection, I conducted a rigorous data analysis using variance-based structural equation modelling, also known as partial least squares structural equation modelling (PLS-SEM). Finally, I will present a comprehensive analysis of the PLS-SEM output, and a stimulating discussion of the study based on the PLS-SEM analysis, culminating in a chapter summary.

5.1 Theoretical Model

The term "*model*" has shaped the scientific foundation across various disciplines for years (Achinstein, 1965). Whether in the natural or social sciences, theoretical models serve as frameworks that incorporate and reflect the underlying assumptions necessary to comprehend and analyse real-world situations. These models provide a structured approach to understanding complex phenomena and are essential for advancing scientific knowledge and understanding societal dynamics.

Sutton & Staw (1995) argue that some scholars have a prevalent misconception about the nature of theoretical models or diagrams representing constructs and their connections. The authors

emphasise that it is not accurate to consider such representations as complete theories. Instead, they assert that while there may be some misunderstanding, the significance of a theoretical model in an empirical study cannot be understated. This underscores the crucial role that theoretical models play in guiding empirical research and shaping the understanding of complex constructs and their relationships. The significance of employing diagrams and figures to visually represent causal relationships and the progression of processes over time is emphasised. It is pointed out that such visual aids enable readers to comprehend a chain of causation or the influence of a third variable on a relationship, thereby enhancing the relevance and impact of your work.

Instead, temporal diagrams are highly valued for their capacity to visually represent the sequential unfolding of a specific process over time (Sutton & Staw, 1995). They play a crucial role in theory building, especially for researchers who encounter challenges in effectively expressing their ideas in writing. Diagrams organise and structure otherwise disjointed arguments, thus helping prolific writers avoid inadvertently clouding their points. However, it is essential to note that diagrams and figures should be considered complementary tools rather than the primary focus. Verbal explanations are essential for thoroughly elucidating proposed connections and patterns. Whetten (1989) highlights the significance of diagrams in facilitating the organisation of conceptualisations by explicitly delineating patterns and causal relationships. Despite their efficacy in bringing order to complex ideas, diagrams must explain the underlying reasons for these connections comprehensively. Therefore, storytelling is vital in this context as it is a powerful tool to elucidate the cause-and-effect relationship and provide a clear rationale behind the connection (Dyer & Wilkins, 1991).

Weick (1995), argues that articulating the literature review is crucial in laying the foundation for theory development. This initial step involves carefully examining and synthesising existing literature to identify gaps, patterns, and contradictions, which can lead to the formulation of

new theories and ideas. When employing a conceptual framework, research methods balance traditional inductive and deductive theory-building research methodologies (Meredith, 1993). A theoretical model can be described as a framework comprising two or more interconnected propositions. These propositions are designed to explain a specific event, offer insight into a particular phenomenon, or propose hypotheses that can be tested (Flynn, 1990; Meredith, 1993; Boyer & Swink, 2008).

Maxwell (2012) elaborates on a theoretical framework, emphasising that it encompasses more than a mere verbal or pictorial representation of ideas. Instead, it constitutes a structured collection of ideas, concepts, and commitments that serve as a guiding force and informational foundation for the study (Collins & Stockton, 2018). Notably, numerous scholars have underscored the necessity of clearly defined constructs and conceptual frameworks in augmenting the research rigour within the realms of operations and supply chain management (Chen & Paulraj, 2004a; Naslund et al., 2010; Dubey et al., 2017). When developing a theoretical framework, it is essential to integrate a wide range of works by identifying common elements, recognising differences, and expanding upon the existing body of work (Meredith, 1993). This process involves carefully analysing and synthesising diverse sources to create a cohesive and comprehensive theoretical foundation (Chen & Paulraj, 2004a). Hence, we argue that the conceptual framework plays a crucial role in research by defining the variables and developing specific predictions (Imenda, 2014). This is achieved by integrating existing theories with logical deduction, ultimately leading to the formulation of propositions (Wacker, 1998; Melnyk & Handfield, 1998).

5.2 Assumptions of the Theoretical Model

The theoretical model is shaped by fundamental philosophical assumptions, which encompass ontological (the nature of reality), epistemological (the nature of knowledge), axiological (the nature of values), and methodological (the nature of research methods) considerations. The

theoretical model is meticulously crafted to specifically target and address the gaps identified in existing research. These gaps were discerned through a comprehensive analysis of the available literature. Furthermore, the identified research gaps question and challenge the existing knowledge body's assumptions (Alvesson & Sandberg, 2011).

Alvesson & Sandberg (2011) propose that the problematisation approach, which involves critically examining the underlying assumptions and issues within a research topic, is more effective than simply identifying or creating research gaps. They emphasise that this method encourages a deeper understanding of the complexities and nuances within a research area, leading to a more robust and insightful identification of gaps in the existing literature. Therefore, identifying research gaps is crucial as it allows researchers to formulate specific and focused research questions, addressing aspects such as what needs to be studied, why it is important, how it can be studied, when and where the study can take place, and who will be involved in the research process (Whetten, 1989).

To answer the question "*what*," it is essential to understand the real situation. For example, during the COVID-19 crisis, the healthcare supply chain gained significant importance. The world has come to a halt in dealing with the exponential rise in COVID-19 cases, and the problems have been further complicated due to the fragile supply chain. In most cases, due to the shortages of PPEs, medicine, sanitiser, and oxygen cylinders, many deaths could not be prevented. It is well understood that the disruption of the supply chain due to the health crisis is a major challenge. However, existing literature remains inconclusive as most studies lack rigour and only provide anecdotal evidence. This is one of the research gaps I have arrived at following the problematisation approach. Therefore, when addressing the question "what," the researcher should look at essential constructs that serve as variables and act as the fundamental building blocks of the theoretical model. During my initial observation, a crucial part of theory building, I observed a lack of collaboration among the partners involved in the healthcare

supply chain. This absence of collaboration negatively impacts the efficiency and effectiveness of the entire healthcare supply chain, potentially leading to patient delays.

Upon conducting a comprehensive literature review, I have identified the critical importance of information visibility and trust among partners in enhancing collaboration within healthcare supply chains, thereby contributing to resilience (Mandal, 2017; Baah et al., 2021; Scala & Lindsay, 2021; Küffner et al., 2022; Zhou et al., 2024). Despite the extensive body of literature on this topic, the existing studies have failed to provide a clear understanding of how trust can be cultivated among partners during times of crisis and how information visibility specifically influences collaboration. Additionally, I am interested in exploring the role of leadership during crisis periods. Numerous unconnected aspects require thorough examination using a suitable theoretical framework.

After conducting a thorough examination and critically evaluating each aspect, the subsequent step involved evaluating the axiological assumptions. This process aimed to determine whether the empirical examination of these constructs and variables holds any potential value. To gain deeper insights, I engaged in in-depth discussions with experts to understand the extent to which collaboration is the missing link in the existing healthcare supply chain. I also profoundly explored the level of information visibility among healthcare supply chain partners and the extent to which trust is lacking within the supply chain. These discussions revealed that, in many cases, collaboration, trust, and information visibility are indeed the missing links impacting the healthcare supply chain.

During the finalisation process, I thoroughly examined the extent to which existing measurement scales exist for the constructs under consideration (Flynn et al., 1994). Access to established measurement scales is crucial as it can help address any potential complexities that may arise from the lack of such scales (Forza, 2002).

Identifying the theory underpinning the study is crucial in developing the theoretical model (Parkhe, 1993). Given that the research encompasses multiple organisations within the healthcare supply chain, organisation theory is the most fitting choice for my case (Van Hoek, 2020). During my evaluation, I critically analysed the theoretical model, considering its underlying assumptions and the conditions that govern it. In my case, the interrelationships among the constructs can be readily elucidated by considering their relational value (Dyer & Singh, 1998). In a highly competitive and complex business environment, establishing solid inter-organisational relationships can be instrumental in gaining a competitive edge (Cousins, 2005). These relationships can provide access to valuable resources, knowledge sharing, and collaboration opportunities, ultimately contributing to a company's success in the marketplace.

When addressing the question of "*how*" these constructs impact each other, I utilised existing theory to establish a clear relationship between the constructs. By strategically positioning the constructs within the model, I ensured that the causality assumption was satisfied (Fiss, 2011). When constructing a theoretical model, it is crucial to carefully consider causality as one of the primary aspects (Handfield & Melnyk, 1998). In the upcoming data analysis section, I will engage in a detailed discussion about the role of causality in the model-building process. As I continue into the next section, I will delve into the finer details of the remaining aspects, including specifics about when, where, and who. It is crucial to consider these essential assumptions when developing the theoretical model.

I propose a theoretical model based on the research questions and underlying assumptions (Figure 5.1). The theoretical model is firmly grounded in two perspectives. The relational view (Dyer & Singh, 1998) explains how specific relational constructs, such as swift trust, information visibility, and collaboration, contribute to developing healthcare supply chain resilience. This resilience is regarded as a critical performance outcome within the context of my model. The relational view, as conceptualised by Dyer & Singh (1998), is an expansion of

the resource-based view (RBV) (Barney, 1991) and focuses on the cooperative behaviour of multiple organisations rather than just a single organisation. This perspective emphasises the interconnectedness and interdependence of organisations within a broader network, highlighting the significance of collaborative efforts and interactions among multiple entities (Dyer & Singh, 1998). The original relational view, as proposed by Dyer & Singh (1998), has been criticised for being static. Dyer et al. (2018) noted that this view cannot provide insights into the dynamics of cooperation, value creation, and value capture over time. This criticism highlights the need for a more dynamic and time-sensitive perspective on relational views in business and management. Recognising the significance of approaching situations from a dynamic perspective is essential. This allows us to gain deeper insights into the factors driving cooperation to create value and the elements leading to competition in capturing value (Dyer et al., 2018). To elucidate this point, I look at the conflicting research results regarding creating value in partnerships (Barringer et al., 2000; Villani et al., 2017). This can be better understood by taking a dynamic perspective. For example, the relational view suggests that informal protections such as trust and goodwill are more effective than formal protections in reducing transaction costs and encouraging knowledge sharing, ultimately leading to improved value creation (Dyer et al., 2018; Rouyre & Fernandez, 2019). Supporting this theoretical perspective, several empirical studies have demonstrated that high levels of trust in partnerships are linked to lower transaction costs, increased information sharing, and overall better performance (Dyer et al., 2018). Leadership plays a vital role in bridging the existing gaps in the relational view. Trust and information visibility are instrumental in fostering effective collaboration among team members. The extent to which collaboration enhances resiliency is intricately tied to the level of involvement and guidance leaders provide.

The relational leadership theory is based on the idea that ongoing relationships create and sustain meaning (McCauley & Palus, 2021). It views individuals as relational constructions,

with the self-being constantly shaped within relational processes. Leadership is seen as emergent and contextual within the processes that enable collective achievements (Plowman et al., 2007). Information visibility aids decision-making, which may influence managers' cognitive biases and values. Hambrick and Mason (1984) argue that the organisation's strategy reflects the top manager's vision and mission. Information visibility influences how managers act and provides desired resources, essential for building supply chain resilience (Williams et al., 2013). During times of crisis, leaders' decision-making can be significantly influenced by their emotions, leading to cognitive biases (Hadley et al., 2011; McCauley & Palus, 2021). Hence, I consider crisis leadership an essential variable based on the *Upper-echelons Theory* (Hambrick & Mason, 1984). It helps expand the theoretical understanding of relational constructs and their influence on healthcare supply chain resilience.

In summary, I present the theoretical model illustrated in Figure 5.1. The collaboration is a mediating variable between the independent variables (information visibility and swift trust) and the dependent variable (healthcare supply chain resilience). Furthermore, considering the varying outcomes in different settings, I have considered crisis leadership (Zhang et al., 2020; Wu et al., 2021; Chatterjee et al., 2022) as a moderating variable in the connection between collaboration and healthcare supply chain resilience.

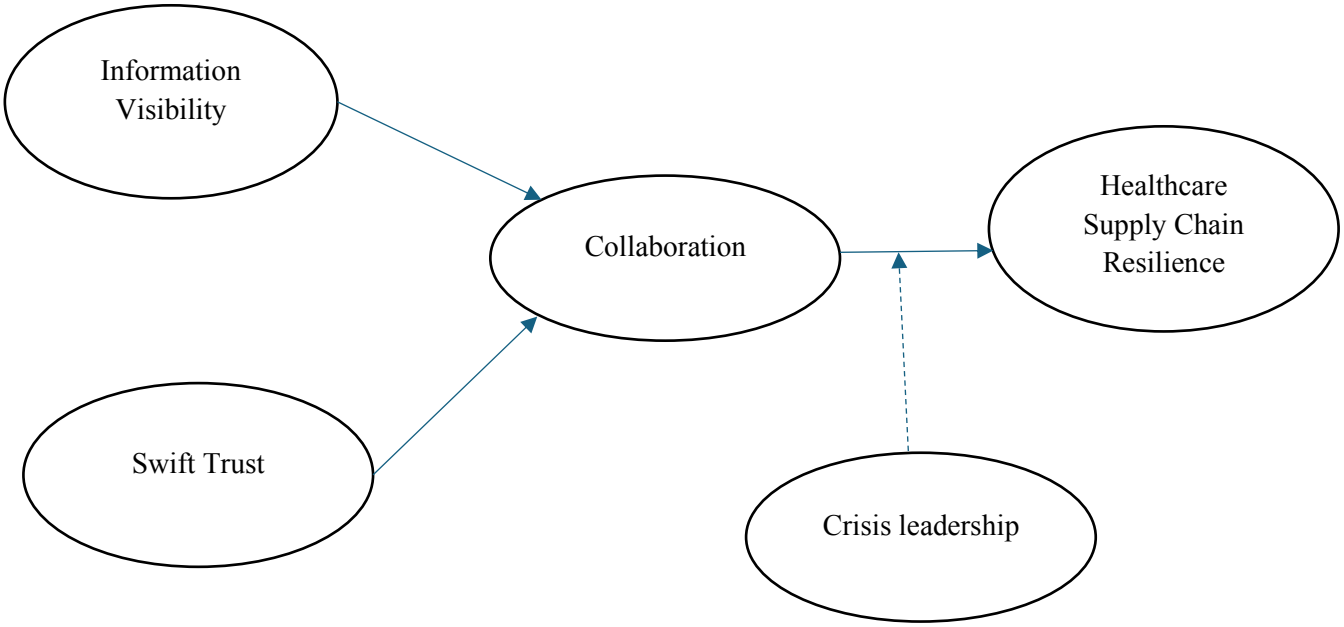


Figure 5.1: Theoretical Model
(Source: Author's work)

5.3 Research Hypotheses

5.3.1 Information Visibility and Collaboration

Visibility within the supply chain is crucial for improving coordination/collaboration among supply chain partners (Barratt & Oke, 2007; Wang & Wei, 2007). Visibility is closely tied to the flow of information, a fundamental aspect of supply chain management (Choi et al., 2021). It allows partners to track inventory, facilitating timely replenishment to avoid stock-outs or accumulating obsolete inventory (Burgos & Ivanov, 2021). Enhanced visibility of information flows fosters trust among partners, thereby improving decision-making capabilities with minimal intervention (Brandon-Jones et al., 2014). Leavitt & Robinson (2017) argue that during crises like natural or man-made disasters, obtaining accurate information is challenging, and the lack of it can lead to significant problems and, in some cases, even cost lives. Furthermore, the widespread sharing of information through social media often leads to confusion about the accuracy of the shared information (Ngai et al., 2015; Pennycook et al., 2021). Therefore, I

argue that having clear and accessible information is crucial for establishing effective collaboration among the partners within the healthcare supply chain. Hence, I hypothesise:

H1: Increased visibility of information exchange among healthcare supply chain partners during a crisis positively and significantly impacts collaboration.

5.3.2 Swift-Trust and Collaboration

Trust is an important aspect that helps minimise opportunistic behaviour among the partners and improve cooperation/collaboration (Morgan & Hunt, 1994; Tatham & Kovacs, 2010; Dubey et al., 2019). Barratt (2004) argues that trust-building is essential to supply chain management. However, crisis management requires an entirely different approach to dealing with uncertain events, and in such a case, swift trust is the most critical element (see Tatham & Kovacs, 2010; Dubey et al., 2020; Schiffling et al., 2020). Crises such as COVID-19 often require high agility (Janssen & Van der Voort, 2020). Hence, supply chain networks are quickly formed to tackle such crises, referred to as hastily formed networks (HFNs) (Tatham & Kovacs, 2010). Thus, even in the case of HFN, trust is equally vital for effective and efficient coordination. Tatham and Kovacs (2010, p. 37) define swift trust as "trust is present when the one party has a fundamental belief that the other can be relied upon to fulfil their obligations with integrity and will act in the best interests of the other". However, in the HFN, trust should be swifter than in other supply chain networks. Hence, such a kind of rapid trust is termed "swift trust". Dubey et al. (2020) argue that swift trust is an essential component of collaboration, a desirable component of resilience. Especially during crises, leaders need to make quick decisions based on trust, as further delay in the execution could cause potential damage to human lives and properties (Smart & Vertinsky, 1977; Wilson, 2020). Hence, I hypothesise it as:

H2: Improving swift-trust levels among supply chain partners during crises enhances collaboration.

5.3.3 Collaboration and Healthcare Supply Chain Resilience

Supply chain collaboration is critical in effectively preparing for, responding to, and recovering from supply chain disruptions while working to minimise their impact (Duong & Chong, 2020). Barratt (2004) identified mutual benefit, risk-sharing during times of uncertainty, and resource-sharing as the primary motivations behind such collaboration. This collaboration is essential for fostering solid relationships among partners, facilitating joint planning efforts, and enabling the exchange of real-time information (Cao & Zhang. 2010; Scholten & Schilder, 2015). Supply chain collaboration presents multiple business advantages (Cao & Zhang, 2010; Scholten & Schilder, 2015). These include heightened visibility into the supply chain, increased flexibility to adapt to changing market conditions, and shorter product lead times. However, it is essential to note that establishing enduring collaborative relationships encompassing all supply chain elements may not always be achievable or preferable in every situation. During times of crisis, organisations often experience significant disruptions in their supply chains (Scholten et al., 2020). The healthcare sector is especially susceptible to such disruptions due to its critical role in providing essential medical supplies and services (Kovacs & Falagara Sigala, 2021). The collaborative efforts among the partners play a crucial role in addressing the information asymmetry that often results in limited visibility of both demand and supply (Michalski et al., 2018). This joint effort ensures that accurate and timely information is shared, leading to better decision-making and operational efficiency within the business ecosystem (Crick & Crick, 2020; Marty & Ruel, 2024). During times of crisis, such as the current healthcare emergency, it is crucial for partners within the healthcare industry to collaborate effectively (Haldane et al., 2021). This collaboration plays a significant role in bolstering the resilience of the healthcare supply chain, ensuring that vital medical supplies and resources continue to flow efficiently to

where they are needed most (Zamiela et al., 2022). Effective collaboration among partners allows for better coordination, resource allocation, and problem-solving, ultimately helping to maintain the stability and functionality of the healthcare supply chain during challenging times (Shah et al., 2008; Caldwell et al., 2017). Thus, I hypothesise as:

H3: Collaboration among supply chain partners has a positive and significant impact on the resilience of healthcare supply chains.

5.3.4 The Mediating Effect of Collaboration between Information Visibility/Swift Trust and Healthcare Supply Chain Resilience.

The literature emphasises the critical role of information visibility and swift trust among partners in the healthcare supply chain in strengthening the system's resilience (Ozawa et al., 2016). Notably, it highlights the direct relationship between information visibility/swift trust and collaboration and the link between collaboration and healthcare supply chain resilience (Friday et al., 2021). Therefore, it is essential to recognise the significant mediating role of collaboration among the partners in ensuring the robustness of the healthcare supply chain (Kovacs & Falagara Sigala, 2021). Collaboration among partners is crucial for boosting the visibility of information and building trust efficiently (Baah et al., 2021). These two factors, visibility and trust, are closely intertwined and play a significant role in the success of any partnership or collaborative effort (Scholten & Schilder, 2015). When partners work together effectively, they can ensure that information is widely accessible and that trust is established and maintained, ultimately leading to achieving common goals. By working together, the partners can create a resilient healthcare supply chain system that effectively responds to challenges and disruptions. This collaborative effort will improve the flow of information and strengthen the overall trust and cooperation among the partners, ultimately leading to a more robust and reliable healthcare supply chain. Hence, we hypothesise it as:

H4a: Collaboration mediates the effect of information visibility on healthcare supply chain resilience.

H4b: Collaboration mediates the effect of swift trust on healthcare supply chain resilience.

5.3.5 Moderating Effect of Crisis Leadership

Upper-echelons theory (UET) posits that an organisation's culture, policies, and performance are significantly influenced by the perspectives and experiences of its top managers (Hambrick & Mason, 1984). According to this theory, the values, beliefs, and decision-making styles of these leaders shape the organisation's overall vision and mission (Abatecola & Cristofaro, 2018). As a result, the priorities and direction set by upper management ultimately manifest throughout the entire organisation, impacting everything from strategic objectives to daily operations. This theory highlights the importance of leadership in steering organisational success and emphasises that the attributes of top managers are reflected in the organisation's outcomes (Hambrick, 2007). According to the upper-echelons theory (UET), *crisis leadership* is characterised by a unique set of skills and approaches that are vital for effectively navigating and managing challenging situations (Gimmon & Zysberg, 2024). During a crisis, leaders must demonstrate resilience, clear communication, and strategic decision-making abilities (Riggio & Newstead, 2023). These skills enable them to assess the situation accurately, coordinate responses, inspire confidence among team members, and adapt quickly to changing circumstances. Understanding the distinctive nature of crisis leadership helps organizations prepare for and respond to emergencies with greater effectiveness and ensure a more cohesive response to unforeseen challenges (James et al., 2011). These crises can arise from various sources, such as natural disasters, man-made incidents, or health emergencies, often leading to chaotic and disruptive environments (Unlu et al., 2010). The impact can be far-reaching, causing significant disruptions in supply chains and affecting the lives of thousands or even millions of people (Handfield et al., 2022). Crisis leaders must be equipped to navigate these

complex and high-pressure situations, making timely and critical decisions to mitigate the impact and effectively lead their teams and communities through the challenges (Wu et al., 2021). Crisis leadership includes the following traits, " *initiating a crisis response; mitigating the harm; serving as a spokesperson; expressing sympathy to victims; framing meaning; remaining accessible and open; facilitating the flow of information; acting decisively; coordinating actions among the various response groups and agencies; reconnecting with stakeholders; maintaining decision vigilance; prioritising activities and resources; communicating core values; paying symbolic attention to the crisis; maintaining appropriate flexibility, and facilitating renewal via public commitments*" (Littlefield & Quennette, 2007, p. 30, c.f. Seeger et al., 2003, p. 250). Several studies have demonstrated that crisis leadership can play a significant role in moderating the level of collaboration among partners (Simo & Bies, 2007; Eisenbeiss, 2012) and its subsequent impact on an organisation's resilience (Teo et al., 2017). In the current literature, researchers have identified conflicting findings regarding the relationship between crisis leadership and collaboration (Wu et al., 2021; Balasubramanian & Fernandes, 2022; Riggio & Newstead, 2023). Some studies have reported a positive correlation (Dubey, 2023), while others have indicated a negative association (Klebe et al., 2022). This discrepancy in results has captured my interest. It has led me to pursue a more in-depth investigation into the impact of crisis leadership, specifically in the context of the ongoing COVID-19 crisis. The current body of research lacks substantial evidence regarding the impact of crisis leadership on the development of collaborative efforts and the resilience of healthcare supply chains. The leadership displayed during a crisis could potentially harm the level of collaboration and teamwork within an organisation (Williams et al., 2017; Klebe et al., 2021).

In times of crisis, leaders often feel the need to create a sense of urgency in their teams (Jaques, 2012). However, this can sometimes have unintended consequences (Conger, 1990; Bauman, 2011). The heightened urgency may cause panic and anxiety among team members, leading to

a breakdown in collaborative efforts (Conger, 1990; Einarsen et al., 2007). Leaders must balance communicating the situation's urgency and ensuring their teams remain calm and focused (Klebe et al., 2021). Despite the widely acknowledged importance of leadership, there is a lack of comprehensive studies on the negative moderating effect of crisis leadership. This oversight presents an opportunity to further our theoretical understanding in this area. As a result, I propose the following hypothesis to address this gap in research:

H5: Crisis leadership negatively moderates collaboration among the partners in the healthcare supply chain and the healthcare supply chain resilience.

5.4 Research Design

To test the research hypotheses (H1-H5), I followed the guidelines from Flynn et al. (1990) and used a survey-based approach to gather responses from key respondents. This method was selected due to its reliability, especially considering the study incorporates psychometric constructs. The survey-based approach has several merits over the traditional approaches used in operations management research (Flynn et al., 1990; Boyer & Swink, 2008). The survey-based approach relies on gathering information through questionnaires and interviews, where individuals report factual data and express their opinions. This method allows researchers to collect quantitative and qualitative data, providing a comprehensive understanding of the subject matter. In this case, I used a structured questionnaire design on a seven-point scale with endpoints “strongly disagree” to “strongly agree” to measure each item of the construct (Chen & Paulraj, 2004b).

I conducted a data collection process by utilising an electronic survey developed based on a modified version of Dillman’s (2007) total design test method. The survey link was disseminated to a diverse range of hospitals across India, and these hospitals were further requested to distribute the link to key respondents who possess in-depth knowledge about the

disruptions in the healthcare supply chain during the COVID-19 pandemic. This approach allowed for a wide-reaching and targeted data collection effort to gain insights into the specific challenges faced in the healthcare supply chain during this critical time.

In my research, I employed a two-staged data collection approach. The first stage involved pre-testing the survey instrument to ensure its effectiveness and accuracy. Following the pre-testing phase, the survey was administered and tested per the methodology outlined by Malhotra and Grover (1998). This two-stage approach allowed for the refinement and validation of the survey instrument, ensuring the reliability and validity of the collected data. In the subsequent section, I will provide a comprehensive overview of developing a questionnaire and conducting a pre-test to ensure its effectiveness before proceeding with the data collection phase.

5.4.1 Questionnaire Development

In Figure 5.3, I have depicted the questionnaire development process, designed to meet three crucial criteria: reliability, validity, and uni-dimensionality, as outlined by Chen and Paulraj (2004b). Developing a questionnaire involves a meticulous three-stage continuous improvement cycle, ensuring the questions are reliable and valid and measure a single construct. In the initial stages, I extensively reviewed the existing literature to meticulously identify and evaluate the presence of reliable and valid constructs within the study. This review was deeply rooted in a diverse and substantial body of interdisciplinary literature relevant to the supply chain management constructs, as illustrated in Figure 5.1. The constructs were firmly grounded in the relational view (RV) proposed by Dyer and Singh (1998) and Upper-echelons Theory (Hambrick & Mason, 1984). Throughout the process of selecting the constructs for the study, I specifically focused on the supply chain management practices within the healthcare sector, drawing on the works of De Vries & Huijsman (2011), Scala & Lindsay (2021), and Senna et al. (2023). I adapted the constructs in Figure 5.1 from various supply chain management literature to better fit the healthcare supply chain management context. These constructs include

information visibility (Wang & Wei, 2007; Lee et al., 2014), swift trust (Robert et al., 2009; Tatham & Kovacs, 2010; Dubey et al., 2019), collaboration (Cao & Zhang, 2011; Moshtari, 2016), crisis leadership (Hadley et al., 2011; Dubey, 2023), and healthcare supply chain resilience (Queiroz et al., 2022; Kähkönen et al., 2023). This approach was taken to ensure the study's content validity. Establishing content validity is a crucial aspect of research methodology. Content validity refers to the extent to which a measure represents all facets of a given construct (Malhotra & Grover, 1998). It involves ensuring that the content of a test or assessment instrument is relevant and comprehensive to the construct being measured (Flynn et al., 1994). This is essential to capture the full scope of the concept under investigation accurately (Chen & Paulraj, 2004). By establishing content validity, researchers can be confident that their measures effectively capture the intended content and are, therefore, suitable for use in their studies (Rositter, 2008).

I began the process by developing the initial draft of the questionnaire, carefully designing it with a seven-point Likert scale for all measurement items. This scale provides respondents with a range of options, from "*strongly disagree*" to "*strongly agree*," allowing for nuanced feedback on their opinions and experiences. To enhance the clarity and effectiveness of the questionnaire, I recognised the importance of conducting a pre-testing phase. This step involves administering the draft to a small group of participants, typically representative of the larger target audience. The purpose of pre-testing is to identify and address any potential issues related to the wording, structure, or format of the questions. This may include ambiguous phrases, overly complex language, or questions that may be misinterpreted (MacKenzie & Podsakoff, 2012).

During the pre-testing, I carefully observed participants' reactions and gathered their feedback on the appropriateness and clarity of each question (Flynn et al., 1990). I also encouraged them to share any confusion or difficulties they experienced while filling out the questionnaire. This

qualitative feedback is invaluable, as it highlights the sections that may need revision to ensure that respondents can easily understand and answer the questions as intended.

Based on these insights, I refined the questionnaire, making necessary adjustments to improve clarity, ensure better flow, and eliminate any ambiguity. This iterative process is crucial in creating a robust tool that accurately captures the intended information from respondents. In the following section, I will provide a detailed account of the pre-testing exercise, including the participant selection process, methods of data collection, and the findings that informed the final adjustments to the questionnaire.

5.4.2 Construct Operationalisation

After conducting a comprehensive review of the existing literature, I have successfully identified the relevant measurements essential for my study. I have operationalised the constructs of the theoretical model as reflective constructs, meaning they are defined by the underlying dimensions that represent the concept. In the following section, I will provide a detailed discussion of each construct, exploring its theoretical foundations, significance, and the implications it has for the overall model. This discussion will help clarify how these constructs interact and contribute to our understanding of the phenomenon under investigation.

5.4.2.1 Information Visibility (IV)

I have conceptualised a seven-item reflective scale to measure information visibility based on the work of Wang & Wei (2007) and Lee (2014). Information visibility includes the following items: maintaining records of relevant information for making important decisions, the organisation maintaining information related to the challenges faced, sharing information related to societal benefits, the organisation sharing information when it is socially responsible to do so, the organisation ensures that the information can be stored, and the organisation shares the information in a systematic way.

5.4.2.2 Swift-Trust (ST)

I have conceptualised a reflective construct consisting of five items, drawing from the work of Robert et al. (2009) and Dubey et al. (2019). The measurements encompass the following aspects: supporting each other in times of emergencies, quickly developing rapport and getting along, trusting in the leaders and organisational policies, fostering good communication among team members, and feeling secure when exchanging information.

5.4.2.3 Collaboration (CO)

I have developed a four-item framework based on the work of Cao & Zhang (2011) and Moshtari (2016) to evaluate the degree of collaboration among various partners in the healthcare supply chain during times of crisis. The items are as follows: objectives are met, we are satisfied with the overall team performance, the organisation is content with our collaborative efforts, and our partnership has been successful.

5.4.2.4 Crisis Leadership (CL)

I have conceptualised crisis leadership as a five-item reflective construct to measure leadership skills during a crisis based on Hadley et al. (2011) and Dubey (2023). The items of crisis leadership are as follows: managers stay in touch with their team members during times of crisis; line managers provide moral support during times of crisis; my line manager took proactive measures to procure necessary healthcare items in anticipation of the crisis; my line manager is effective in communicating with stakeholders; and my line manager is effective in coordinating with stakeholders during a crisis.

5.4.2.5 Healthcare Supply Chain Resilience (HSCR)

I have developed the concept of healthcare supply chain resilience (HSCR) as a five-item reflective construct based on the works of Queiroz et al. (2022) and Kähkönen et al. (2023). The measurements include the availability of necessary healthcare items, quick supplier

response during times of crisis, swift restoration of PPE shortages, the ability to expand hospital or clinic capacity during crises, and the development of capabilities to deal with uncertain times.

5.4.3 Pre-testing of the Questionnaire

I conducted outreach to 16 esteemed experts in the field of healthcare supply chain resilience, intentionally choosing individuals from both the healthcare sector and academia to gather a well-rounded array of insights. Among these experts are distinguished senior academic scholars who have dedicated significant portions of their careers to researching healthcare supply chain resilience. These scholars have published extensively in reputable journals, contributing to the academic discourse and editing various influential publications within the field. In addition to these academic voices, I also included senior professionals from the healthcare sector who occupy critical leadership positions. These individuals have played instrumental roles in equipping their organisations to effectively navigate health crises, drawing on their practical experience to implement successful strategies and solutions. By combining these diverse perspectives, I aim to foster a comprehensive understanding of the challenges and opportunities present in enhancing healthcare supply chain resilience.

The initial draft of the questionnaire was sent out on 16th September 2023, and after two follow-ups, I received detailed responses from seven experts by 16th October 2023. Each response was carefully reviewed, leading to significant changes in the questionnaire wording. Additionally, I identified and removed two similar-sounding items from the initial questionnaire to eliminate potential confusion. As a result, I have finalised a comprehensive questionnaire that was emailed to the targeted respondents for their valuable input (see Appendix B). In this manner, I have evaluated face validity, a fundamental component of the research process. This involves ensuring that the research instrument appears to measure what it is intended to measure at face value. Assessing the validity of the construct used in a study involves considering both face validity and content validity. Face validity refers to the extent to which a measure appears to

assess the construct of interest at face value. In contrast, content validity involves ensuring that the measure includes all relevant aspects of the construct. Both aspects are important for establishing the credibility and accuracy of the study's findings.

5.4.4 Data Collection

In the upcoming section, I will elaborate on the data collection strategy. The data collection process was undertaken in three stages to address two specific research objectives. In Chapter 4, I extensively discussed the DELPHI study, which was conducted to develop an Interpretive Structural Modelling (ISM) and conduct the MICMAC analysis. I developed a comprehensive theoretical model (Figure 5.1) and various research hypotheses to address the second research objective. To rigorously test these research hypotheses, I gathered cross-sectional data using a survey based on a seven-point Likert scale. To collect cross-sectional data, I chose to utilise a probabilistic sampling design approach. This approach involves randomly selecting a sample from the population, which allows for the generalisation of the findings to the entire population. This method is advantageous because it helps to reduce bias and ensures that every member of the population has an equal chance of being included in the sample. In this specific scenario, I conducted thorough research to identify healthcare centres by leveraging the extensive Ministry of Health & Family Welfare (Government of India body) database. This database offers a comprehensive list of healthcare facilities, encompassing various medical services such as hospitals, clinics, and healthcare laboratories. These facilities are equipped with a dedicated team of healthcare professionals who possess in-depth knowledge about the critical role of the healthcare supply chain, particularly emphasising its importance during times of crisis, such as the ongoing COVID-19 pandemic reached out to 26 healthcare units via email, providing them with a Google link that I had developed. In my email, I requested that they share the link with various healthcare staff, including nurses, doctors, the OPD department, the materials management section, and chief medical officers with direct experience dealing with the crisis

caused by COVID-19. I aimed to gather unbiased responses from respondents with different roles and experiences within the healthcare units. After two follow-up rounds, I received 111 responses (see Table 5.1). Additionally, following the suggestions from Kock & Hadaya (2018), based on the inverse square root methods and gamma exponential methods, I found that, at a power level of 0.65, the minimum sample size required was 107 using the inverse square method and 96 using the gamma exponential method (see Figure 5.2). Based on these calculations, I can confidently assert that my sample size is sufficient for conducting the statistical analyses using WarpPLS 7.0. Subsequently, I proceeded with statistical analyses using the PLS-SEM.

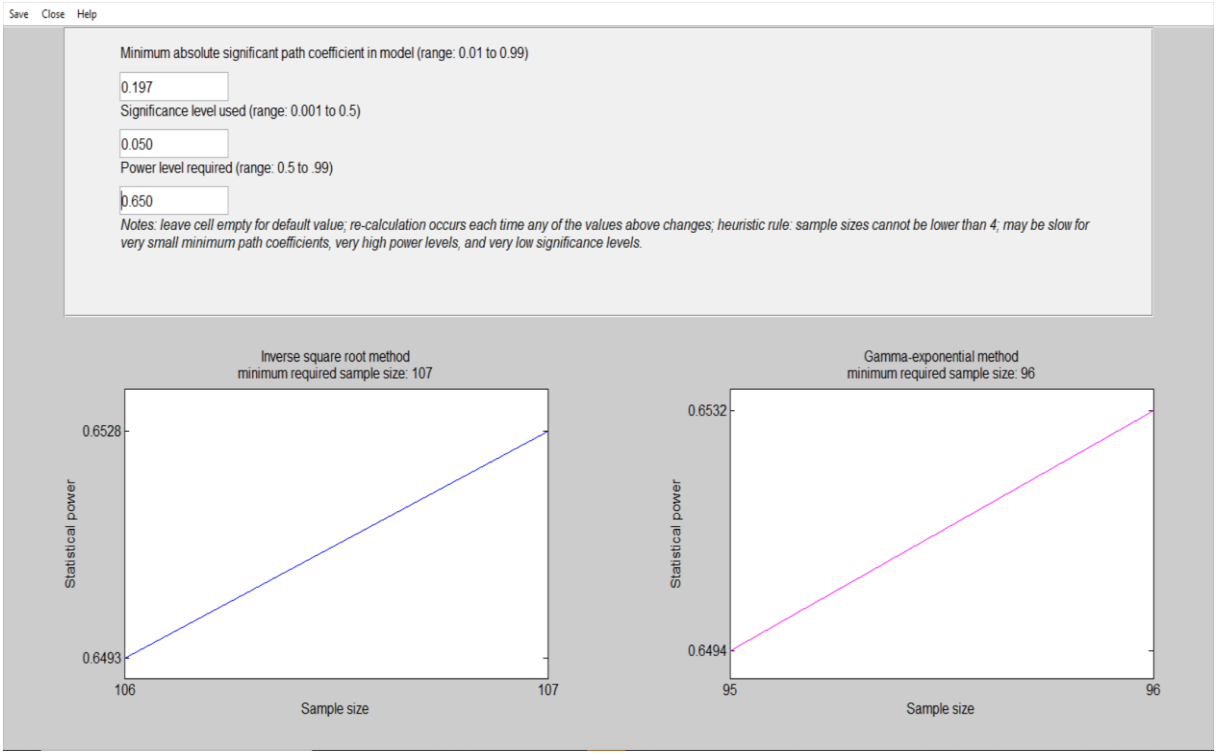


Figure 5.2: Minimum Sample Size Determination
(Source: Author's work)

I have meticulously outlined the demographic characteristics of the individuals who participated in the survey. 14.41% of the total respondents reported having work experience ranging from 0 to 5 years. 18.92% of the respondents indicated working experience between 6

to 10 years. Additionally, 32.43% of the participants reported having 11 to 15 years of work experience, while 27.03% stated having 16 to 20 years of experience. Lastly, 7.21% of the respondents reported having more than 20 years of work experience (see Figure 5.4)

Out of the total respondents, 54.05% were identified as medical specialists. Medical specialists encompass diverse healthcare professionals with specialised training and expertise who work alongside physicians to provide comprehensive patient care. This group may include nurse practitioners, physician assistants, pharmacists, physical therapists, and other allied health professionals. Their collaborative efforts help ensure patients receive the highest care and support across various healthcare settings. 25.23% of the survey participants held the position of healthcare support manager. Healthcare support managers oversee a wide range of services, including, but not limited to, coordinating patient care, managing healthcare facilities, and providing administrative support to healthcare professionals. Out of all the respondents, 4.5% were identified as staff nurses. During the COVID-19 crisis, nurses have played a critical and indispensable role in providing care and support to those affected by the pandemic. Among them, the staff nurse has stood out for their significant contributions, demonstrating exceptional dedication and resilience in the face of unprecedented challenges. Out of the total respondents, 16.22% were identified as medical superintendents. Medical superintendents hold the head position in hospitals or clinics (see Figure 5.5). Of the respondents, 52.25% were male, and 47.75% were female (see Figure 5.6).

Table 5.1: Demographic Profile of the Respondents

Experience (years)		
Years	Frequency	%
0-5	16	14.41
6-10	21	18.92
11-15	36	32.43
16-20	30	27.03
>20	8	7.21
Designation		
Medical Specialist	60	54.05
Healthcare Support Manager	28	25.23
Staff Nurse	5	4.5
Medical superintendent	18	16.22
Gender		
Male	58	52.25
Female	53	47.75

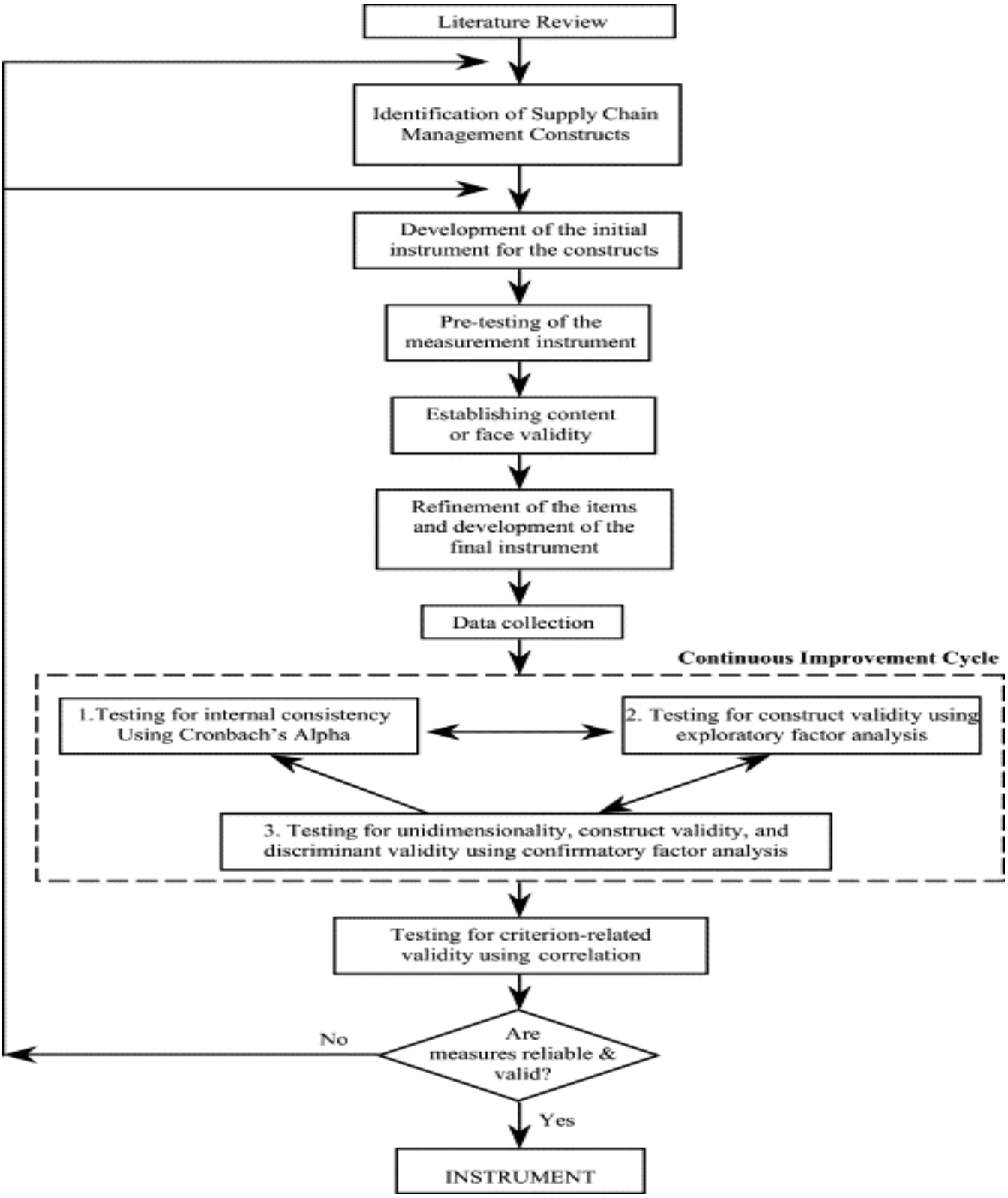


Figure 5.3: Questionnaire Development Process (adapted from Chen & Pauraj, 2004b)
(Source: Author's work)

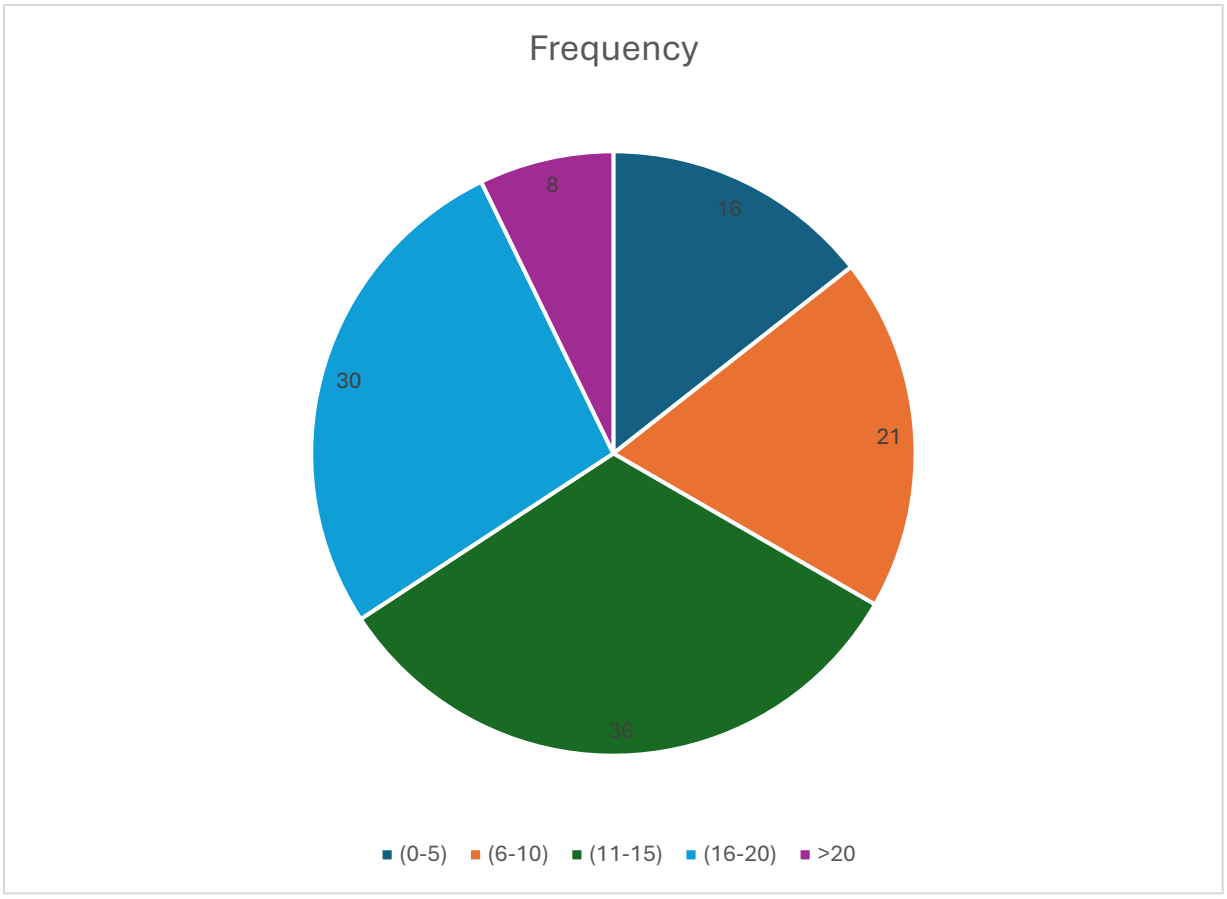


Figure 5.4: Respondents Experience (years)

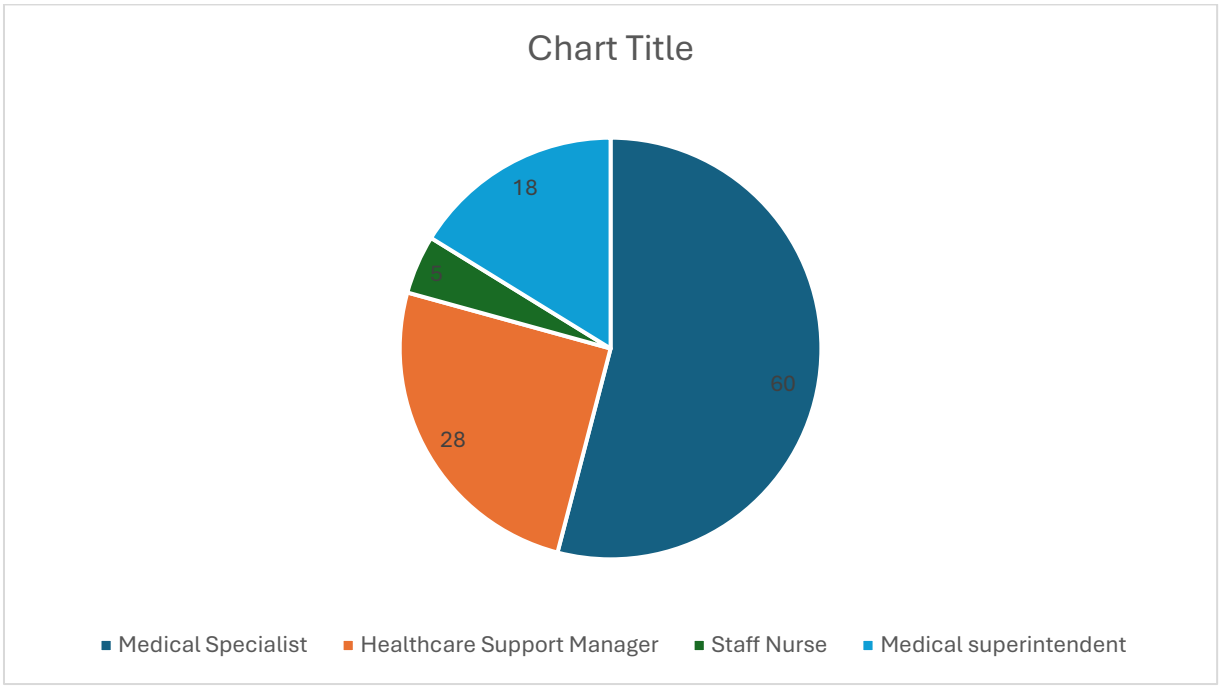


Figure 5.5: Respondents Designation

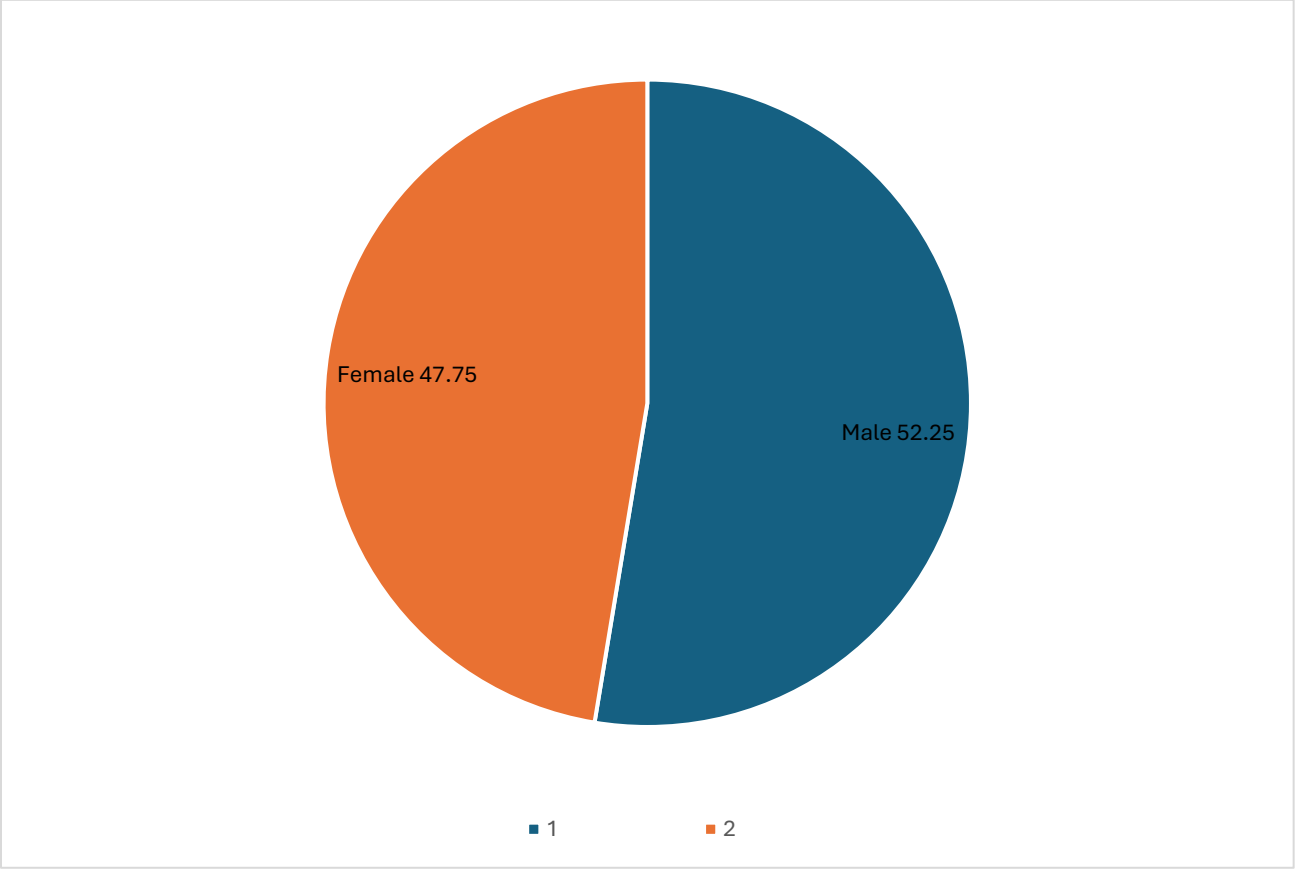


Figure 5.6: Respondents Gender

5.4.5 Non-Response Bias Test

In survey-based research, the lack of response from certain participants raises concerns about the reliability and validity of the study. When respondents do not return their surveys, it can introduce bias and affect the overall quality of the research findings. This non-respondent bias may skew the results and compromise the accuracy of the study's conclusions (Armstrong & Overton, 1977; Hulland et al., 2018). Researchers must address and account for non-respondent bias to ensure the trustworthiness of their research. Fawcett et al. (2014) argue that traditionally, researchers have tested non-response bias using the wave analysis method proposed by Armstrong & Overton (1977), which compares early and late responses using the t-test. Wagner

& Kemmerling (2010) suggest that the extrapolation approach recommended by Armstrong & Overton (1977) has limitations. The approach assumes that late respondents share similarities with those who have not yet returned their responses. It is crucial to acknowledge that the assumption mentioned may not always be accurate, as articulated by several scholars (Pace, 1939; Wagner & Kemmerling, 2010). Wagner & Kemmerling (2010) have proposed an alternative approach, suggesting that comparing the demographic profiles of the respondent with those of the population can provide valuable insights. If the respondent's demographic profile closely aligns with the population's demographic profile, then the presence of non-response bias may not be a significant concern. Finally, it can be quite demanding and challenging to follow up with those who have not responded (Wagner & Kemmerling, 2010). This task requires a lot of time and effort, as it involves reaching out to individuals multiple times through different communication channels (Frohlich, 2002). It can also be emotionally challenging and may involve rejection or indifference. Nonetheless, it is an important part of the process to ensure that everyone's input is accounted for and to gather as much information as possible.

After carefully evaluating various perspectives, I have compiled the wave analysis results in Table 5.2, as suggested by Armstrong & Overton (1977). The analysis indicates that the p-value exceeds 0.05, signifying that there is no statistically significant difference between the responses of the early and late respondents. The t-statistics, assuming unequal variances, have been calculated for two distinct waves: the early wave and the late wave. The fact that the p-value is greater than 0.05 in all cases suggests that, to a certain degree, non-response bias is not a significant concern.

Table 5.2: Wave Analysis

Scale	**Items**	**p-value**
IV (Information Visibility)	IV1	0.089
	IV2	0.080
	IV3	0.364
	IV4	0.086
	IV5	0.431
	IV6	0.374
	IV7	0.461
ST (Swift-Trust)	ST1	0.321
	ST2	0.292
	ST3	0.097
	ST4	0.082
	ST5	0.305
CO (Collaboration)	CO1	0.063
	CO2	0.156
	CO3	0.099
	CO4	0.39
CL (Crisis Leadership)	CL1	0.202
	CL2	0.094
	CL3	0.172
	CL4	0.377
	CL5	0.375
HSCR (Healthcare Supply Chain Resilience)	HSCR1	0.314
	HSCR2	0.465

	HSCR3	0.369
	HSCR4	0.253
	HSCR5	0.373

5.5 Measurement Development and Analysis

In this section, I will explore deeper into Figure 5.2, providing a detailed explanation of the three essential steps in the continuous improvement cycle as described by Flynn et al. (1994) and Chen & Paulraj (2004). In the first stage, it is essential to measure the internal consistency of the measures, which plays a crucial role in the development of the instrument. Once the content validity has been established through an extensive review of relevant literature, as extensively discussed in Chapter 2 and Chapter 3, the constructs and their measuring items were meticulously selected based on this validation. To ensure the reliability of the instrument being developed, it is important to establish face validity through qualitative assessment. In this process, I sent the questionnaire to experts with established experience and credentials in the research field before finalising data collection. The next step involves checking the construct validity, which entails a quantitative assessment of the constructs and their measuring items.

Before we proceed, I would like to provide a more detailed explanation of the constructs and indicators and their interrelation to enhance comprehension of the quantitative assessment of internal consistency measurement, uni-dimensionality, and construct validity. The nature of the relationship between indicators and the underlying construct, a key aspect in my study, can be categorised as either reflective or formative (Edwards & Bagozzi, 2000; Baxter, 2009; MacKenzie et al., 2011). The measurement model, whether reflective or formative, elucidates the link between these observable indicators and the latent construct (MacKenzie et al., 2011). Reflective models, for instance, entail indicators influenced by the latent variable, while formative models involve indicators that define the latent variable (Becker et al., 2012).

Reflective indicators are interchangeable, conveying a common theme reflecting the underlying concept (Coltman et al., 2008). In a reflective model, the latent construct exists independently of the specific measures adopted (MacKenzie et al., 2011). Even if one of the reflective indicators is removed, the latent variable will persist (Diamantopoulos & Siguaw, 2006). Conversely, formative indicators are not interchangeable, as each indicator contributes a distinct meaning to the latent variables. In formative models, a change in the indicators leads to a change in the underlying construct being studied. Most scales in organisational studies, such as operations management and information management, are based on the reflective model (Guide & Ketokivi, 2015; Hillman & Guenther, 2021). Therefore, based on the previous discussions, I have used reflective constructs. However, I also recognise that formative constructs are equally crucial in certain situations. The foundational ideas and theories within the realm of supply chain and information management are extensively discussed in the works of Rai et al. (2006), Petter et al. (2007), Liang et al. (2007), and Klein et al. (2007). These scholarly contributions offer valuable insights into the fundamental constructs underpinning supply chain management and information management.

In the previous section, I comprehensively explained the nature of the constructs utilised in the study. Conducting a thorough assessment of the psychometric properties of these constructs is crucial to my study. This assessment will contribute significantly to the overall validity and reliability of the study's findings. In my research, I employed confirmatory factor analysis (CFA) as a statistical method to validate the convergent, discriminant, and uni-dimensionality of the factors under consideration (Flynn et al., 1990; Chen & Paulraj, 2004; Brandon-Jones et al., 2014). This involved assessing the extent to which different measures of the same construct converge, distinguishing between different constructs, and ensuring that each factor represents a single underlying dimension (Fornell & Larcker, 1981). Before entering the process of confirmatory factor analysis, it is essential to provide an overview of factor analysis and its

significance in research. Factor analysis is a statistical method used to identify underlying relationships between observed variables, helping researchers understand the data structure and the underlying constructs that may be driving these relationships (Hair et al., 2010).

Factor analysis has been widely used in various management disciplines, including operations and supply chain management, information management, marketing management, strategic management, human resource management, and organisational behaviour (Hair et al., 2010). It is a valuable tool for researchers aiming to identify critical factors contributing to their studies and to delve deeper into the underlying relationships within their respective fields of inquiry (Hair et al., 2010). Factor analysis is defined by Hair et al. (2010, p. 92) as an interdependence technique with the primary purpose of defining the underlying structure among the variables in the analysis. Factor analysis can be categorised into exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

Exploratory factor analysis (EFA) is a statistical technique commonly employed by researchers to explore the underlying structure of observed variables. It is valuable for identifying latent factors or gaining deeper insights into the uni-dimensionality of constructs in a study. EFA helps researchers uncover patterns and relationships within their data, making it an essential tool in the initial phases of research or when dealing with complex datasets. Conversely, confirmatory factor analysis (CFA) is a statistical method utilised to assess the validity of a measurement model. It allows researchers to determine whether the observed data aligns with the anticipated factor structure, providing a more precise understanding of the relationships between measured variables and their underlying constructs (Hair et al., 2010). Hence, I present the three-step analysis recommended by Flynn et al. (1994) for the construct selection, which includes internal consistency measurement of the instrument (Cronbach's alpha), uni-dimensionality and construct validity. In the upcoming section, I will conduct a comprehensive

analysis of the data. Before exploring the comprehensive analysis using data, I will provide an in-depth explanation of the statistical method chosen for my study.

5.6 Data Analysis

Before assessing the construct's validity, it is essential to identify and select the most suitable statistical tool for the analyses. This initial step is critical as it lays the foundation for accurate data evaluation and ensures that the subsequent analyses are conducted effectively. Before proceeding with the statistical analysis, I conducted descriptive statistics to better understand the data. Additionally, I performed a test to assess the reflective nature of the constructs to ensure the accuracy and reliability of the results.

In Table 5.3, the data shows that the maximum absolute value of the skewness is 2.23, and the kurtosis is 6.33. This suggests that the distribution is moderately skewed and has heavy tails (Curran et al., 1996). The univariate skewness is slightly greater than 2, and the univariate kurtosis is less than 7. Additionally, the distribution's mean, median, and mode values are all very close, indicating a relatively symmetrical distribution. After thoroughly analysing all these values, I have determined that variance-based structural equation modelling is the preferred method for my research or analysis.

Partial Least Squares-Structural Equation Modelling (PLS-SEM) is a variance-based structural equation modelling technique that is particularly useful in situations where the strict normality assumptions of traditional SEM are not fully met (Sarstedt et al., 2021). It is a flexible approach that can handle complex models and small sample sizes, making it suitable for research in diverse fields such as social sciences, business, and engineering (Peng & Lai, 2012; Hair et al., 2017a; Benitez et al., 2020). PLS-SEM is especially valuable when dealing with non-normal data distributions, measurement errors, and latent variable models (Sarstedt et al., 2016). In addition to the previously mentioned arguments, it is essential to note that PLS-SEM is a

composite-based modelling approach. It uses a combination of indicators to represent latent variables, allowing for a more comprehensive and flexible analysis of complex relationships within a model (Henseler et al., 2014; Hair et al., 2017b).

The PLS-SEM algorithm primarily estimates composite models. In a reflective measurement model (i.e., where there are relationships from the construct to the indicators), the PLS algorithm computes the composites using the outer weights as the correlations between the construct and the indicators. On the other hand, in a formative measurement model (i.e., with relationships from the indicators to the construct), the PLS algorithm computes the composites using the outer weights as the multiple regression coefficients with the indicators as independent variables and the latent variable as the dependent variable (Henseler et al., 2014). In the meantime, it is worth noting that covariance-based SEM (CB-SEM) refers to a statistical modelling technique that involves the use of factor-based modelling to analyse relationships between observed variables and latent constructs (Henseler et al., 2014; Hair et al., 2017c; Kock, 2019). I want to clarify that I aim not to compare these two approaches. I want to discuss the reasons that led me to choose the PLS-SEM tool in this case. a method called consistent PLS (PLSc) (Dijkstra & Henseler, 2015). Among the two popular commercial PLS-SEM tools, Smart PLS and WarpPLS have been used and have consistently produced results (Becker et al., 2023). I have utilised WarpPLS 7.0, developed by Ned Kock, based on the consistent PLS (Kock, 2019, p. 676). The consistent PLS is more robust than the traditional PLS-SEM (Dijkstra & Henseler, 2015; Kock, 2019). In the upcoming section, I will thoroughly assess the psychometric properties of the construct I have utilised in the model. This will involve a detailed exploration of the construct's reliability, validity, and other relevant aspects to ensure its suitability for the model. It is important to note that PLS-SEM and CB-SEM are distinct methods that have prompted scholars to develop a hybrid. I present the following analyses using the WarpPLS 7.0.

5.6.1 Reliability Analysis

The reliability of the questionnaire developed to gather data is assessed by measuring internal consistency, which involves estimating Cronbach's alpha (Cronbach, 1951; Nunnally, 1978). Internal consistency measurement helps ensure that the questionnaire items are measuring the same underlying construct, and Cronbach's alpha is a widely used statistical measure for assessing this reliability (Chen & Paulraj, 2004). When Cronbach's alpha value is higher than 0.7, it indicates that the internal consistency of the construct and its items is high, suggesting that the measurements are reliable (Nunally, 1978; Hair et al., 2010). This means that the construct and its items consistently produce similar results when tested in different situations, making them dependable for analysis and interpretation (Chen & Paulraj, 2004). When developing a scale for the first time, it is generally considered acceptable for the Cronbach alpha value to be up to 0.6 (Nunally, 1978). Cronbach's alpha is a statistical measure used to assess the internal consistency of a scale or test (Chen & Paulraj, 2004). It measures how closely related a set of items are as a group. A value of Cronbach's alpha that is greater than 0.7 is generally considered acceptable for established scales, indicating high internal consistency among the items (Forza, 2002; Chen & Paulraj, 2004). This means that the items in the scale are reliably measuring the same underlying construct. Before conducting the reliability test, it is crucial to analyse the intercorrelation values using descriptive statistics, which can be found in Table 5.3. These intercorrelation values provide essential insights into the relationships between the examined variables and can help inform the reliability testing process. I have conducted a reliability test for my instrument to assess its consistency and dependability. The results of the test, along with relevant data, are in Table 5.4.

Table 5.3: Descriptive Statistics

	IV1	IV2	IV3	IV4	IV5	IV6	IV7	ST1	ST2	ST3	ST4	ST5	CO1	CO2	CO3	CO4	CL1	CL2	CL3	CL4	CL5	HSCR1	HSCR2	HSCR3	HSCR4	HSCR5
IV1	1	0.646	0.613	0.404	0.608	0.536	0.57	0.513	0.509	0.533	0.418	0.407	0.376	0.344	0.246	0.282	0.363	0.333	0.252	0.405	0.406	0.369	0.368	0.344	0.388	0.468
IV2	0.646	1	0.459	0.354	0.525	0.458	0.482	0.401	0.412	0.448	0.306	0.389	0.207	0.331	0.174	0.273	0.259	0.279	0.248	0.293	0.348	0.244	0.357	0.292	0.33	0.445
IV3	0.613	0.459	1	0.5	0.621	0.679	0.654	0.558	0.444	0.623	0.396	0.39	0.379	0.436	0.344	0.313	0.407	0.497	0.42	0.424	0.371	0.405	0.525	0.479	0.493	0.528
IV4	0.404	0.354	0.5	1	0.465	0.436	0.418	0.499	0.439	0.404	0.115	0.203	0.115	0.238	0.205	0.139	0.086	0.098	0.152	0.118	0.079	0.103	0.211	0.181	0.192	0.311
IV5	0.608	0.525	0.621	0.465	1	0.568	0.746	0.576	0.468	0.621	0.43	0.36	0.395	0.487	0.317	0.292	0.305	0.384	0.18	0.3	0.221	0.344	0.379	0.388	0.368	0.387
IV6	0.536	0.458	0.679	0.436	0.568	1	0.683	0.635	0.565	0.717	0.475	0.39	0.392	0.424	0.373	0.327	0.429	0.524	0.399	0.403	0.411	0.476	0.569	0.541	0.564	0.531
IV7	0.57	0.482	0.654	0.418	0.746	0.683	1	0.643	0.518	0.675	0.44	0.366	0.443	0.533	0.394	0.301	0.389	0.437	0.294	0.409	0.353	0.382	0.45	0.487	0.466	0.416
ST1	0.513	0.401	0.558	0.499	0.576	0.635	0.643	1	0.643	0.637	0.413	0.382	0.375	0.399	0.358	0.337	0.351	0.367	0.316	0.348	0.344	0.339	0.441	0.426	0.39	0.414
ST2	0.509	0.412	0.444	0.439	0.468	0.565	0.518	0.643	1	0.574	0.428	0.369	0.352	0.324	0.265	0.372	0.282	0.349	0.235	0.317	0.328	0.356	0.392	0.422	0.299	0.418
ST3	0.533	0.448	0.623	0.404	0.621	0.717	0.675	0.637	0.574	1	0.513	0.43	0.447	0.434	0.461	0.362	0.439	0.485	0.367	0.415	0.397	0.551	0.55	0.584	0.533	0.577
ST4	0.418	0.306	0.396	0.115	0.43	0.475	0.44	0.413	0.428	0.513	1	0.573	0.471	0.53	0.534	0.381	0.51	0.58	0.367	0.379	0.393	0.58	0.507	0.58	0.473	0.459
ST5	0.407	0.389	0.39	0.203	0.36	0.39	0.366	0.382	0.369	0.43	0.573	1	0.554	0.527	0.578	0.363	0.504	0.508	0.423	0.488	0.474	0.567	0.575	0.597	0.561	0.558
CO1	0.376	0.207	0.379	0.115	0.395	0.392	0.443	0.375	0.352	0.447	0.471	0.554	1	0.544	0.469	0.413	0.539	0.563	0.405	0.418	0.463	0.609	0.535	0.632	0.555	0.466
CO2	0.344	0.331	0.436	0.238	0.487	0.424	0.533	0.399	0.324	0.434	0.53	0.527	0.544	1	0.539	0.427	0.571	0.571	0.466	0.487	0.423	0.614	0.595	0.586	0.555	0.547
CO3	0.246	0.174	0.344	0.205	0.317	0.373	0.394	0.358	0.265	0.461	0.534	0.578	0.469	0.539	1	0.438	0.574	0.547	0.468	0.504	0.471	0.52	0.522	0.539	0.494	0.431
CO4	0.282	0.273	0.313	0.139	0.292	0.327	0.301	0.337	0.372	0.362	0.381	0.363	0.413	0.427	0.438	1	0.416	0.503	0.305	0.271	0.365	0.361	0.329	0.39	0.354	0.375
CL1	0.363	0.259	0.407	0.086	0.305	0.429	0.389	0.351	0.282	0.439	0.51	0.504	0.539	0.571	0.574	0.416	1	0.692	0.605	0.597	0.603	0.592	0.556	0.572	0.639	0.515
CL2	0.333	0.279	0.497	0.098	0.384	0.524	0.437	0.367	0.349	0.485	0.58	0.508	0.563	0.571	0.547	0.503	0.692	1	0.588	0.615	0.566	0.671	0.63	0.652	0.637	0.513
CL3	0.252	0.248	0.42	0.152	0.18	0.399	0.294	0.316	0.235	0.367	0.367	0.423	0.405	0.466	0.468	0.305	0.605	0.588	1	0.615	0.572	0.469	0.58	0.492	0.516	0.491
CL4	0.405	0.293	0.424	0.118	0.3	0.403	0.409	0.348	0.317	0.415	0.379	0.488	0.418	0.487	0.504	0.271	0.597	0.615	0.615	1	0.651	0.507	0.558	0.557	0.558	0.511
CL5	0.406	0.348	0.371	0.079	0.221	0.411	0.353	0.344	0.328	0.397	0.393	0.474	0.463	0.423	0.471	0.365	0.603	0.566	0.572	0.651	1	0.488	0.559	0.497	0.612	0.559
HSCR1	0.369	0.244	0.405	0.103	0.344	0.476	0.382	0.339	0.356	0.551	0.58	0.567	0.609	0.614	0.52	0.361	0.592	0.671	0.469	0.507	0.488	1	0.732	0.767	0.66	0.639
HSCR2	0.368	0.357	0.525	0.211	0.379	0.569	0.45	0.441	0.392	0.55	0.507	0.575	0.535	0.595	0.522	0.329	0.556	0.63	0.58	0.558	0.559	0.732	1	0.748	0.737	0.681
HSCR3	0.344	0.292	0.479	0.181	0.388	0.541	0.487	0.426	0.422	0.584	0.58	0.597	0.632	0.586	0.539	0.39	0.572	0.652	0.492	0.557	0.497	0.767	0.748	1	0.762	0.69
HSCR4	0.388	0.33	0.493	0.192	0.368	0.564	0.466	0.39	0.299	0.533	0.473	0.561	0.555	0.555	0.494	0.354	0.639	0.637	0.516	0.558	0.612	0.66	0.737	0.762	1	0.747
HSCR5	0.468	0.445	0.528	0.311	0.387	0.531	0.416	0.414	0.418	0.577	0.459	0.558	0.466	0.547	0.431	0.375	0.515	0.513	0.491	0.511	0.559	0.639	0.681	0.69	0.747	1
(Mean)	6.025	6.051	5.873	5.936	5.917	5.777	5.777	5.873	5.675	5.771	5.955	5.936	5.847	5.873	6.146	5.987	5.968	6.032	6.115	6.051	6.051	5.949	5.822	5.828	5.701	5.936
(SD)	1.08	0.89	1.254	1.09	1.203	1.238	1.207	1.186	1.215	1.235	0.996	1.084	1.051	1.131	0.905	0.927	1.146	1.157	1.05	1.024	1.005	1.339	1.318	1.341	1.318	1.158
(Min)	2	2	1	2	1	1	1	1	2	1	3	3	2	1	2	3	2	1	1	1	2	1	1	1	1	1
(Max)	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
(Median	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
(Mode)	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	7	6	6	7	6	6	6	6
Skewness	-1.46	-1.084	-1.616	-1.572	-1.678	-1.4	-1.563	-1.464	-1.143	-1.362	-0.927	-0.994	-1.088	-1.457	-1.439	-1.09	-1.528	-2.229	-1.964	-1.755	-1.432	-1.917	-2.062	-1.862	-1.915	-1.563
Kurtosis	2.668	2.204	2.648	3.108	3.149	2.068	3.174	2.578	1.355	1.991	0.515	0.35	1.101	2.84	3.202	1.365	2.531	6.331	6.105	4.633	2.447	3.889	4.568	3.846	4.354	3.063
Unimodal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Unimod	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Normal	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Normal	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Histogram	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View	View

Table 5.4: Reliability Test of Constructs

Constructs	**Cronbach's Alpha**
Information Visibility (IV)	0.89
Swift-Trust (ST)	0.83
Collaboration (CO)	0.78
Crisis Leadership (CL)	0.89
Healthcare Supply Chain Resilience (HSCR)	0.93

In my study, Cronbach's alpha values, which measure the internal consistency of a set of survey items, fall within the range of 0.78 to 0.93. This indicates that the constructs and measures employed in our study, which were carefully selected based on extensive literature review and pre-testing, exhibit high reliability. As a result, we can expect these measures to yield consistent results across various scenarios.

5.5.2 Uni-dimensionality

Uni-dimensionality is a critical concept in research that evaluates whether the indicators used in a study effectively measure a single underlying construct or if they are influenced by multiple constructs (Gerbing & Anderson, 1988). It helps to determine how much the measurements truly reflect the intended construct. The assumptions that need to be met to establish uni-dimensionality are: first, the empirical measuring items I used in the questionnaire (see Appendix B) must be an empirical representation of the construct that I have used in my study, and secondly, they must be associated with one and only one construct (Anderson & Gerbing, 1988; Hair et al., 2010). Hence, the construct and its measuring items must fulfil these two aspects to satisfy the uni-dimensionality condition. In this study, I assessed using the

confirmatory factor analysis (CFA). In this section, I present combined loadings and cross-loadings in Table 5.5.

The structure presented in Table 5.5 demonstrates a concise structure achieved through oblique rotation. I chose oblique rotation because of the significant interconnectedness between the constructs and the items, indicating that the constructs are not independent of each other. This choice was made to accommodate the observed correlations and ensure a more precise representation of the relationships within the data. In this study, I use measuring items or indicators interchangeably as both have similar meanings in my study. Table 5.5 shows how the indicators (IV1-IV6) are loaded on a single construct IV, suggesting that the indicators (IV1-IV6) empirically represent a single construct. The results empirically confirm that the construct and the measuring items used in the study represent information visibility (IV). This is in line with previous findings of the study (Wang & Wei, 2007; Lee et al., 2014). Additionally, the measuring items (IV1-IV6) are significantly loaded on a single construct IV. However, IV1, IV2, IV3, IV4, IV5, and IV6 are weakly loaded on other constructs such as ST, CO, CL, and HSCR because the factor loadings on other constructs are less than 0.5 (Hair et al., 2010). Therefore, the construct IV satisfies both conditions of uni-dimensionality (Gerbing & Anderson, 1988).

The indicators of swift-trust are significantly loaded onto a single construct called ST (swift-trust). Additionally, the factor loadings of indicators (ST1-ST6), which are greater than 0.5, are loaded onto the single construct ST. However, ST1, ST2, ST3, ST4, and ST5 are weakly loaded onto other constructs such as IV, CO, CL, and HSCR (<0.5). This indicates that the indicators and constructs empirically represent swift-trust, which is consistent with previous studies (Robert et al., 2009; Tatham & Kovacs, 2010; Dubey et al., 2019).

The construct collaboration (CO) and its indicators - CO1, CO2, CO3, and CO4 - are significantly loaded on a single-construct CO. This suggests that the indicators (CO1-CO4)

represent a single construct, CO. Additionally, the factor loadings of indicators (CO1-CO4) are >0.5 on CO and <0.5 on other constructs such as IV, ST, CL, and HSCR. This indicates that the construct CO satisfies the condition of being uni-dimensional. This empirical evidence confirms the construct CO (collaboration) that I have used to measure in the healthcare setting, which is consistent with previous studies (Cao & Zhang, 2011; Moshtari, 2016).

The crisis leadership (CL) construct and its indicators, CL1, CL2, CL3, CL4, and CL5, are all significantly related to a single construct, CL. This suggests that these indicators represent a single construct, CL. Furthermore, the factor loadings of these indicators (CL1-CL5) are all greater than 0.5 on CL and less than 0.5 on other constructs such as IV, ST, CO, and HSCR. This indicates that the construct CL meets the criteria for being uni-dimensional. This empirical evidence supports the existence of the construct CL (crisis leadership) that I have used to measure in the healthcare setting, which is consistent with previous studies (Hadley et al., 2011; Dubey, 2023).

The concept of healthcare supply chain resilience (HSCR) and its indicators (HSCR1, HSCR2, HSCR3, HSCR4, and HSCR5) are all significantly linked to a single concept, HSCR. This suggests that these indicators represent a unified concept, HSCR. Additionally, the factor loadings of these indicators (HSCR1-HSCR5) are all greater than 0.5 on HSCR and less than 0.5 on other constructs, such as IV, ST, CO, and CL. This indicates that the concept of HSCR meets the criteria for being uni-dimensional. This empirical evidence supports the existence of the concept of HSCR (healthcare supply chain resilience) that I have used to measure in the healthcare setting, which is consistent with previous studies (Queiroz et al., 2022; Kähkönen et al., 2023).

Table 5.5: Combined Loadings and Cross-Loadings

	IV	ST	CO	CL	HSCR	CL*CO	Type (a	SE	P value
IV1	0.802	0.015	-0.075	0.465	-0.094	0.389	Reflect	0.067	<0.001
IV2	0.709	-0.166	-0.109	0.336	0.009	0.281	Reflect	0.068	<0.001
IV3	0.834	-0.204	-0.084	0.039	0.131	-0.151	Reflect	0.067	<0.001
IV4	0.632	0.016	0.003	-0.123	-0.054	0.197	Reflect	0.07	<0.001
IV5	0.836	-0.072	0.339	-0.37	-0.098	-0.13	Reflect	0.067	<0.001
IV6	0.803	0.346	-0.291	-0.098	0.208	-0.26	Reflect	0.067	<0.001
IV7	0.844	0.056	0.185	-0.211	-0.108	-0.228	Reflect	0.066	<0.001
ST1	0.25	0.806	-0.112	0.094	-0.265	0.067	Reflect	0.067	<0.001
ST2	-0.029	0.787	-0.209	0.161	-0.224	0.226	Reflect	0.067	<0.001
ST3	0.297	0.826	-0.143	-0.199	0.217	-0.171	Reflect	0.067	<0.001
ST4	-0.351	0.748	0.227	-0.143	0.038	-0.201	Reflect	0.068	<0.001
ST5	-0.233	0.694	0.293	0.1	0.263	0.088	Reflect	0.069	<0.001
CO1	-0.056	0.001	0.783	0.004	0.264	0.159	Reflect	0.067	<0.001
CO2	0.255	-0.307	0.816	-0.125	0.224	-0.06	Reflect	0.067	<0.001
CO3	-0.2	0.248	0.79	-0.041	-0.156	-0.349	Reflect	0.067	<0.001
CO4	-0.009	0.075	0.717	0.183	-0.371	0.279	Reflect	0.068	<0.001
CL1	-0.049	-0.03	0.261	0.845	-0.028	0.066	Reflect	0.066	<0.001
CL2	-0.027	0.053	0.232	0.836	0.082	-0.291	Reflect	0.067	<0.001
CL3	0.017	-0.055	-0.166	0.813	-0.031	-0.174	Reflect	0.067	<0.001
CL4	0.075	-0.009	-0.184	0.839	-0.033	0.132	Reflect	0.067	<0.001
CL5	-0.015	0.042	-0.153	0.816	0.009	0.268	Reflect	0.067	<0.001
HSCR1	-0.217	0.142	0.156	-0.19	0.863	-0.143	Reflect	0.066	<0.001
HSCR2	0.028	0.018	-0.1	0.016	0.887	-0.098	Reflect	0.066	<0.001
HSCR3	-0.137	0.177	0.083	-0.213	0.904	-0.136	Reflect	0.066	<0.001
HSCR4	0.137	-0.24	-0.037	0.161	0.889	0.039	Reflect	0.066	<0.001
HSCR5	0.194	-0.1	-0.103	0.233	0.853	0.351	Reflect	0.066	<0.001
CL*CO	0	0	0	0	0	1	Reflect	0.064	<0.001

5.5.3 Construct Validity

In Table 5.6, all the factor loadings (λi) of each indicator variable are greater than 0.5. Each construct's scale composite reliability (SCR) is above 0.7, and the average variance extracted (AVE) is higher than 0.5. This indicates that the construct and its measuring indicators meet the criteria for convergent validity, as proposed by Fornell & Larcker (1981). Furthermore, Table 5.6 also shows that the square root of each construct's average variance extracted (AVE) is greater than the inter-construct correlations, suggesting that the construct possesses sufficient discriminant validity (Fornell & Larcker, 1981; Chin, 1998). I conducted both the Fornell & Larcker (1981) discriminant validity test and the Heterotrait-Monotrait (HTMT) test as recommended by Henseler et al. (2015) (refer to Table 5.8). The HTMT threshold values range from 0.85 (Clark & Watson, 1995; Kline, 2011) to 0.90 (Gold et al., 2001; Teo et al., 2008). In most instances, the values in my study are above 0.85, but in a few cases, they fall below 0.90. The values for discriminant validity, as suggested by Henseler et al. (2015), fall within the expected range. This indicates that the construct used in my study exhibits both convergent and discriminant validity, meeting the criteria for construct validity.

Table 5.6: Factor Loadings of Indicator Variables, Scale Composite Reliability and Average Variance Extracted (convergent validity)

Construct	**Indicator**	**Factor Loadings (λi)**	**Variance**	**Error (ξi)**	**Scale Composite Reliability (SCR)**	**Average Variance Extracted (AVE)**
IV	IV1	0.80	0.64	0.36	0.92	0.61
	IV2	0.71	0.50	0.50		
	IV3	0.83	0.70	0.30		
	IV4	0.63	0.40	0.60		
	IV5	0.84	0.70	0.30		
	IV6	0.80	0.64	0.36		

	IV7	0.84	0.71	0.29		
ST	ST1	0.81	0.65	0.35	0.88	0.60
	ST2	0.79	0.62	0.38		
	ST3	0.83	0.68	0.32		
	ST4	0.75	0.56	0.44		
	ST5	0.69	0.48	0.52		
CO	CO1	0.78	0.61	0.39	0.86	0.60
	CO2	0.82	0.67	0.33		
	CO3	0.79	0.62	0.38		
	CO4	0.72	0.51	0.49		
CL	CL1	0.85	0.71	0.29	0.92	0.69
	CL2	0.84	0.70	0.30		
	CL3	0.81	0.66	0.34		
	CL4	0.84	0.70	0.30		
	CL5	0.82	0.67	0.33		
HSCR	HSCR1	0.86	0.74	0.26	0.94	0.77
	HSCR2	0.89	0.79	0.21		
	HSCR3	0.90	0.82	0.18		
	HSCR4	0.89	0.79	0.21		
	HSCR5	0.85	0.73	0.27		

Table 5.7: Discriminant Validity

	IV	ST	CO	CL	HSCR
IV	0.78				
ST	0.75	0.77			
CO	0.54	0.70	0.77		

CL	0.51	0.62	0.73	0.83	
HSCR	0.58	0.71	0.74	0.76	0.88

Note: The bold sign represents the square root of AVE

Table 5.8: HTMT Value

	IV	ST	CO	CL	HSCR
IV					
ST	0.896**				
CO	0.64*	0.871**			
CL	0.559*	0.725*	0.869**		
HSCR	0.631*	0.815*	0.861**	0.843*	

Note : ** Teo et al. (2008); **Gold et al. (2001), *Clark & Watson (1995); *Kline (2011)

5.6 Common Method Bias

When working with self-reported data, it is important to be mindful of potential common method biases that may arise from various sources such as consistency motif and social desirability (Podsakoff et al., 2003). Common method biases can occur when respondents provide information that is influenced by the way questions are asked or by their desire to present themselves in a favourable light (Ketokivi & Schroeder, 2004). It is essential to consider these factors when interpreting self-reported data to ensure the accuracy and reliability of the results. To minimise common method biases, I have implemented procedural remedies. Based on MacKenzie & Podsakoff (2012) recommendations, I have taken measures to minimise the impact of data collected from a single source. While designing the questionnaire, it is important to be aware of potential biases that can arise from various sources. For example, questions that

are overly complex or abstract, as noted by Doty & Glick (1998), can challenge respondents regarding understanding and interpretation. To address this issue, I took the initiative to conduct qualitative interviews to gauge the level of difficulty that participants experienced in comprehending the questions. This approach allowed me to gain valuable insights into the potential barriers participants may face when responding to the questionnaire. Based on the feedback, I have rephrased the questions to make them easier to understand.

In addition to the information provided by Podsakoff et al. (2003), item ambiguity can contribute to common method bias. I used clear and concise language in the survey questions to mitigate this potential issue. This approach reduced ambiguity and ensured the respondents could easily comprehend the questions.

Furthermore, I have avoided using complex syntax or providing excessive explanations. I also carefully avoided double-barrelled questions, which can lead to biases (Krosnick, 1991; Bradburn et al., 2004).

To ensure that the respondents were not burdened, I consciously tried to refrain from asking questions that required them to recall past events or experiences (Krosnick, 1991). Instead, I focused on formulating questions that pertained to their current state, allowing for immediate and relevant responses.

Podsakoff et al. (2024) emphasise the significance of procedural remedies in managing common method biases. I also conducted Harman's single-factor test. Despite the literature's criticism of its conservative nature (see Hulland et al., 2018), I chose to perform it to avoid endorsing any viewpoint. Upon conducting the Exploratory Factor Analysis (EFA), I loaded all the variables on a single factor. The total variance explained by this single factor was less than 50%. Based on this analysis, it can be inferred that the common method bias in my study is not

a major issue. It is important to note that while eliminating common method bias can be challenging, I have made diligent efforts to minimise its impact to the best of my ability.

5.7 Hypothesis Testing

Before presenting the results of the hypothesis testing, I carefully assessed for endogeneity to ensure that our hypothesised model did not produce bidirectional results. This involved thoroughly considering potential causal relationships and associated issues to validate our findings. I noted the non-linear bivariate causality direction ratio (NLBCDR) to be approximately 1.0, well above the threshold value of 0.7. Additionally, the average variance inflation factor (AVIF) is 1.976, which is below the acceptable value of 5. Furthermore, the goodness of fit (GoF) value is 0.645, as suggested by Tenenhaus et al. (2005), indicating a strong fit. Therefore, I can assert that in this specific scenario, the concept of causality is not applicable. Additionally, the issue of multicollinearity does not pose a barrier to interpreting the results, as the Variance Inflation Factor (VIF) values are significantly lower than the threshold limit.

Figure 5.7 shows the estimates obtained through PLS analysis. The final model's average R-squared is 0.715, indicating that the combined impact of IV, ST, and CL explains almost 71.5% of the total variance in the HSCR. The results confirm that information visibility, swift trust, collaboration, and crisis leadership are crucial for healthcare supply chain resilience. The hypothesised link (H1) (IV→CO) (β=0.17, p=0.04) suggests that information visibility significantly influences collaboration positively, supporting the hypothesis that access to information is vital for enabling collaboration. Furthermore, for the hypothesised path (H2) (ST→CO), it was found that swift trust significantly drives collaboration (β=0.72, p<0.01).

During the challenging period of the health crisis, there has been a noticeable improvement in the visibility of information and the establishment of trust among partners responsible for

managing the supply chain of essential healthcare items. This enhancement has led to a significant boost in collaboration. It is important to note that collaboration plays a crucial role in supply chain management and is often the critical missing component in ensuring smooth operations and effective responses during crises. The findings of our study align with the perspectives presented in Kovacs & Falagara Sigala (2021) publication and the study by Friday et al. (2021).

Next, I found that the hypothesised path (H3) joining CO and HSCR (CO→HSCR) has a positive and significant influence on the HSCR ($\beta=0.48$, $p<0.01$). The findings indicate that when there is a disruption in the supply chain of essential healthcare items during a crisis, collaborating with various stakeholders can play a crucial role in restoring the original state. This collaboration may involve coordination between healthcare providers, suppliers, and government agencies to ensure the efficient distribution of necessary items and address supply chain bottlenecks. The collective efforts of these parties can help effectively respond to the crisis and mitigate the impact of supply chain disruptions on healthcare delivery. The results align with the earlier research findings of Crick & Crick (2020) and Marty & Ruel (2024). Hence, I conclude that hypotheses H1-H3 found support.

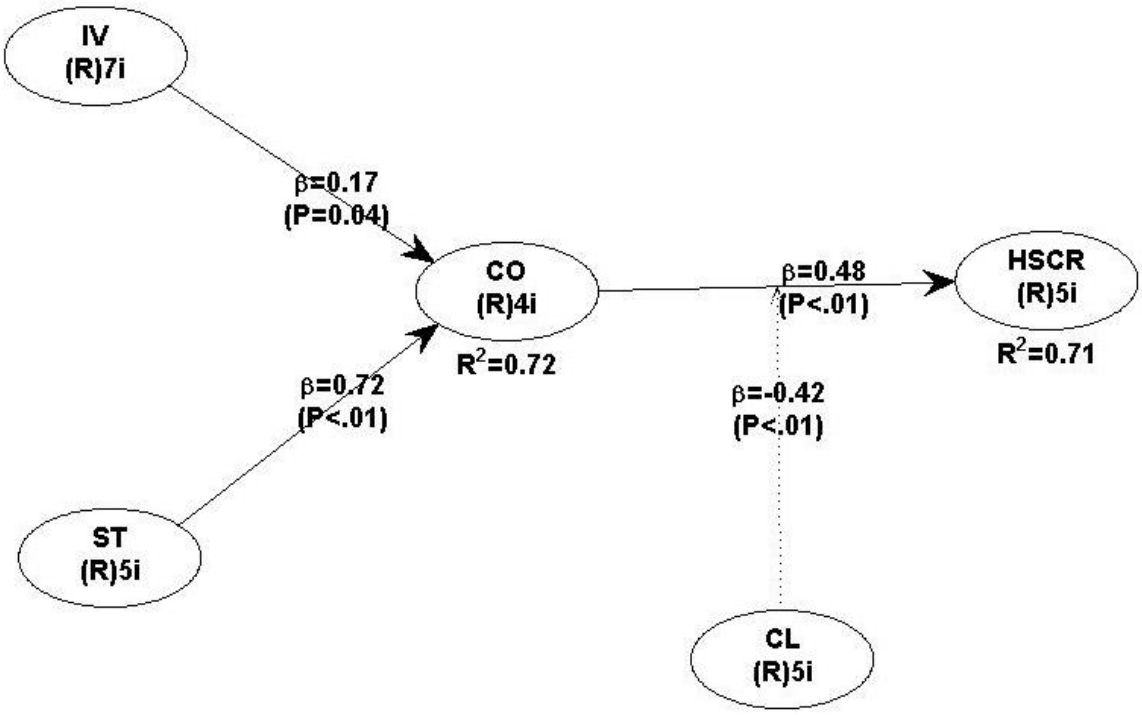


Figure 5.7: Final Model after PLS Analysis
(Source: Author's work)

I examined hypotheses H4a and H4b, specifically focusing on investigating how collaboration between information visibility and healthcare supply chain resilience, as well as between swift trust and healthcare supply chain resilience, mediate the effects. I followed the four-step procedure recommended by Baron & Kenny (1986) for the test. In addition to the conservative test suggested by Baron & Kenny (1986), I also conducted an indirect test recommended by Kock (2011) and Kock & Gaskins (2014) (refer to Figure 5.8). Using WarpPLS 7.0, I could view indirect and total effects, which helped me understand the indirect and total effects associated with all latent variables linked through one or more paths with more than one segment. Based on the findings in Figure 5.8, I can conclude that collaboration partially mediates the relationship between IV/ST and HSCR (Huboma & Belkhamza, 2021).

*** Indirect and total effects ***

Indirect effects for paths with 2 segments

	IV	ST	CO	CL	HSCR	CL*CO
IV						
ST						
CO						
CL						
HSCR	0.172	0.235				
CL*CO						

Number of paths with 2 segments

	IV	ST	CO	CL	HSCR	CL*CO
IV						
ST						
CO						
CL						
HSCR	1	1				
CL*CO						

P values of indirect effects for paths with 2 segments

	IV	ST	CO	CL	HSCR	CL*CO
IV						
ST						
CO						
CL						
HSCR	<0.001	<0.001				
CL*CO						

Figure 5.8: Indirect and Total Effects of the Mediation Test (H4a/H4b)

The moderation effect of CL on the relationship between CO and HSCR (H5) suggests that when the level of CL is low, it significantly impacts the path connecting CO and HSCR. During times of crisis, it is interesting to note that crisis leaders often impede collaboration among supply chain partners due to their direct influence (see Figure 5.9). This could be due to their need to assert control or make decisions quickly, which can hinder the open communication and collaboration necessary for effective supply chain management during a crisis. This discovery serves as a significant addition to the ongoing discourse on crisis leadership and its profound influence on fostering collaboration among individuals and teams during challenging

times. Hence, my hypothesis (H5) is supported. Therefore, I have summarised the hypotheses testing (H1-H5) except H4a/4b in Table 5.9.

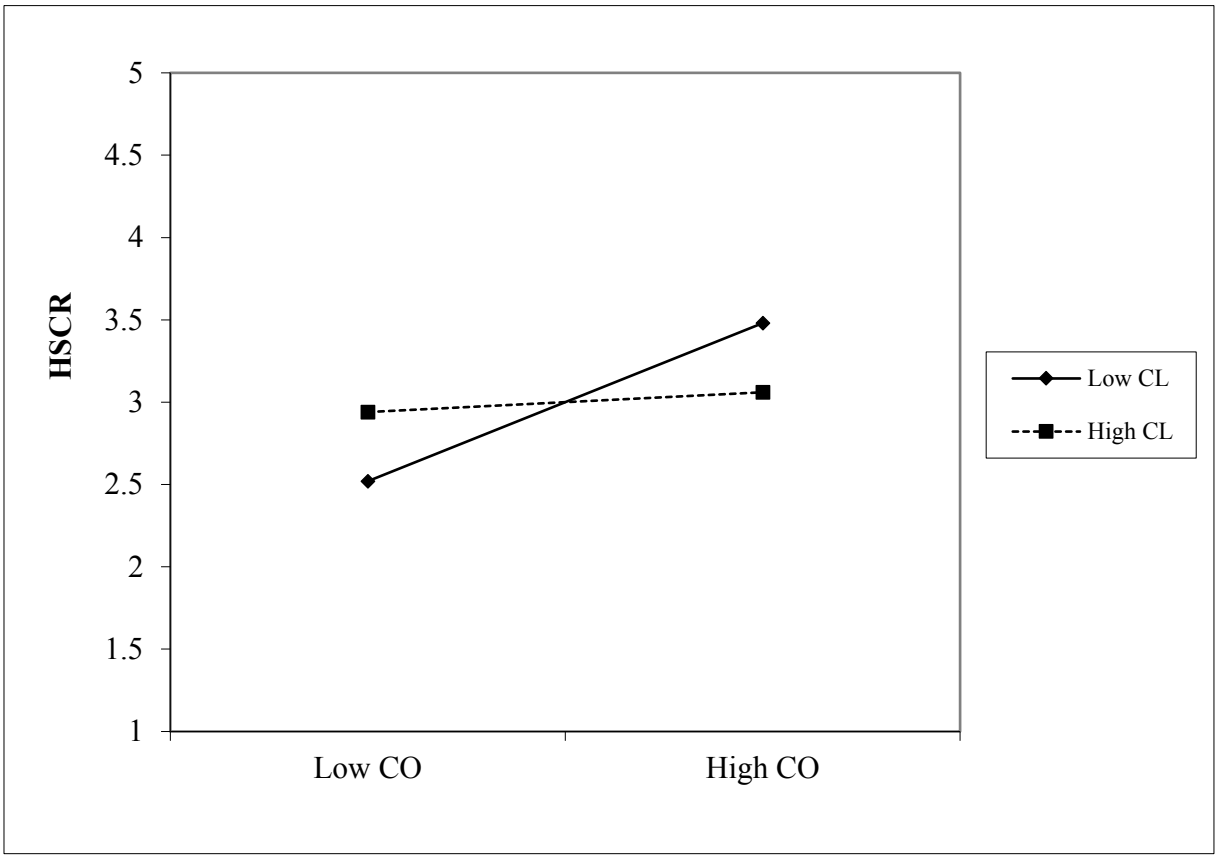


Figure 5.9: Moderation Effect of Crisis Leadership

Table 5.9: Hypothesis Testing

Hypothesis	Independent variable	Dependent variable	β	p	Results
H1	IV	CO	0.17	0.04	supported
H2	ST	CO	0.72	<0.01	Supported
H3	CO	HSCR	0.48	<0.01	Supported
H5	CO*CL	HSCR	-0.42	<0.01	supported

5.8 Chapter Summary

In this chapter, I have explored my second research objective by thoroughly examining the principles and concepts of positivistic philosophy. I have provided an in-depth discussion that encompasses the central tenets, historical context, and contemporary relevance of positivism in the field of research and inquiry. To address the research questions RQ2 and RQ3, I meticulously developed a theoretical model grounded in the relational view and upper echelon theory, which served as the foundation for outlining five research hypotheses. The process of questionnaire development was thoroughly discussed, and I systematically operationalised the questionnaire in three distinct steps. Subsequently, I meticulously collected data using a pre-tested questionnaire and rigorously tested the research hypotheses with a sample size of 111 through variance-based SEM. To examine the hypotheses, I employed WarPLS 7.0, a software tool based on consistent Partial Least Squares (PLS) methodology. Notably, consistent PLS is known for yielding more robust findings when compared to traditional PLS-SEM. I carefully presented the results of the study, ensuring that every detail had been captured. The implications derived from the results were thoroughly summarised, covering the wide-ranging impact of the findings. Within this chapter, a comprehensive discussion is presented regarding both the direct and indirect effects of the variables under study. Furthermore, I conducted an in-depth analysis of the moderation effect, which is a distinctive and significant aspect of my study, shedding light on its unique contribution to the research.

In the upcoming chapter, I will thoroughly examine and combine the results obtained from the DELPHI study, qualitative interviews, and hypothesis testing. The discussion section will be meticulously structured into four distinct parts, with a particular focus on the implications of the findings for theory, managerial practices, and policymaking. Furthermore, it will comprehensively investigate the study's limitations and offer insights into potential avenues for future research.

CHAPTER 6: DISCUSSION

In the upcoming chapter, I will discuss the results obtained from the ISM modelling, which draws on the findings of the DELPHI study, qualitative interviews, and quantitative analyses using the graph-theoretic approach. I will discuss how the ISM model and the MICMAC analyses have contributed to developing a distinctive social support system for resilient healthcare systems. Secondly, I conducted comprehensive tests on a theoretical model rooted in the relational view and the upper-echelon theory. By employing the PLS-SEM using commercial software (WarpPLS 7.0), I conducted statistical analyses that yielded interesting insights. Through qualitative and quantitative methods, the study advanced the theoretical comprehension of the intricate healthcare supply chain resilience and presented valuable insights for practitioners and policymakers grappling with global crises, such as the unprecedented challenges posed by the novel coronavirus. The study's findings contribute substantially to understanding complex healthcare systems in developing countries, specifically India.

In this chapter, I will delve into the theoretical and scholarly contributions in *section 6.1*. This will involve a comprehensive discussion of the research's impact on existing theory and its contributions to academic literature. In *section 6.2*, I will thoroughly analyse and discuss the specific managerial insights that have emerged from the study findings. This in-depth examination will clearly understand these findings' practical implications for management and organisational practices. In *section 6.3*, I will examine how the study's findings can provide valuable direction to policymakers by elucidating their relevance and potential impact on policy decisions. In *section 6.4*, I will present a detailed analysis of the study's limitations, offering insights into the boundaries of its findings. In *section 6.5*, I will explore potential avenues for future research, outlining areas that merit further investigation based on the current study's

outcomes. Finally, in *section 6.6*, I will synthesise the study's key findings and insights to present a comprehensive conclusion.

6.1 Contributions to Theory

The following is an overview of the study's findings and a synthesis of qualitative and quantitative analyses. I will revisit the initial theory before discussing the study's theoretical contribution. I will evaluate two influential works to elaborate on the arguments in chapters 2 and 3. Whetten (1989) emphasised the importance of addressing questions such as *what, how, why, who, when,* and *where* to understand theory. Understanding "*what*" involves answering questions related to essential study elements. A critical review of existing literature helped me understand the topic and identify factors contributing to healthcare supply chain resilience. However, the literature lacks a comprehensive overview of healthcare supply chain resilience, especially during a crisis. This gap highlights the need for further research and a more holistic approach. I proposed the initial research objective of comprehensively understanding healthcare supply chain resilience to address this gap. After identifying eighteen key variables, I gathered input from experts. Employing a comprehensive approach, I analysed the substantial impact of diverse variables on healthcare supply chain resilience through a thorough DELPHI study and in-depth qualitative interviews. Furthermore, I used a theoretical framework, drawing inspiration from Boyer & Swink (2008), to gain a comprehensive view of the enablers supporting healthcare supply chain resilience. This approach was crucial in answering "*what*", which is the first step towards building a theory. Whetten (1989) identified the second question, "*how*," as a critical theory element. This inquiry delves into the intricate relationships and interactions between the various factors or variables studied, aiming to comprehend these elements' interconnected mechanisms and processes. To address the question, "*how*", I adopted two steps. In my research, I devoted considerable effort to comprehensively understand how the eighteen variables (refer to Chapter 4 Table 4.2) are interconnected. This is a significant

aspect as the current literature does not completely understand the interrelationships among these variables. To address this gap, I employed ISM modelling, a suitable method to explore the relationships between the variables, discerning causes and effects among the 18 variables. In addition to this, I further tested the theoretical model (refer to Chapter 5 Figure 5.1), using the variance-based structural equation modelling (PLS-SEM) using commercial software (WarpPLS 7.0). The PLS-SEM analysis has provided valuable insights into how information visibility and swift trust impact collaboration within the healthcare sector. This collaboration, in turn, directly influences the resilience of the healthcare supply chain. It is exciting to note that these relationships are influenced by crisis leadership, which plays a moderating role in shaping the overall dynamics. Such findings have significant implications for understanding and enhancing the robustness of healthcare supply chains, especially in times of crisis and uncertainty. Hence, one of the fundamental components of the theory revolves around addressing the question of "*how*". Emphasising the methods, procedures, and mechanisms is crucial for comprehensively understanding the theory. The third most important question, "*Why*," holds significant importance as it is the pivotal element of the theory. Understanding the reasons behind a certain phenomenon or occurrence is crucial for gaining comprehensive insights and drawing accurate conclusions. The selection of eighteen variables was based on the following rationale. While no strict rules govern the selection of eighteen variables, I based my decision on the saturation theory (Glaser & Strauss, 1967; Saunders et al., 2018). This theory suggests that the chosen variables must effectively represent the resilience of the healthcare supply chain. The saturation principle is a concept that helps researchers determine the appropriate variables to include in their study to explain the context under investigation effectively. By applying this principle, researchers can ensure that the selected variables provide comprehensive coverage of the subject matter, resulting in a more accurate and meaningful analysis. I conducted a thorough analysis and identified eighteen variables based on their

comprehensiveness and parsimonious nature (Larsen, 2003). After careful consideration, I decided to drop certain variables as they were causing confusion and overlapping with the existing ones. This process was essential to ensure the accuracy and efficiency of the analysis. In Figure 5.1, I have formulated a theoretical model that delineates the intricate interplay between information visibility, swift trust, collaboration, crisis leadership, and healthcare supply chain resilience. This conceptual framework is underpinned by the relational view and upper-echelon theory. According to the relational view, relational competencies are instrumental in gaining a competitive advantage. However, it is important to acknowledge that the relational view has its own set of limitations. I have proposed crisis leadership as a moderating construct in response to these limitations. This move is intended to pave the way for a more nuanced understanding of the dynamics at play. Ultimately, I aim to contribute meaningfully to the ongoing theoretical discourse in this domain. In full, I strived to thoroughly explore the primary inquiries that serve as the foundational components of any theory, namely, *what*, *how*, and *why*.

To further address the remaining questions, such as *who* is involved, *when*, and where the situation occurred. In this instance, I delve deeper into the "who" concept, emphasising its crucial role in theory development. This aspect significantly influenced my decision-making process about sample selection and the choice of target respondents. It is important to note that in empirical research within the social sciences, the selection of the sample and the valuable input from the respondents are foundational in constructing and refining theory.

"*When*", the next element of the theory, the fifth component of theory development, is essential to understand. The study is relevant to the pandemic, suggesting that the situation in which the variables operate is essential to theory development. When considering contextual factors, it becomes crucial to address the element of "*when*," as it plays a significant role in understanding

the broader context. This temporal aspect influences how contextual factors impact a situation and helps comprehend the timing and sequencing of events or decisions within a given context.

The final component of the theory, "*where*," is significant as it offers invaluable insights into theories' limitations. Understanding the boundary conditions is crucial for comprehending how variables impact one another. In my study, I delved into detailing the specific underpinning conditions that govern the influence of variables on each other.

In my current work, I further included the critical arguments in Sutton and Staw's (1995) work. These arguments carefully outline the conditions not essential for theory development, providing valuable insights for my research. By addressing common misconceptions, this article not only enhances our understanding but also prompts a re-evaluation of Whetten's (1989) five W's and one H's framework, offering a comprehensive approach to theory development. The discussion focused on identifying the specific "*what*" regarding the variables and constructs. However, it is essential to emphasise the limitations of merely outlining these variables or constructs in explaining the theory. The theory transcends the mere identification of variables and constructs, as the key lies in delving into the underlying narratives associated with each variable or construct. In the same vein, it is essential to note that while valuable, diagrams and data analyses do not constitute a strong theory. I agree with this viewpoint and would like to further elaborate on the idea that simply developing an ISM model (see Figure 4.2) or a theoretical model (see Figure 5.1) is insufficient. Understanding that building arguments is a fundamental aspect of theory is crucial. Therefore, within the context of social science, it is essential to consider how these arguments are interconnected and how they are constructed. To outline my main contributions to the theory, I employed the arguments presented by Whetten (1989) and those by Sutton and Staw (1995). I firmly believe that these contributions represent a significant addition to the existing body of knowledge. I have analysed and identified several significant contributions based on interpretive structural modelling.

According to Figure 4.2, it is apparent that government support has been identified as having a strong driving force and low dependence power in comparison to the other seventeen variables. This suggests that nations where the government has provided substantial support to the healthcare sector have demonstrated better performance during times of crisis than nations where government support to the healthcare sector is not as extensive.

Furthermore, it is essential to recognise the substantial impact of government support on the decisions made by top management in the healthcare sector. A robust governance framework is essential in providing clear direction and support to healthcare leaders, allowing them to make informed decisions and take decisive action in response to rapidly evolving healthcare challenges and crises. This framework ensures that leaders have the necessary tools and authority to mobilise resources, coordinate efforts, and implement effective strategies to safeguard public health and well-being.

Top management support is crucial for enhancing the visibility of information within an organisation and among the partners involved in the healthcare supply chain. It involves providing the necessary financial backing and family support, which are essential connecting variables in ensuring the smooth functioning and success of the organisation. This support from the top management not only aids in making critical information more accessible but also creates a supportive environment for the employees, contributing to the overall effectiveness and efficiency of the organisation. The arguments presented align with the upper echelons theory (UET) proposed by Hambrick and Mason (1984). The theory posits that the formulation of organisational strategy is intricately linked to the beliefs, values, and cognitive framework of top managers, shaping the vision and direction of the organisation.

After conducting the MICMAC analysis, we classified the factors into four distinct categories based on their level of influence and driving power. As illustrated in Figure 4.3, the figure revealed that government support, top management support, family support, information

visibility, and information sharing are characterised by strong driving power and weak dependence. This implies that these factors drive trust, mutual respect, inventory management, alignment, agility, and adaptability within the analysed context. Hence, combining the ISM model and the MICMAC analysis further helped develop an interesting theory (refer to Figure 4.5) called *the social support system* for the resilient healthcare system. This theory contributes to the social aspect of building resilience in times of crisis (Shumaker & Brownell, 1984; Ntontis et al., 2023). It explores the significant role of strong social networks in developing nations struggling with scarce resources, demonstrating how robust social systems have made essential contributions to the theory. During times of crisis, such as natural disasters or economic downturns, the social system plays a vital role in supporting and assisting individuals and communities. This becomes even more crucial when countries are faced with limited resources. The social system, including government assistance programs, non-profit organisations, and community initiatives, helps to ensure that those in need receive the necessary aid and resources to overcome the challenges brought about by the crisis. By working together and mobilising available resources, the social system can significantly mitigate the effects of a crisis and support the affected population.

By addressing the first research objective, I can argue that my study provides a comprehensive definition of healthcare supply chain resilience. In addition to the existing body of literature, the role of government support, top management support, and family support are crucial. These findings suggest that the social dimensions are critical in uncertain times when resources are limited. Therefore, the study contributes to the definition of healthcare supply chain resilience. It satisfies the six elements of Whetten's (1989) framework. In this, I have explained the eighteen variables (what), that contribute to the healthcare supply chain resilience,(how) with the help of interpretivism logic, I have developed an ISM model that depicts the complex association among these eighteen variables, and why, based on the saturation principle and the

DELPHI study, I have arrived at these eighteen variables. In addition to what, how, and why, I have also explained the who, when, and where. These elements are enough to justify the contribution.

The primary focus of the second research objective was to construct a comprehensive theoretical model that elucidates the pivotal role of relational competencies, such as *information visibility* and *swift trust*, in bolstering collaboration and fortifying the resilience of the healthcare supply chain (HSCR). The intent was to establish a robust framework and validate its effectiveness by leveraging survey-based data collection and analysis. The framework underscores the critical nature of comprehending how relational competencies, such as communication, trust, and mutual understanding, contribute to fostering effective collaboration among various stakeholders within the healthcare supply chain during periods of crisis. This argument is well-supported by existing academic literature (Morgan & Hunt, 1994; Moshtari, 2016; Dubey et al., 2019), highlighting robust collaborative practices' positive impact. However, the disconnect between theoretical insights and practical implementation signifies that collaboration inadequacies persist as a predominant factor contributing to the breakdown of healthcare supply chains during challenging periods such as the recent pandemic (Flynn et al., 2021; Kovács & Falagara Sigala, 2021). Considering the extensive literature available, I embarked on a study to assess the significance of information visibility and swift trust in fostering collaboration. The aim was to examine how these factors contribute to building trust and facilitating effective teamwork, particularly during times of crisis. By delving into this topic, I aimed to fill a gap in the existing research and provide insights into the dynamics of swift trust in challenging contexts (Gilson et al., 2015; Schiffling et al., 2020).

I further conducted an in-depth analysis to explore the significance of crisis leadership in amplifying the influence of collaboration on the resilience of healthcare supply chains during crises. It is widely considered that crisis leadership plays a pivotal role in distinguishing the

response to crises (James et al., 2011). During turbulent times, crisis leadership has been the subject of mixed observations, as reported by Klebe et al. (2021). Upon considering their study, I have postulated that crisis leadership may have a detrimental influence on relationships (refer to hypothesis H5 in Chapter 5). The findings demonstrate that crisis leadership negatively moderates the connection between collaboration and healthcare supply chain resilience. Strong and effective leadership within the healthcare supply chain during a crisis may inadvertently impede collaboration among partners. This lack of collaboration can harm the overall resilience and efficacy of the healthcare supply chain, potentially leading to disruptions in the delivery of essential medical supplies and services. The findings significantly contribute to one aspect of crisis leadership theory, indicating that leaders who exhibit strong crisis management skills may struggle to navigate and lead during times of crisis effectively. This suggests that certain qualities or traits typically associated with effective leadership may not necessarily translate to success in crises. It is becoming increasingly evident during challenging times that crisis leadership plays a crucial role (Riggio & Newstead, 2023). The ability to lead with empathy is particularly critical in such situations (König et al., 2020). The contribution of my study provides valuable insights into a relatively unexplored area within the field of leadership. The implications of this research offer new perspectives and potential opportunities for further exploration. This work builds on the findings of Riggio & Newstead (2023) and aims to contribute to the ongoing discourse on leadership and its various dimensions.

The empirical validation of the theoretical framework, detailed in Figure 5.1, makes three significant contributions to advancing theory in this study area. This study emphasises the importance of integrating two critical perspectives: the relational view (proposed by Dyer & Singh, 1998) and the upper echelons theory (set forth by Hambrick & Mason, 1984). These two theories complement each other, especially when considering the role of collaboration in enhancing the resilience of the healthcare supply chain during crises such as a pandemic.

Understanding the interplay between these theories is crucial for recognising how collaboration can effectively contribute to building resilience in the face of major challenges within the healthcare supply chain. Secondly, the study underscores the essential role of crisis leadership in managing challenging situations. However, it also highlights a potential downside: excessive focus on crisis management can hinder the collaborative efforts necessary for building healthcare supply chain resilience. This cautionary note emphasises the need for a balanced approach that ensures effective crisis leadership without inhibiting broader collaborative efforts. The third aspect of this study makes a valuable contribution to the perspective of healthcare supply chain resilience. It emphasises the importance of establishing swift trust and ensuring clear information visibility, as these factors enhance collaborative efforts and ultimately lead to improved resilience in the healthcare supply chain. It is worth noting that the mediating effect of collaboration plays a significant role in amplifying our critical understanding of healthcare supply chain resilience.

In summary, the study makes two notable contributions that distinguish it from existing literature. The first contribution is towards building the social support system perspective of the healthcare system. The second contribution is demonstrating how integrating the relational view and the upper-echelon theory can help explain the formation of healthcare supply chains during times of crisis.

6.2 Managerial Implications

The research was driven by the significant challenges observed during the initial and subsequent waves of the COVID-19 crisis. Notably, the healthcare sector bore the brunt of the impact, experiencing deficiencies in visibility, governance, collaboration, and ownership. These factors exacerbated the situation, resulting in acute shortages of PPE, sanitisers, medications, and healthcare facilities. The study, underpinned by both qualitative and quantitative analyses, furnishes valuable insights that can aid healthcare professionals, medical specialists, and

healthcare facility administrators in navigating similar challenges in the future. The role of government support has a substantial impact on various aspects of a nation's well-being. A country with solid governance not only provides clear direction during times of crisis but also plays a crucial role in ensuring the welfare and stability of its citizens. Government support encompasses a wide range of factors, such as policy implementation, resource allocation, and public services, all of which are essential for the overall development and resilience of the nation.

The support of top management and the nature of leadership play pivotal roles in ensuring healthcare supply chain resilience. The commitment and active involvement of top management are essential for implementing strategic initiatives and providing the necessary resources to enhance the resilience of the healthcare supply chain. Understanding effective leadership's specific attributes and behaviours within healthcare supply chain management is imperative for successfully navigating challenges and disruptions. Influential leaders can inspire collaboration, drive innovation, and cultivate a resilient organisational culture that can adapt to changing demands and circumstances within the healthcare supply chain.

The top management in the healthcare sector should prioritise the well-being of their employees' families because it plays a crucial role in providing support during times of crisis. This is particularly important for healthcare personnel who work long hours and are dedicated to serving others. Family support can help alleviate stress and provide a strong foundation for healthcare workers, enabling them to focus on their important roles better.

Information visibility and trust are essential in establishing effective collaboration within healthcare organisations. Information visibility refers to the accessibility and transparency of relevant data, which allows all stakeholders to understand the information at hand clearly. When healthcare managers prioritise information visibility, they enable smoother communication and decision-making processes, ultimately fostering a collaborative environment. On the other

hand, trust plays a critical role in building strong relationships among teams and departments. When stakeholders trust each other and the information available, they are more likely to work together cohesively, improving patient care and organisational outcomes. Therefore, understanding and prioritising information visibility and trust is vital for healthcare managers seeking to promote collaboration within their organisations.

I argue that effective communication among healthcare managers is crucial during times of crisis, such as the current pandemic. This includes being transparent, empathetic, and showing respect and trust. Healthcare teams must collaborate effectively, as past relief efforts have often failed due to a lack of collaboration. Effective communication and coordination play a pivotal role in successfully managing crises in virtual teams. Given the dispersed nature of virtual teams, the ability to seamlessly connect and collaborate becomes even more critical during challenging situations.

6.3 Implications for the Policymakers

The research presented in this study is a valuable and thought-provoking contribution, particularly in policy development. The study's approach and findings serve as an exemplary model that other researchers and policymakers could adopt. In my research, I comprehensively analysed eighteen variables contributing to healthcare supply chain resilience. Among these variables, I determined that government support exhibits the highest level of influence and the least dependence. This suggests that a nation with strong governance and active government involvement during a crisis is better equipped to mitigate the adverse impacts of the crisis and facilitate a rapid recovery to pre-crisis conditions. My comprehensive study unearthed notable disparities in how Indian states coped with the pandemic. While certain states exhibited remarkable resilience, others grappled with the crisis. What emerged as a significant factor was the visibility of information in public hospitals; those with poor information visibility demonstrated lower performance during the crisis. These findings hold considerable potential

to offer valuable insights to public servants, providing them with actionable guidance on how to enhance the overall efficiency and effectiveness of the system.

During times of crisis, the concept of swift trust, which refers to the initial willingness of individuals to trust others in temporary or urgent situations, plays a critical role in fostering effective collaboration. In India, collaboration among various government bodies during a crisis was lacking. This was due to the organisations' failure to communicate with each other effectively and efficiently, thereby hindering their ability to respond to the crisis cohesively. This has been identified as one of the main reasons behind acute shortages of oxygen cylinders and PPEs during the second wave, contributing to the highest casualties in three states of India. A strong and competent leadership has led the state government. However, there has been a noticeable communication gap between the state government and government officers. This lack of effective communication has resulted in discrepancies in the utilised data and has also contributed to inefficiencies in governance processes. This underscores the critical significance of leveraging digital technologies to prevent miscommunication and lack of clarity within the state government-run hospitals and health clinics. Implementing digital solutions will enable real-time monitoring and oversight of these facilities, ensuring efficient and effective operations while improving overall healthcare outcomes for the community (Tiwari et al., 2024).

Policymakers must recognise and understand the critical importance of robust and empathetic leadership during times of crisis. My research findings further validate this claim, as they are consistent with the qualitative insights I have obtained. I have observed that states with robust and decisive leadership have experienced significant challenges in effectively managing health crises. Conversely, leaders with empathy and a cooperative approach have proven more effective in navigating and addressing crises. Therefore, the role of crisis leadership is exceedingly significant. Investing in comprehensive leadership training programs to equip

government senior officials with the necessary skills and expertise to manage and mitigate future crises effectively is crucial.

6.4 Limitations of the study

Reflecting on my work, I find it essential to acknowledge that despite exerting considerable effort, I am aware of several limitations in my study. In my study, I utilised samples from India, a prominent developing nation. While I am cognizant of this fact, I also acknowledge that it would have been advantageous to include samples from other developing nations to gain a more comprehensive understanding of the context. This approach could have offered profound insights and enriched the study's findings. Extensive travel to various countries is necessary to gather data from other countries. This involves visiting hospitals and clinics and conversing with healthcare providers and researchers to obtain rich and detailed insights.

During my extensive literature review, I discovered that national culture substantially influences organisational strategies in times of crisis. For example, Japan's approach to handling crises differs significantly from that of the United States, the United Kingdom, and India (Yan et al., 2020). This highlights the importance of considering cultural factors when developing crisis management strategies (Banik et al., 2020). To streamline the study and avoid introducing additional layers of complexity, I decided to exclude the consideration of national culture as a moderating construct. Upon contemplating the considerable influence of culture on the formation of leadership strategies, it would have been highly compelling to conduct a more in-depth exploration of its potential impact within the study (Liu, 2021).

I discovered that in addition to the relational view, the application of resource dependence theory (RDT) significantly contributes to explaining the collaborative relationships among partners during times of crisis in establishing resilience in the healthcare supply chain (Craighead et al., 2020). This theory focuses on how organisations depend on key resources

from external partners and how these interdependencies influence their behaviour and decision-making during crises. By understanding and applying RDT, organisations can better strategise and collaborate with their partners to enhance the resilience of the healthcare supply chain, ultimately improving their ability to respond effectively to crises and disruptions.

In my analysis, I employed the interpretive structural modelling (ISM) approach to investigate the complex interrelationships among the eighteen variables that contribute to the resilience of the healthcare supply chain. However, I encountered significant inconsistencies during the DELPHI study, where the traditional binary representation option is limited to either 0 or 1, restricting the ability to fully capture the influence of one variable over another. I propose utilising the FUZZY theory to address these inconsistencies and enhance the robustness of the analysis. Notably, there is a substantial body of scholarly literature wherein researchers have effectively leveraged the FUZZY theory in similar contexts (Gorane & Kant, 2013; Dubey & Ali, 2014; Bhosale & Kant, 2016). In fuzzy theory, the traditional binary representation of the influence of one variable over another (0 or 1) is replaced by a continuum of options ranging from 0 to 1 (0, 0.3, 0.5, 0.7, 0.9, 1). This approach allows for a more nuanced and detailed portrayal of the relationship between variables, capturing shades of influence that binary representation may overlook. It provides a comprehensive set of options to capture the true nature of the relationship accurately.

I have assembled cross-sectional data to evaluate the theoretical model depicted in Figure 5.1. It is essential to recognise that cross-sectional data comes with various limitations. Therefore, despite these limitations, I took several precautions to mitigate the common method bias. Using longitudinal data, which involves gathering information from the same subjects over time, could have been more beneficial for testing research hypotheses. This method allows for observing changes and developments within the subjects, providing a more comprehensive understanding of the phenomena under investigation.

6.5 Future research directions

The limitations of the study serve as a valuable guide for researchers, policymakers, and practitioners, offering insights into the opportunities for further advancement in debates. It is recommended that future research incorporates different theories, comprehensive samples drawn from multiple countries, longitudinal data, and the inclusion of national culture as a moderating construct. Moreover, it is advised that future studies also consider controlling the effects of interdependence, absorptive capacity, and supply base complexity for a more comprehensive understanding of the subject matter. Throughout the course of the pandemic, we have noted a noticeable improvement in the performance of healthcare units as time has progressed. This improvement can be attributed to a learning effect, indicating that with increased experience and knowledge, the healthcare units have enhanced their performance in dealing with the challenges posed by the pandemic. Hence, from my perspective, I strongly believe that the management and enhancement of absorptive capacity within an organisation or system could potentially lead to the generation of a wider range of diverse and valuable insights, thereby contributing to improved decision-making and problem-solving processes (Yildiz et al., 2024). By exerting control over absorptive capacity, it is possible to improve the generalisation of the study's findings.

Mutual interdependence plays a crucial role in shaping the resilience of the healthcare supply chain (Gölgeci & Ponomarov, 2015). The interconnectedness and interrelatedness of various components within the supply chain profoundly impact its ability to withstand and recover from disruptions. This includes the relationships between healthcare providers, suppliers, manufacturers, distributors, and other stakeholders and the flow of goods, information, and resources throughout the network. Understanding and managing these interdependencies is essential for strengthening the overall resilience of the healthcare supply chain. Thus,

effectively managing the mutual interdependence within the healthcare supply chain is crucial for assessing its resilience during times of crisis. By analysing and addressing the complex relationships and dependencies between various supply chain elements, organisations can better prepare for and respond to disruptions, ensuring the continuous delivery of essential healthcare products and services during challenging circumstances.

The intricate and multifaceted nature of the supply chain infrastructure during the pandemic has significantly disrupted the overall supply chain. This complexity encompasses fluctuating demand, manufacturing and transportation disruptions, and regional restrictions (Brandon-Jones et al., 2014).

Upon reflection, it is worth noting that the study may have generated more comprehensive insights by incorporating alternative theories, such as resource dependence theory (RDT) or strategic choice theory (SCT) (Craighead et al., 2020). Given the intricate nature of healthcare supply chain resilience, the integration of multiple theories can offer a more holistic perspective, enabling a deeper understanding of its complexity.

Upon reflection, I have come to appreciate the profound importance of longitudinal data in unequivocally establishing the causality of the links. As a result, future studies incorporating longitudinal data could delve deeper into the understanding of healthcare supply chain resilience and yield more robust and comprehensive analyses.

6.6 Chapter Summary

In this chapter, I discussed the results of interpretive structural modelling, which relied on an inductive approach and PLS-SEM analysis of the theoretical model grounded in the relational view and the upper-echelon theory. I used cross-sectional data gathered using a pre-tested questionnaire to test the research hypotheses. The results obtained through qualitative and quantitative analyses helped to understand how they contribute to theory and expand the

theoretical boundaries. The interpretive study helped develop a hierarchical model, and further MICMAC analyses categorised the enablers of healthcare supply chain resilience into four categories depending upon their driving power and dependence. The synthesis of these two independent analyses helped develop a model that expanded the boundary of social support system theory in the context of the healthcare supply chain. Additionally, the PLS-SEM analyses expanded the theoretical boundary of the relational view. The moderating effect of crisis leadership helped bridge the theoretical gaps in the relational view. Moreover, the negative moderating effect further helped us understand the boundary limits of crisis leadership. Next, I analysed the results concerning practical applications and policy implications. I delved into how the results could guide healthcare workers in managing disruptions that cause acute shortages of critical healthcare items. Additionally, I discussed how policymakers can proactively prepare for high-level health emergencies stemming from poor planning, coordination, visibility, and transparency. Furthermore, I highlighted leaders' significant role and approach to handling crises. In addition to contributing to theory and practice, I acknowledged the limitations of my study and proposed various research directions to address unanswered questions. In the following chapter, I will present a comprehensive conclusion.

CHAPTER 7: CONCLUSIONS

This chapter aims to provide a comprehensive overview of the motivations that have driven me to embark on this study. Furthermore, I will delve into the research gaps I have identified through problematisation (Alvesson & Sandberg, 2011; Chatterjee & Davison, 2021) and illustrate my methodology to tackle the research objectives. Every journey possesses distinct beginnings and endpoints, and I believe this study is now reaching its concluding phase. However, the conclusion of this project signifies the opening of new avenues for me. These fresh opportunities are rooted in the invaluable lessons I have assimilated throughout this extensive journey. I have thoroughly examined the existing research and identified the areas that need further exploration. I have meticulously documented my approach to addressing these research gaps, detailing the specific methodologies and tools to achieve meaningful progress in these areas.

7.1 Overview of Research Problems

Before discussing each research gap and how I addressed it, I must reflect on the research problems and the literature that shaped my philosophy (Hirschman, 1986). The COVID-19 pandemic not only impacted nations but also affected our lives. After conducting an in-depth study, I realised these issues could have been easily avoided. The lessons learned during this period can help us tackle global health crises through empathy, information exchange, proper communication, trust, and effective collaboration. These are essential elements well understood in the context of management, yet nations, organisations, and individuals tend to forget and repeat the same mistakes during times of crisis and uncertainty. This study led me to address minor issues that left the healthcare supply chain vulnerable. Additionally, the study attempted to uncover the myths often associated with solid leadership styles, which can complicate issues. Inspired by Alvesson & Sandberg (2013), I formulated four research gaps that challenge the study's existing assumptions and expand the theoretical understanding.

7.2 Research gaps and the way they were addressed

First gap: The healthcare supply chain relies heavily on trust and visibility to build resilience. While there is broad agreement on this, the existing literature does not delve into how information visibility and swift trust enhance resilience within the healthcare supply chain. This gap in understanding leaves a significant area for further research and exploration.

To address this research gap, I used a mixed method to understand how information visibility and swift trust play essential roles in building healthcare supply chain resilience. The first approach used the DELPHI study to gather experts' input, capturing their perceptions regarding how eighteen variables contribute to healthcare supply chain resilience. The study's findings revealed that information visibility is critically essential in enhancing trust among the partners in the healthcare supply chain. Additionally, I developed a theoretical model grounded in the relational view and tested the model using cross-sectional data gathered through a survey-based instrument. The results suggest that information visibility and swift trust, under the mediating effect of collaboration, significantly explain the variation in healthcare supply chain resilience. Hence, in simple words, it can be argued that relational competencies such as information visibility and swift trust are critical in building healthcare supply chain resilience.

Second gap: There is a lack of understanding about the significance of crisis leadership in utilising information visibility and rapid trust to enhance resilience in the healthcare supply chain.

To address a particular gap in research, I employed the upper-echelon theory to put forward the idea that crisis leadership could act as a moderating factor in the relationship between collaboration and healthcare supply chain resilience. This strategy was instrumental in overcoming the limitations associated with the relational view. Subsequently, I conducted a rigorous test of the proposed model using cross-sectional data, and the results revealed that

crisis leadership exerted a significant effect. However, the moderating impact was observed to be negative. This discovery has substantially contributed to our understanding of crisis leadership in the context of healthcare supply chain resilience.

Third gap: The micro-foundation of healthcare supply chain resilience is poorly understood.

The third gap, which we have identified in our analysis, is a pivotal area of focus. To address this gap, I conducted a comprehensive study to understand the micro-foundation view of healthcare supply chain resilience. To achieve this, I utilised ISM to develop a detailed and intricate model that captures the complex relationships among the eighteen variables contributing to healthcare supply chain resilience. This process allowed for a thorough exploration of the interconnectedness and interdependencies of these variables within the healthcare supply chain context.

Fourth gap: There is a lack of research using a mixed methods approach to improve the theoretical understanding of healthcare supply chain resilience.

I have employed an interpretivist and positivist approach to address this research gap. In this study, I utilised ISM modelling using the DELPHI method to address the first research gap. Furthermore, I used the relational view and the upper-echelon theory to address the second and third research objectives to develop a theoretical model. In our approach, we have employed the principles and rationale presented by Boyer & Swink (2008) work. We aim to provide an in-depth and well-rounded perspective by integrating the mixed-method approach.

Exploring these four research gaps has helped to advance our comprehension of the theoretical framework that supports the resilience of healthcare supply chains. This increased understanding will assist in the development of more effective strategies and solutions to strengthen healthcare supply chain resilience, ultimately benefiting both patients and healthcare providers.

7.3 Lessons learned

I want to discuss my unusual approach to presenting my experience, which I find necessary to share as I conclude my thesis (Lotty, 2021; Brunet, 2022). My doctoral journey has been a wonderful experience and is the best moment of my life. Throughout this journey, I have learned invaluable skills I did not acquire while working with major consulting organisations such as E&Y and Tata Consultancy Services.

The first lesson I learned is to be humble. I still remember when my first article was rejected twice, which taught me that rejection teaches you to be pragmatic and makes you realise that even minor issues that we take for granted might be enough for rejection. Publication is not the goal of research but rather one of the outcomes (Venkatesh, 2011). Therefore, one should never be demotivated because a journal rejected their manuscript. Publication is a complex process that goes beyond just submitting a manuscript. Developing a manuscript requires several skills, such as understanding the nature and scope of the publication outlet and identifying the target audience. This process is like my experience at E&Y, where, as a consultant, I needed to understand my client's needs and tailor my services accordingly.

Secondly, I learned that doctoral students are expected to master research methods. However, understanding each method's practical application and usefulness in different situations is challenging. This understanding comes with extensive exposure and experience (Abutabenjeh et al., 2012). I still have a long way to go, but I am eager to continue my journey in this challenging and intellectually demanding field. Choosing an appropriate theory or developing a new one is a critical aspect that often involves philosophical choices and ultimately determines the research strategies. Additionally, selecting the right tools depends on the nature and characteristics of the data. Therefore, *flexibility* and *adaptability* are crucial traits for the journey.

Thirdly, being a doctoral student involves more than just mastering theories and methods; it also entails developing crucial intangible skills. One of the most important of these is working effectively with a diverse team and striking a balance with each team member. In my case, I am fortunate to have three supervisors who exemplify diversity. Each supervisor brings a unique level of expertise and comes from a different background, culture, and expectations. I have found that assimilating inputs from such diverse backgrounds brings a different flavour to the research and plays a vital role in eliminating biases. This diversity of perspectives is an excellent example of how working with a team with varied backgrounds and experiences can help avoid the *common biases* that might have impacted my research if I had been working with only one supervisor or supervisors with similar backgrounds.

I have identified three key learnings to help me navigate academic and personal life complexities. These elements are essential for becoming a better individual and building resilience. In the next section, I will present my framework based on my PhD journey, inspired by two important articles that are pivotal in operations and supply chain management. The first article, "*Triple-A Supply Chain*," was authored by Hau Lee in 2004 and published in the Harvard Business Review. The second article, authored by Escamilla and team in 2021 and titled "*Improving agility, adaptability, alignment, accessibility, and affordability in nanostore supply chains*," was published in the Production and Operations Management Society Journal. These articles have provided valuable insights into the complexities of my journey, which has been a defining aspect of my life.

7.4 Ontological and Epistemological Reflections: A Research Traits Framework

Lee (2004) and Escamilla et al. (2021) contributed to the development of my framework, termed "*Traits of Research*".

7.4.1 Agility

I believe that agility is one of the most important traits of a good researcher. A researcher must possess dynamic *sensing capability*, enabling them to identify the right research topics and understand what needs immediate attention. For example, when I chose my research topic, the healthcare supply chain was one area that needed immediate attention. Despite being a crucial pillar of the economy, the healthcare sector's vulnerabilities were exposed by COVID-19. In addition, *dynamic flexibility* is crucial for researchers to be agile. This includes the ability to respond to supervisor demands for methods and theories, the recent need for peer-reviewed journals, and the expectations of editors. Being flexible is key to navigating these challenges. The *dynamic speed* of research is also essential. Instead of delaying, I preferred to embrace speed to achieve desired outcomes without compromising research expectations and scientific rigour. Therefore, I argue that agility is the most important trait for a researcher to possess.

7.4.2 Adaptability

As I progress through my doctoral studies and pursue an international PhD, I have come to deeply appreciate the profound significance of adaptability in the realm of academic research. I have found that the capacity to adjust to new environments swiftly and effectively, seamlessly immerse oneself in different cultures, and skilfully acclimate to unfamiliar surroundings demands a multifaceted approach characterised by *dynamic structural sensing*, *flexibility*, and innovation. By cultivating and demonstrating adaptability, researchers are better equipped to navigate the intricacies of diverse academic and cultural landscapes, thereby fostering the cultivation of unique insights and perspectives. Moreover, it is essential to acknowledge and express gratitude for the instrumental role played by my esteemed supervisors, the supportive administrators of my university, and the invaluable knowledge and skills acquired through continuous training programs and workshops meticulously organised by the university.

7.4.3 Alignment

As a doctoral student, I have come to recognise the pivotal role of alignment on various fronts within the academic terrain. Ensuring alignment among supervisors, editors, reviewers, and administrators in terms of their *expectations* is crucial for the smooth progression of research. Additionally, establishing alignment in *communication methodologies* and *the dissemination of information* to supervisors, editors, and reviewers is paramount. Furthermore, ensuring alignment in the overall *process* is pivotal for the seamless navigation of the doctoral journey.

7.4.4 Accessibility

As I embarked on my doctoral journey, I became keenly aware of the stark contrast between the lofty aspirations I held and the practical realities I encountered. Originally, I was driven to pursue studies focused on developing nations. However, as time progressed, I understood that access to reliable and comprehensive data is an indispensable cornerstone of any empirical research endeavour. This critical insight prompted me to refine the scope of my study, recognising that the accessibility of data, information, and resources is pivotal to its success. Regrettably, this lack of accessibility forces many students to prematurely discontinue their research, underscoring the significant impact of these foundational elements on the pursuit of academic inquiry.

7.4.5 Affordability

The guidance and support of my supervisors have been invaluable as I have contemplated the concept of affordability in my research. Delving into the question of how much I can afford to sacrifice my earnings as a full-time doctoral student, the impact of being away from my family and friends, and the extent to which I can take risks have been integral in shaping the parameters of my research. Acknowledging that research is an ongoing journey, I recognise the significance of the element of affordability in establishing crucial boundaries for this project.

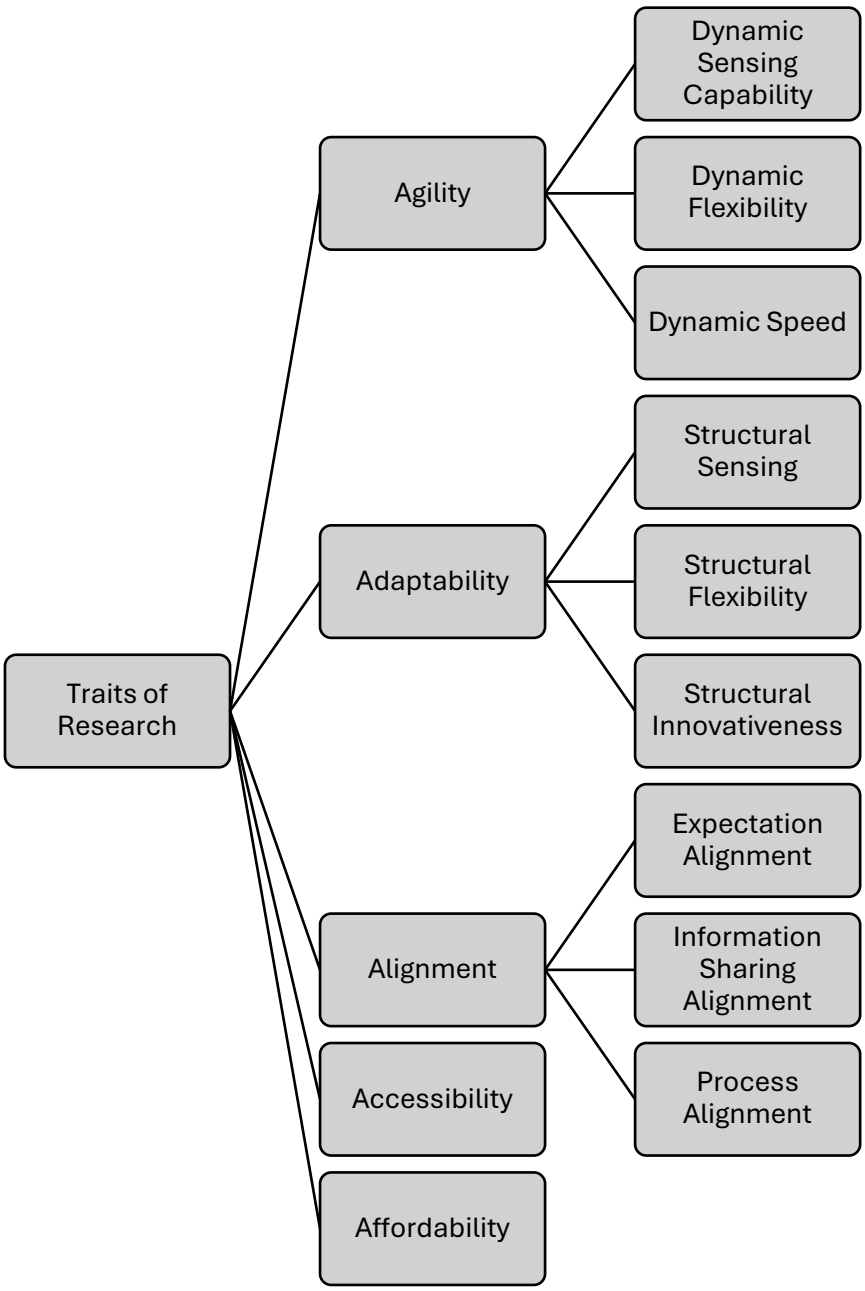


Figure 7.1: Research Traits Framework
(Source: Author's work)

7.5 Chapter Summary

In summarising this chapter, I intend to inspire my future colleagues who may be navigating through my thesis. I have detailed how I addressed the research gaps I identified and then developed a comprehensive framework rooted in my ontological and epistemological

reflections. This framework, which I have named the "*Research Traits*" framework, serves as an outcome of my scholarly introspection and critical thinking.

REFERENCE

Abatecola, G., & Cristofaro, M. (2018). Hambrick and Mason's "Upper Echelons Theory": evolution and open avenues. *Journal of Management History*, *26*(1), 116-136.

Abutabenjeh, S., Calida, B., & Jaradat, R. E. (2012). A Collective Reflection on the Ph. D. Student's Journey: Shades of Technicism and Epistemic Pluralism. *Administrative Theory & Praxis*, *34*(2), 273-278.

Achinstein, P. (1965). Theoretical Models. *The British Journal for the Philosophy of Science*, *16*(62), 102-120.

Adeyeye, S. A. O., Ashaolu, T. J., Bolaji, O. T., Abegunde, T. A., & Omoyajowo, A. O. (2023). Africa and the Nexus of poverty, malnutrition and diseases. *Critical Reviews in Food Science and Nutrition*, *63*(5), 641-656.

Adobor, H. (2020). Supply chain resilience: an adaptive cycle approach. *The International Journal of Logistics Management*, *31*(3), 443-463.

Agarwal, A., Shankar, R., & Tiwari, M. K. (2007). Modeling agility of supply chain. *Industrial Marketing Management*, *36*(4), 443-457.

Aggarwal, P., Castleberry, S. B., Ridnour, R., & Shepherd, C. D. (2005). Salesperson empathy and listening: Impact on relationship outcomes. *Journal of Marketing Theory and Practice*, *13*(3), 16-31.

Akkermans, H. A., Bogerd, P., Yücesan, E., & Van Wassenhove, L. N. (2003). The impact of ERP on supply chain management: Exploratory findings from a European Delphi study. *European Journal of Operational Research*, *146*(2), 284-301.

Akrout, H., & Diallo, M. F. (2017). Fundamental transformations of trust and its drivers: A multi-stage approach of business-to-business relationships. *Industrial Marketing Management*, *66*, 159-171.

Akter, S., & Wamba, S. F. (2019). Big data and disaster management: a systematic review and agenda for future research. *Annals of Operations Research*, *283*, 939-959.

Alam, S. T., Ahmed, S., Ali, S. M., Sarker, S., & Kabir, G. (2021). Challenges to COVID-19 vaccine supply chain: Implications for sustainable development goals. *International Journal of Production Economics*, *239*, 108193.

Alawamleh, M., & Popplewell, K. (2011). Interpretive structural modelling of risk sources in a virtual organisation. *International Journal of Production Research*, *49*(20), 6041-6063.

Aldrighetti, R., Battini, D., Ivanov, D., & Zennaro, I. (2021). Costs of resilience and disruptions in supply chain network design models: a review and future research directions. *International Journal of Production Economics*, *235*, 108103.

Ali, I., & Kannan, D. (2022). Mapping research on healthcare operations and supply chain management: a topic modelling-based literature review. *Annals of Operations Research*, *315*(1), 29-55.

Allen, C. R., & Holling, C. S. (2010). Novelty, adaptive capacity, and resilience. *Ecology and Society*, *15*(3), 24.

Allred, C. R., Fawcett, S. E., Wallin, C., & Magnan, G. M. (2011). A dynamic collaboration capability as a source of competitive advantage. *Decision Sciences*, *42*(1), 129-161.

Alvesson, M., & Sandberg, J. (2011). Generating research questions through problematization. *Academy of Management Review*, *36*(2), 247-271.

Alvesson, M., & Sandberg, J. (2013). Has management studies lost its way? Ideas for more imaginative and innovative research. *Journal of Management Studies*, *50*(1), 128-152.

Alvesson, M., & Sandberg, J. (2020). The problematizing review: A counterpoint to Elsbach and Van Knippenberg's argument for integrative reviews. *Journal of Management Studies*, *57*(6), 1290-1304.

Anderson, E., Gupta, S., Joglekar, N., & Starr, M. (2023). Managing pandemics: A POM perspective and directions for future research. *Production and Operations Management*, *32*(5), 1295-1306.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, *103*(3), 411.

Aragón-Correa, J. A., & Sharma, S. (2003). A contingent resource-based view of proactive corporate environmental strategy. *Academy of Management Review*, *28*(1), 71-88.

Armstrong, J. S., & Overton, T. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research*, *14*(3), 396-402.

Attri, R., Dev, N., & Sharma, V. (2013). Interpretive structural modelling (ISM) approach: an overview. *Research Journal of Management Sciences*, *2319*(2), 1171.

Attri, R., Dev, N., & Sharma, V. (2013). Interpretive structural modelling (ISM) approach: an overview. *Research Journal of Management Sciences*, 2 (2), 3-8.

Azadegan, A., & Dooley, K. (2021). A typology of supply network resilience strategies: complex collaborations in a complex world. *Journal of Supply Chain Management*, *57*(1), 17-26.

Baah, C., Agyeman, D. O., Acquah, I. S. K., Agyabeng-Mensah, Y., Afum, E., Issau, K., ... & Faibil, D. (2021). Effect of information sharing in supply chains: understanding the roles of supply chain visibility, agility, collaboration on supply chain performance. *Benchmarking: An International Journal*, *29*(2), 434-455.

Bag, S., Choi, T. M., Rahman, M. S., Srivastava, G., & Singh, R. K. (2022). Examining collaborative buyer–supplier relationships and social sustainability in the "new normal"

era: The moderating effects of justice and big data analytical intelligence. *Annals of Operations Research*. DOI: 10.1007/s10479-022-04875-1.

Bag, S., Gupta, S., Choi, T. M., & Kumar, A. (2021). Roles of innovation leadership on using big data analytics to establish resilient healthcare supply chains to combat the COVID-19 pandemic: A multimethodological study. *IEEE Transactions on Engineering Management*. DOI: 10.1109/TEM.2021.3101590.

Bai, C., & Sarkis, J. (2013). A grey-based DEMATEL model for evaluating business process management critical success factors. *International Journal of Production Economics*, *146*(1), 281-292.

Bakshi, N., & Kleindorfer, P. (2009). Co-opetition and investment for supply-chain resilience. *Production and Operations Management*, *18*(6), 583-603.

Balasubramanian, S., & Fernandes, C. (2022). Confirmation of a crisis leadership model and its effectiveness: Lessons from the COVID-19 pandemic. *Cogent Business & Management*, *9*(1), 2022824.

Balcik, B., Beamon, B. M., Krejci, C. C., Muramatsu, K. M., & Ramirez, M. (2010). Coordination in humanitarian relief chains: Practices, challenges and opportunities. *International Journal of Production Economics*, *126*(1), 22-34.

Banik, A., Nag, T., Chowdhury, S. R., & Chatterjee, R. (2020). Why do COVID-19 fatality rates differ across countries? An explorative cross-country study based on select indicators. *Global Business Review*, *21*(3), 607-625.

Banomyong, R., Varadejsatitwong, P., & Oloruntoba, R. (2019). A systematic review of humanitarian operations, humanitarian logistics and humanitarian supply chain performance literature 2005 to 2016. *Annals of Operations Research*, *283*, 71-86.

Barasa, E., Mbau, R., & Gilson, L. (2018). What is resilience and how can it be nurtured? A systematic review of empirical literature on organizational resilience. *International Journal of Health Policy and Management*, *7*(6), 491.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120.

Barney, J. B., Ketchen Jr, D. J., & Wright, M. (2011). The future of resource-based theory: revitalization or decline?. *Journal of Management*, *37*(5), 1299-1315.

Barratt, M. (2004). Understanding the meaning of collaboration in the supply chain. *Supply Chain Management: An International Journal*, *9*(1), 30-42.

Barratt, M., & Oke, A. (2007). Antecedents of supply chain visibility in retail supply chains: a resource-based theory perspective. *Journal of Operations Management*, *25*(6), 1217-1233.

Barringer, B. R., & Harrison, J. S. (2000). Walking a tightrope: Creating value through interorganizational relationships. *Journal of Management*, *26*(3), 367-403.

Bastani, P., Sadeghkhani, O., Bikine, P., Mehralian, G., Samadbeik, M., & Ravangard, R. (2023). Medication supply chain resilience during disasters: exploration of causes, strategies, and consequences applying Strauss and Corbin's approach to the grounded theory. *Journal of Pharmaceutical Policy and Practice*, *16*(1), 99.

Bauman, D. C. (2011). Evaluating ethical approaches to crisis leadership: Insights from unintentional harm research. *Journal of Business Ethics*, *98*, 281-295.

Baxter, R. (2009). Reflective and formative metrics of relationship value: A commentary essay. *Journal of Business Research*, *62*(12), 1370-1377.

Bealt, J., Fernández Barrera, J. C., & Mansouri, S. A. (2016). Collaborative relationships between logistics service providers and humanitarian organizations during disaster relief operations. *Journal of Humanitarian Logistics and Supply Chain Management*, *6*(2), 118-144.

Becker, J. M., Cheah, J. H., Gholamzade, R., Ringle, C. M., & Sarstedt, M. (2023). PLS-SEM's most wanted guidance. *International Journal of Contemporary Hospitality Management*, *35*(1), 321-346.

Becker, J. M., Klein, K., & Wetzels, M. (2012). Hierarchical latent variable models in PLS-SEM: guidelines for using reflective-formative type models. *Long Range Planning*, *45*(5-6), 359-394.

Behrens, D. A., Rauner, M. S., & Sommersguter-Reichmann, M. (2022). Why resilience in health care systems is more than coping with disasters: implications for health care policy. *Schmalenbach Journal of Business Research*, *74*(4), 465-495.

Benitez, J., Henseler, J., Castillo, A., & Schuberth, F. (2020). How to perform and report an impactful analysis using partial least squares: Guidelines for confirmatory and explanatory IS research. *Information & Management*, *57*(2), 103168.

Bergmann, M., & Wagner, M. (2023). Back to normal? The health care situation of home care receivers across Europe during the COVID-19 pandemic and its implications on health. *Plos one*, *18*(10), e0287158.

Bhakoo, V., & Choi, T. (2013). The iron cage exposed: Institutional pressures and heterogeneity across the healthcare supply chain. *Journal of Operations Management*, *31*(6), 432-449.

Bhosale, V. A., & Kant, R. (2016). An integrated ISM fuzzy MICMAC approach for modelling the supply chain knowledge flow enablers. *International Journal of Production Research*, *54*(24), 7374-7399.

Bianco, D., Godinho Filho, M., Osiro, L., Ganga, G. M. D., & Tortorella, G. L. (2023). The driving and dependence power between Lean leadership competencies: an integrated ISM/fuzzy MICMAC approach. *Production Planning & Control*, *34*(11), 1037-1061.

Birkel, H., Hohenstein, N. O., & Hähner, S. (2023). How have digital technologies facilitated supply chain resilience in the covid-19 pandemic? An exploratory case study. *Computers & Industrial Engineering*, *183*, 109538.

Bisht, R., Saharia, R., & Sarma, J. (2021). COVID-19 and the burden of ill-health: a double crisis of disruptions and inequalities. *Journal of Social and Economic Development*, *23*(Suppl 2), 342-356.

Boin, A., & Hart, P. T. (2003). Public leadership in times of crisis: mission impossible?. *Public Administration Review*, *63*(5), 544-553.

Bond, P. L., Green Jr, K. W., & Inman, R. A. (2020). Relationships among JIT practices: an interpretive modeling approach. *Production Planning & Control*, *31*(5), 400-411.

Borsboom, D., Mellenbergh, G. J., & Van Heerden, J. (2004). The concept of validity. *Psychological review*, *111*(4), 1061-1071.

Bowman, A. (2022). Leadership and resilience: where the literature stands. *Journal of Leadership Studies*, *16*(2), 33-41.

Boyer, K. K., & Swink, M. L. (2008). Empirical elephants—why multiple methods are essential to quality research in operations and supply chain management. *Journal of Operations Management*, *26*(3), 338-344.

Braa, J., Hanseth, O., Heywood, A., Mohammed, W., & Shaw, V. (2007). Developing health information systems in developing countries: the flexible standards strategy. *Mis Quarterly*, 31(2), 381–402.

Brandon-Jones, E., Squire, B., Autry, C. W., & Petersen, K. J. (2014). A contingent resource-based perspective of supply chain resilience and robustness. *Journal of Supply Chain Management*, *50*(3), 55–73.

Brodie, R. J., Ranjan, K. R., Verreynne, M. L., Jiang, Y., & Previte, J. (2021). Coronavirus crisis and health care: learning from a service ecosystem perspective. *Journal of Service Theory and Practice*, *31*(2), 225–246.

Brunet, M. (2022). Conducting a PhD as a project: sharing insights from my doctoral journey. *International Journal of Managing Projects in Business*, *15*(7), 1032–1047.

Burgos, D., & Ivanov, D. (2021). Food retail supply chain resilience and the COVID-19 pandemic: A digital twin-based impact analysis and improvement directions. *Transportation Research Part E: Logistics and Transportation Review*, *152*, 102412.

Burnard, K., & Bhamra, R. (2011). Organisational resilience: development of a conceptual framework for organisational responses. *International Journal of Production Research*, *49*(18), 5581-5599.

Burns, L. R. (2005). The Business of Healthcare Innovation. Cambridge: Cambridge University Press.

Cairney, P. (2021). The UK government's COVID-19 policy: assessing evidence-informed policy analysis in real time. *British Politics*, *16*(1), 90-116.

Caldwell, N. D., Roehrich, J. K., & George, G. (2017). Social value creation and relational coordination in public-private collaborations. *Journal of Management Studies*, *54*(6), 906-928.

Cao, M., & Zhang, Q. (2011). Supply chain collaboration: Impact on collaborative advantage and firm performance. *Journal of Operations Management*, *29*(3), 163-180.

Capaldo, A., & Giannoccaro, I. (2015). How does trust affect performance in the supply chain? The moderating role of interdependence. *International journal of production Economics*, *166*, 36-49.

Caringal-Go, J. F., Teng-Calleja, M., Franco, E. P., Manaois, J. O., & Zantua, R. M. S. (2021). Crisis leadership from the perspective of employees during the COVID-19 pandemic. *Leadership & Organization Development Journal*, *42*(4), 630-643.

Caro, J. C., Clark, A. E., d'Ambrosio, C., & Vögele, C. (2022). The impact of COVID-19 lockdown stringency on loneliness in five European countries. *Social Science & Medicine*, *314*, 115492.

Chakraborty, S. (2018). Enablers of co-creation in hospital-supplier relationships: empirical study in Indian healthcare context. In *Supply Chain Forum: An International Journal*, 19(4), 331-352.

Chakraborty, S., Bhatt, V., Chakravorty, T., & Chakraborty, K. (2021). Analysis of digital technologies as antecedent to care service transparency and orchestration. *Technology in Society*, *65*, 101568.

Chatterjee, S., Chaudhuri, R., & Vrontis, D. (2022). Does remote work flexibility enhance organization performance? Moderating role of organization policy and top management support. *Journal of Business Research*, *139*, 1501-1512.

Chatterjee, S., & Davison, R. M. (2021). The need for compelling problematisation in research: The prevalence of the gap-spotting approach and its limitations. *Information Systems Journal*, *31*(2), 227-230.

Chave, J. (2013). The problem of pattern and scale in ecology: what have we learned in 20 years?. *Ecology Letters*, *16*, 4-16.

Chen, D. Q., Preston, D. S., & Xia, W. (2013). Enhancing hospital supply chain performance: A relational view and empirical test. *Journal of Operations Management*, *31*(6), 391-408.

Chen, H., Hsu, C. W., Shih, Y. Y., & Caskey, D. A. (2022). The reshoring decision under uncertainty in the post-COVID-19 era. *Journal of Business & Industrial Marketing*, *37*(10), 2064-2074.

Chen, I. J., & Paulraj, A. (2004a). Understanding supply chain management: critical research and a theoretical framework. *International Journal of Production Research*, *42*(1), 131-163.

Chen, I. J., & Paulraj, A. (2004b). Towards a theory of supply chain management: the constructs and measurements. *Journal of Operations Management*, *22*(2), 119-150.

Chen, L., Li, T., Jia, F., & Schoenherr, T. (2023). The impact of governmental COVID-19 measures on manufacturers' stock market valuations: The role of labor intensity and operational slack. *Journal of Operations Management*, *69*(3), 404-425.

Chin, W. W. (1998). Commentary: Issues and opinion on structural equation modeling. *MIS Quarterly*, 22 (1), vii-xvi.

Choi, T. M. (2021). Risk analysis in logistics systems: A research agenda during and after the COVID-19 pandemic. *Transportation Research Part E: Logistics and Transportation Review*, *145*, 102190.

Choi, T. Y., Narayanan, S., Novak, D., Olhager, J., Sheu, J. B., & Wiengarten, F. (2021). Managing extended supply chains. *Journal of Business Logistics*, *42*(2), 200-206.

Chopra, S., & Sodhi, M. S. (2004). Managing risk to avoid supply-chain breakdown. *MIT Sloan Management Review*, 46(1), 53-61.

Chowdhury, M. M. H., & Quaddus, M. (2017). Supply chain resilience: Conceptualization and scale development using dynamic capability theory. *International Journal of Production Economics*, *188*, 185-204.

Chowdhury, N. R., Ahmed, M., Mahmud, P., Paul, S. K., & Liza, S. A. (2022). Modeling a sustainable vaccine supply chain for a healthcare system. *Journal of Cleaner Production*, *370*, 133423.

Chowdhury, P., Paul, S. K., Kaisar, S., & Moktadir, M. A. (2021). COVID-19 pandemic related supply chain studies: A systematic review. *Transportation Research Part E: Logistics and Transportation Review*, *148*, 102271.

Clark, L. A., & Watson, D. (1995). Constructing validity: basic issues in objective scale development. *Psychological Assessment*, 7(3), 309–319.

Collins, C. S., & Stockton, C. M. (2018). The central role of theory in qualitative research. *International Journal of Qualitative Methods*, *17*(1), 1-10.

Collins, M. D., Dasborough, M. T., Gregg, H. R., Xu, C., Deen, C. M., He, Y., & Restubog, S. L. D. (2023). Traversing the storm: An interdisciplinary review of crisis leadership. *The Leadership Quarterly*, *34*(1), 101661.

Coltman, T., Devinney, T. M., Midgley, D. F., & Venaik, S. (2008). Formative versus reflective measurement models: Two applications of formative measurement. *Journal of Business Research*, *61*(12), 1250-1262.

Comes, T., Van de Walle, B., & Van Wassenhove, L. (2020). The coordination-information bubble in humanitarian response: theoretical foundations and empirical investigations. *Production and Operations Management*, *29*(11), 2484-2507.

Comstock, G. (2012). Research ethics: A philosophical guide to the responsible conduct of research. Cambridge University Press.

Conger, J. A. (1990). The dark side of leadership. *Organizational Dynamics*, *19*(2), 44-55.

Corbett, C. J., Pedraza-Martinez, A. J., & Van Wassenhove, L. N. (2022). Sustainable humanitarian operations: An integrated perspective. *Production and Operations Management*, *31*(12), 4393-4406.

Coughlan, P., Draaijer, D., Godsell, J., & Boer, H. (2016). Operations and supply chain management: The role of academics and practitioners in the development of research and practice. *International Journal of Operations & Production Management*, *36*(12), 1673-1695.

Cousins, P. D. (2005). The alignment of appropriate firm and supply strategies for competitive advantage. *International Journal of Operations & Production Management*, *25*(5), 403-428.

Craighead, C. W., Ketchen Jr, D. J., & Darby, J. L. (2020). Pandemics and supply chain management research: toward a theoretical toolbox. *Decision Sciences*, *51*(4), 838-866.

Crayne, M. P., & Medeiros, K. E. (2021). Making sense of crisis: Charismatic, ideological, and pragmatic leadership in response to COVID-19. *American Psychologist*, *76*(3), 462-474.

Crick, J. M., & Crick, D. (2020). Coopetition and COVID-19: Collaborative business-to-business marketing strategies in a pandemic crisis. *Industrial Marketing Management*, *88*, 206-213.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297-334.

Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods*, *1*(1), 16-29.

Dagdeviren, H., Donoghue, M., & Promberger, M. (2016). Resilience, hardship and social conditions. *Journal of Social Policy*, *45*(1), 1-20.

Dalingwater, L., Mangrio, E., Strange, M., & Zdravkovic, S. (2023). Policies on marginalized migrant communities during Covid-19: migration management prioritized over population health. *Critical Policy Studies*, *17*(2), 316-336.

Dasaklis, T. K., Pappis, C. P., & Rachaniotis, N. P. (2012). Epidemics control and logistics operations: A review. *International Journal of Production Economics*, *139*(2), 393-410.

Davies, S. E. (2020). The introduction of research ethics review procedures at a university in South Africa: Review outcomes of a social science research ethics committee. *Research Ethics*, *16*(1-2), 1-26.

Davoudi, S., Brooks, E., & Mehmood, A. (2013). Evolutionary resilience and strategies for climate adaptation. *Planning Practice & Research*, *28*(3), 307-322.

De Vries, J., & Huijsman, R. (2011). Supply chain management in health services: an overview. *Supply Chain Management: An International Journal*, *16*(3), 159-165.

Demlehner, Q., Schoemer, D., & Laumer, S. (2021). How can artificial intelligence enhance car manufacturing? A Delphi study-based identification and assessment of general use cases. *International Journal of Information Management*, *58*, 102317.

DePoy, E., & Gitlin, L.N. (2016). Chapter 3 - Research Ethics, Editor(s): Elizabeth DePoy, Laura N. Gitlin, Introduction to Research (Fifth Edition), Mosby, pp. 24-42.

Detwal, P. K., Agrawal, R., Samadhiya, A., Kumar, A., & Garza-Reyes, J. A. (2024). Revolutionizing healthcare organizations with Operational Excellence and Healthcare 4.0: a systematic review of the state-of-the-art literature. *International Journal of Lean Six Sigma*, *15*(1), 80-102.

Devi, Y., Srivastava, A., Koshta, N., & Chaudhuri, A. (2023). The role of operations and supply chains in mitigating social disruptions caused by COVID-19: a stakeholder dynamic capabilities view. *The International Journal of Logistics Management*, *34*(4), 1219-1244.

Dhingra, V., & Krishnan, H. (2021). Managing reputation risk in supply chains: The role of risk sharing under limited liability. *Management Science*, *67*(8), 4845-4862.

Diabat, A., Govindan, K., & Panicker, V. V. (2012). Supply chain risk management and its mitigation in a food industry. *International Journal of Production Research*, *50*(11), 3039-3050.

Diamantopoulos, A., & Siguaw, J. A. (2006). Formative versus reflective indicators in organizational measure development: A comparison and empirical illustration. *British Journal of Management*, *17*(4), 263-282.

Dickens, J. M., Anderson, J. R., Reiman, A., Uvet, H., & Nowicki, D. R. (2023). Supply chain resilience: an empirical examination of the bouncing back or forward phenomenon. *International Journal of Logistics Research and Applications*, *26*(2), 190-210.

Dijkstra, T. K., & Henseler, J. (2015). Consistent partial least squares path modeling. *MIS Quarterly*, *39*(2), 297-316.

Dirani, K. M., Abadi, M., Alizadeh, A., Barhate, B., Garza, R. C., Gunasekara, N., ... & Majzun, Z. (2020). Leadership competencies and the essential role of human resource development in times of crisis: a response to Covid-19 pandemic. *Human Resource Development International*, *23*(4), 380-394.

Dixit, A., & Dutta, P. (2023). Thematic review of healthcare supply chain in disasters with challenges and future research directions. *International Journal of Disaster Risk Reduction*, 104161.

Dobrzykowski, D. (2019). Understanding the downstream healthcare supply chain: Unpacking regulatory and industry characteristics. *Journal of Supply Chain Management*, *55*(2), 26-46.

Dobrzykowski, D. D., & Tarafdar, M. (2015). Understanding information exchange in healthcare operations: Evidence from hospitals and patients. *Journal of Operations Management*, *36*, 201-214.

Dobrzykowski, D. D., Callaway, S. K., & Vonderembse, M. A. (2015). Examining pathways from innovation orientation to patient satisfaction: A relational view of healthcare delivery. *Decision Sciences*, *46*(5), 863-899.

Dobrzykowski, D., Deilami, V. S., Hong, P., & Kim, S. C. (2014). A structured analysis of operations and supply chain management research in healthcare (1982–2011). *International Journal of Production Economics*, *147*, 514-530.

Dohmen, A. E., Merrick, J. R., Saunders, L. W., Stank, T. P., & Goldsby, T. J. (2023). When preemptive risk mitigation is insufficient: The effectiveness of continuity and resilience techniques during COVID-19. *Production and Operations Management*, *32*(5), 1529-1549.

Dolgui, A., Ivanov, D., & Sokolov, B. (2018). Ripple effect in the supply chain: an analysis and recent literature. *International Journal of Production Research*, *56*(1-2), 414-430.

Donaldson, L. (2006). The Contingency Theory of Organizational Design: Challenges and Opportunities. In: Burton, R.M., Håkonsson, D.D., Eriksen, B., Snow, C.C. (eds) Organization Design. Information and Organization Design Series, vol 6. Springer, Boston, MA . https://doi.org/10.1007/0-387-34173-0_2.

Döring, T. F., Vieweger, A., Pautasso, M., Vaarst, M., Finckh, M. R., & Wolfe, M. S. (2015). Resilience as a universal criterion of health. *Journal of the Science of Food and Agriculture*, *95*(3), 455-465.

Doty, D. H., & Glick, W. H. (1998). Common methods bias: does common methods variance really bias results?. *Organizational Research Methods*, *1*(4), 374-406.

Drennon-Gala, D. T. (1994). The effects of social support and inner containment on the propensity toward delinquent behavior and disengagement in education. University of Rochester.

Dubey, R. (2023). Unleashing the potential of digital technologies in emergency supply chain: the moderating effect of crisis leadership. *Industrial Management & Data Systems*, *123*(1), 112-132.

Dubey, R., & Ali, S. S. (2014). Identification of flexible manufacturing system dimensions and their interrelationship using total interpretive structural modelling and fuzzy MICMAC analysis. *Global Journal of Flexible Systems Management*, *15*, 131-143.

Dubey, R., Altay, N., & Blome, C. (2019). Swift trust and commitment: The missing links for humanitarian supply chain coordination?. *Annals of Operations Research*, *283*, 159-177.

Dubey, R., Bryde, D. J., Blome, C., Roubaud, D., & Giannakis, M. (2021a). Facilitating artificial intelligence powered supply chain analytics through alliance management during the pandemic crises in the B2B context. *Industrial Marketing Management*, *96*, 135-146.

Dubey, R., Bryde, D. J., Dwivedi, Y. K., Graham, G., & Foropon, C. (2022). Impact of artificial intelligence-driven big data analytics culture on agility and resilience in humanitarian supply chain: A practice-based view. *International Journal of Production Economics*, *250*, 108618.

Dubey, R., Bryde, D. J., Foropon, C., Tiwari, M., Dwivedi, Y., & Schiffling, S. (2021). An investigation of information alignment and collaboration as complements to supply chain agility in humanitarian supply chain. *International Journal of Production Research*, *59*(5), 1586-1605.

Dubey, R., Bryde, D. J., Foropon, C., Tiwari, M., Dwivedi, Y., & Schiffling, S. (2021b). An investigation of information alignment and collaboration as complements to supply chain agility in humanitarian supply chain. *International Journal of Production Research*, *59*(5), 1586-1605.

Dubey, R., Gunasekaran, A., & Papadopoulos, T. (2017). Green supply chain management: theoretical framework and further research directions. *Benchmarking: An International Journal*, *24*(1), 184-218.

Dubey, R., Gunasekaran, A., Bryde, D. J., Dwivedi, Y. K., & Papadopoulos, T. (2020). Blockchain technology for enhancing swift-trust, collaboration and resilience within a humanitarian supply chain setting. *International Journal of Production Research*, *58*(11), 3381-3398.

Dunkel-Schetter, C., Folkman, S., & Lazarus, R. S. (1987). Correlates of social support receipt. *Journal of Personality and Social Psychology*, *53*(1), 71-80.

Duong, L. N. K., & Chong, J. (2020). Supply chain collaboration in the presence of disruptions: a literature review. *International Journal of Production Research*, *58*(11), 3488-3507.

Durach, C. F., & Machuca, J. A. (2018). A matter of perspective–the role of interpersonal relationships in supply chain risk management. *International Journal of Operations & Production Management*, *38*(10), 1866-1887.

Durugbo, C. M., Anouze, A. L., Amoudi, O., & Al-Balushi, Z. (2021). Competitive priorities for regional operations: a Delphi study. *Production Planning & Control*, *32*(15), 1295-1312.

Dyer Jr, W. G., & Wilkins, A. L. (1991). Better stories, not better constructs, to generate better theory: A rejoinder to Eisenhardt. *Academy of Management Review*, *16*(3), 613-619.

Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, *23*(4), 660-679.

Dyer, J. H., Singh, H., & Hesterly, W. S. (2018). The relational view revisited: A dynamic perspective on value creation and value capture. *Strategic Management Journal*, *39*(12), 3140-3162.

Eckstein, D., Goellner, M., Blome, C., & Henke, M. (2015). The performance impact of supply chain agility and supply chain adaptability: the moderating effect of product complexity. *International Journal of Production Research*, *53*(10), 3028-3046.

Edwards, J. R., & Bagozzi, R. P. (2000). On the nature and direction of relationships between constructs and measures. *Psychological Methods*, *5*(2), 155-174.

Einarsen, S., Aasland, M. S., & Skogstad, A. (2007). Destructive leadership behaviour: A definition and conceptual model. *The Leadership Quarterly*, *18*(3), 207-216.

Eisenbeiss, S. A. (2012). Re-thinking ethical leadership: An interdisciplinary integrative approach. *The Leadership Quarterly*, *23*(5), 791-808.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they?. *Strategic Management Journal*, *21*(10-11), 1105-1121.

Faisal, M. N., Banwetm, D. K., & Shankar, R. (2006). An analysis of the dynamics of information risk in supply chains of select SME clusters. *Vision*, *10*(4), 49-61.

Falcone, E. C., Fugate, B. S., & Dobrzykowski, D. D. (2022). Supply chain plasticity during a global disruption: Effects of CEO and supply chain networks on operational repurposing. *Journal of Business Logistics*, *43*(1), 116-139.

Fan, D., Zhou, Y., Yeung, A. C., Lo, C. K., & Tang, C. (2022). Impact of the US–China trade war on the operating performance of US firms: The role of outsourcing and supply base complexity. *Journal of Operations Management*, *68*(8), 928-962.

Farris, D. R., & Sage, A. P. (1975). On the use of interpretive structural modeling for worth assessment. *Computers & Electrical Engineering*, *2*(2-3), 149-174.

Fawcett, S. E., Waller, M. A., Miller, J. W., Schwieterman, M. A., Hazen, B. T., & Overstreet, R. E. (2014). A trail guide to publishing success: tips on writing influential conceptual, qualitative, and survey research. *Journal of Business Logistics*, *35*(1), 1-16.

Fernandez, A. A., & Shaw, G. P. (2020). Academic leadership in a time of crisis: The Coronavirus and COVID-19. *Journal of Leadership Studies*, *14*(1), 39-45.

Filip, R., Gheorghita Puscaselu, R., Anchidin-Norocel, L., Dimian, M., & Savage, W. K. (2022). Global challenges to public health care systems during the COVID-19 pandemic: a review of pandemic measures and problems. *Journal of Personalized Medicine*, *12*(8), 1295.

Finkenstadt, D. J., & Handfield, R. (2021). Blurry vision: Supply chain visibility for personal protective equipment during COVID-19. *Journal of Purchasing and Supply Management*, *27*(3), 100689.

Finkenstadt, D. J., & Handfield, R. (2021b). Blurry vision: Supply chain visibility for personal protective equipment during COVID-19. *Journal of Purchasing and Supply Management*, *27*(3), 100689.

Finkenstadt, D. J., & Handfield, R. (2023). The influence of supply chain immunity perceptions on COVID-19 vaccine willingness in supply chain professionals. *The International Journal of Logistics Management*, *34*(1), 84-105.

Finkenstadt, D. J., & Handfield, R. B. (2021a). Tuning value chains for better signals in the post-COVID era: vaccine supply chain concerns. *International Journal of Operations & Production Management*, *41*(8), 1302-1317.

Fiss, P. C. (2011). Building better causal theories: A fuzzy set approach to typologies in organization research. *Academy of Management Journal*, *54*(2), 393-420.

Flynn, B. B., Sakakibara, S., Schroeder, R. G., Bates, K. A., & Flynn, E. J. (1990). Empirical research methods in operations management. *Journal of Operations Management*, *9*(2), 250-284.

Flynn, B. B., Schroeder, R. G., & Sakakibara, S. (1994). A framework for quality management research and an associated measurement instrument. *Journal of Operations management*, *11*(4), 339-366.

Flynn, B.B., Cantor, D., Pagell, M., Dooley, K. J., & Azadegan, A. (2021). From the editors: introduction to managing supply chains beyond Covid-19-preparing for the next global mega-disruption. *Journal of Supply Chain Management*, *57*(1), 3-6.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39-50.

Forza, C. (2002). Survey research in operations management: a process-based perspective. *International Journal of Operations & Production Management*, *22*(2), 152-194.

Fosso Wamba, S., Queiroz, M. M., Roscoe, S., Phillips, W., Kapletia, D., & Azadegan, A. (2021). Guest editorial: Emerging technologies in emergency situations. *International Journal of Operations & Production Management*, *41*(9), 1405-1416.

Friday, D., Savage, D. A., Melnyk, S. A., Harrison, N., Ryan, S., & Wechtler, H. (2021). A collaborative approach to maintaining optimal inventory and mitigating stockout risks

during a pandemic: capabilities for enabling health-care supply chain resilience. *Journal of Humanitarian Logistics and Supply Chain Management*, *11*(2), 248-271.

Frohlich, M. T. (2002). Techniques for improving response rates in OM survey research. *Journal of Operations Management*, *20*(1), 53-62.

Furstenau, L. B., Zani, C., Terra, S. X., Sott, M. K., Choo, K. K. R., & Saurin, T. A. (2022). Resilience capabilities of healthcare supply chain and supportive digital technologies. *Technology in Society*, *71*, 102095.

Gabler, C. B., Richey Jr, R. G., & Stewart, G. T. (2017). Disaster resilience through public–private short-term collaboration. *Journal of Business Logistics*, *38*(2), 130-144.

Galbraith, J. R. (1974). Organization design: An information processing view. *Interfaces*, *4*(3), 28-36.

Ganguly, S. (2020). Mangling the COVID Crisis: India's response to the pandemic. *The Washington Quarterly*, *43*(4), 105-120.

Garretsen, H., Stoker, J. I., Soudis, D., & Wendt, H. (2022). The pandemic that shocked managers across the world: The impact of the COVID-19 crisis on leadership behavior. *The Leadership Quarterly*, 101630.

Gebhardt, M., Spieske, A., Kopyto, M., & Birkel, H. (2022). Increasing global supply chains' resilience after the COVID-19 pandemic: Empirical results from a Delphi study. *Journal of Business Research*, *150*, 59-72.

Gebhardt, M., Spieske, A., Kopyto, M., & Birkel, H. (2022). Increasing global supply chains' resilience after the COVID-19 pandemic: Empirical results from a Delphi study. *Journal of Business Research*, *150*, 59-72.

Gerbing, D. W., & Anderson, J. C. (1988). An updated paradigm for scale development incorporating unidimensionality and its assessment. *Journal of Marketing Research*, *25*(2), 186-192.

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), 287-301.

Gillespie, N., Searle, R., Gustafsson, S., & Hailey, V. H. (2020). Preserving employee trust during crisis. *Behavioral Science & Policy*, *6*(2), 59-68.

Gilson, L. L., Maynard, M. T., Jones Young, N. C., Vartiainen, M., & Hakonen, M. (2015). Virtual teams research: 10 years, 10 themes, and 10 opportunities. *Journal of Management*, *41*(5), 1313-1337.

Glaser, B., & Strauss, A. (1967). Awareness of dying. Chicago, IL: Aldine Publishing Co.

Gimmon, E., & Zysberg, L. (2024). Personal characteristics of small business owners and their strategic change behavior during the COVID-19 pandemic. *Management Research Review*, *47*(2), 165-182.

Golan, M. S., Trump, B. D., Cegan, J. C., & Linkov, I. (2021). The vaccine supply chain: a call for resilience analytics to support COVID-19 vaccine production and distribution. In *COVID-19: systemic risk and resilience* (pp. 389-437). Cham: Springer International Publishing.

Gold, A. H., Malhotra, A., & Segars, A. H. (2001). Knowledge management: An organizational capabilities perspective. *Journal of Management Information Systems*, *18*(1), 185-214.

Gölgeci, I., & Ponomarov, S. Y. (2015). How does firm innovativeness enable supply chain resilience? The moderating role of supply uncertainty and interdependence. *Technology Analysis & Strategic Management*, *27*(3), 267-282.

Gooding, K., Bertone, M. P., Loffreda, G., & Witter, S. (2022). How can we strengthen partnership and coordination for health system emergency preparedness and response? Findings from a synthesis of experience across countries facing shocks. *BMC Health Services Research*, *22*(1), 1441.

Gooding, K., Bertone, M. P., Loffreda, G., & Witter, S. (2022). How can we strengthen partnership and coordination for health system emergency preparedness and response? Findings from a synthesis of experience across countries facing shocks. *BMC health services research*, *22*(1), 1441.

Gorane, S. J., & Kant, R. (2013). Modelling the SCM enablers: an integrated ISM-fuzzy MICMAC approach. *Asia Pacific Journal of Marketing and Logistics*, *25*(2), 263-286.

Gostin, L. O., & Mok, E. A. (2009). Grand challenges in global health governance. *British Medical Bulletin*, *90*(1), 7-18.

Götz, P., Auping, W. L., & Hinrichs-Krapels, S. (2024). Contributing to health system resilience during pandemics via purchasing and supply strategies: an exploratory system dynamics approach. *BMC Health Services Research*, *24*(1), 130.

Govindan, K., Mina, H., & Alavi, B. (2020). A decision support system for demand management in healthcare supply chains considering the epidemic outbreaks: A case study of coronavirus disease 2019 (COVID-19). *Transportation Research Part E: Logistics and Transportation Review*, *138*, 101967.

Govindan, K., Palaniappan, M., Zhu, Q., & Kannan, D. (2012). Analysis of third party reverse logistics provider using interpretive structural modeling. *International Journal of Production Economics*, *140*(1), 204-211.

Guide Jr, V. D. R., & Ketokivi, M. (2015). Notes from the Editors: Redefining some methodological criteria for the journal. *Journal of Operations Management*, *37*(1), v-viii.

Guide Jr, V. D. R., & Ketokivi, M. (2015). Notes from the Editors: Redefining some methodological criteria for the journal. *Journal of Operations Management*, *37*(1), v-viii.

Gunderson, L. H. (2000). Ecological resilience—in theory and application. *Annual Review of Ecology and Systematics*, *31*(1), 425-439.

Gunessee, S., & Subramanian, N. (2020). Ambiguity and its coping mechanisms in supply chains lessons from the Covid-19 pandemic and natural disasters. *International Journal of Operations & Production Management*, *40*(7/8), 1201-1223.

Gupta, I. (2020). Relying on serendipity is not enough: building a resilient health sector in India. *Indian Economic Review*, *55*(Suppl 1), 125-147.

Gupta, S., Starr, M. K., Farahani, R. Z., & Asgari, N. (2022). OM Forum—Pandemics/Epidemics: Challenges and opportunities for operations management research. *Manufacturing & Service Operations Management*, *24*(1), 1-23.

Gupta, S., Verma, R., & Victorino, L. (2006). Empirical research published in production and operations management (1992–2005): Trends and future research directions. *Production and Operations management*, *15*(3), 432-448.

Hadley, C. N., Pittinsky, T. L., Sommer, S. A., & Zhu, W. (2011). Measuring the efficacy of leaders to assess information and make decisions in a crisis: The C-LEAD scale. *The Leadership Quarterly*, *22*(4), 633-648.

Hair Jr, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, *1*(2), 107-123.

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., & Thiele, K. O. (2017b). Mirror, mirror on the wall: a comparative evaluation of composite-based structural equation modelling methods. *Journal of the Academy of Marketing Science*, *45*, 616-632.

Hair, J., Hollingsworth, C. L., Randolph, A. B., & Chong, A. Y. L. (2017a). An updated and expanded assessment of PLS-SEM in information systems research. *Industrial Management & Data Systems*, *117*(3), 442-458.

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010) Multivariate Data Analysis, 7th ed., Prentice Hall, Upper Saddle River, NJ

Haldane, V., De Foo, C., Abdalla, S. M., Jung, A. S., Tan, M., Wu, S., ... & Legido-Quigley, H. (2021). Health systems resilience in managing the COVID-19 pandemic: lessons from 28 countries. *Nature Medicine*, *27*(6), 964-980.

Hall, R. (1993). A framework linking intangible resources and capabiliites to sustainable competitive advantage. *Strategic Management Journal*, *14*(8), 607-618.

Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review*, *9*(2), 193-206.

Hambrick, D. C. (2007). Upper echelons theory: An update. *Academy of Management Review*, *32*(2), 334-343.

Handfield, R. B., & Melnyk, S. A. (1998). The scientific theory-building process: a primer using the case of TQM. *Journal of Operations Management*, *16*(4), 321-339.

Handfield, R., Apte, A., & Finkenstadt, D. J. (2022). Developing supply chain immunity for future pandemic disruptions. *Journal of Humanitarian Logistics and Supply Chain Management*, *12*(4), 482-501.

Hanefeld, J., Mayhew, S., Legido-Quigley, H., Martineau, F., Karanikolos, M., Blanchet, K., ... & Balabanova, D. (2018). Towards an understanding of resilience: responding to health systems shocks. *Health Policy and Planning*, *33*(3), 355-367.

Harland, C. (2021). Discontinuous wefts: Weaving a more interconnected supply chain management tapestry. *Journal of Supply Chain Management*, *57*(1), 27-40.

Harland, C. M., Knight, L., Patrucco, A. S., Lynch, J., Telgen, J., Peters, E., ... & Ferk, P. (2021). Practitioners' learning about healthcare supply chain management in the COVID-19 pandemic: a public procurement perspective. *International Journal of Operations & Production Management*, *41*(13), 178-189.

Harland, C. M., Knight, L., Patrucco, A. S., Lynch, J., Telgen, J., Peters, E., ... & Ferk, P. (2021). Practitioners' learning about healthcare supply chain management in the COVID-19 pandemic: a public procurement perspective. *International Journal of Operations & Production Management*, *41*(13), 178-189.

Haslam, S. A., Steffens, N. K., Reicher, S. D., & Bentley, S. V. (2021). Identity leadership in a crisis: A 5R framework for learning from responses to COVID-19. *Social Issues and Policy Review*, *15*(1), 35-83.

Hastig, G. M., & Sodhi, M. S. (2020). Blockchain for supply chain traceability: Business requirements and critical success factors. *Production and Operations Management*, *29*(4), 935-954.

Haynes, K. (2012). Reflexivity in qualitative research. Qualitative organizational research: Core methods and current challenges, 26, 72-89.

Henseler, J., Dijkstra, T. K., Sarstedt, M., Ringle, C. M., Diamantopoulos, A., Straub, D. W., ... & Calantone, R. J. (2014). Common beliefs and reality about PLS: Comments on Rönkkö and Evermann (2013). *Organizational Research Methods*, *17*(2), 182-209.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*, 115-135.

Hicks, C., McGovern, T., Prior, G., & Smith, I. (2015). Applying lean principles to the design of healthcare facilities. *International Journal of Production Economics*, *170*, 677-686.

Hillman, A. J., Withers, M. C., & Collins, B. J. (2009). Resource dependence theory: A review. *Journal of Management*, *35*(6), 1404-1427.

Hillmann, J., & Guenther, E. (2021). Organizational resilience: a valuable construct for management research?. *International Journal of Management Reviews*, *23*(1), 7-44.

Hirschman, E. C. (1986). Humanistic inquiry in marketing research: philosophy, method, and criteria. *Journal of Marketing Research*, *23*(3), 237-249.

Hitt, M. A., Xu, K., & Carnes, C. M. (2016). Resource based theory in operations management research. *Journal of Operations Management*, *41*, 77-94.

Hohn, M. M., & Durach, C. F. (2021). Additive manufacturing in the apparel supply chain—impact on supply chain governance and social sustainability. *International Journal of Operations & Production Management*, *41*(7), 1035-1059.

Holge-Hazelton, B., Kjerholt, M., Rosted, E., Hansen, S. T., Borre, L. Z., & McCormack, B. (2021). Improving Person-Centred Leadership: A Qualitative Study of Ward Managers' Experiences During the COVID-19 Crisis. *Risk Management and Healthcare Policy*, *14*, 1401-1412.

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*, *4*(1), 1-23.

Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, *4*, 390-405.

Hollos, D., Blome, C., & Foerstl, K. (2012). Does sustainable supplier co-operation affect performance? Examining implications for the triple bottom line. *International Journal of Production Research*, *50*(11), 2968-2986.

Hossain, M. K., Thakur, V., & Kazancoglu, Y. (2023). Developing a resilient healthcare supply chain to prevent disruption in the wake of emergency health crisis. *International Journal of Emerging Markets*, *18*(6), 1307-1329.

Hossain, M. K., Thakur, V., & Mangla, S. K. (2022). Modeling the emergency health-care supply chains: responding to the COVID-19 pandemic. *Journal of Business & Industrial Marketing*, *37*(8), 1623-1639.

Hosseini, S., & Ivanov, D. (2022). A new resilience measure for supply networks with the ripple effect considerations: A Bayesian network approach. *Annals of Operations Research*, *319*(1), 581-607.

Hu, L. (2022). The PPE industry in Italy during COVID-19: supply chain disruption and the adoption of digital and social media in B2B firms. *Journal of Business & Industrial Marketing*, *37*(10), 2050-2063.

Hu, X., Gurnani, H., & Wang, L. (2013). Managing risk of supply disruptions: Incentives for capacity restoration. *Production and Operations Management*, *22*(1), 137-150.

Hubona, G., & Belkhamza, Z. (2021). Testing a moderated mediation in PLS-SEM: A full latent growth approach. *Data Analysis Perspectives Journal*, *2*(4), 1-5.

Hussain, M., Ajmal, M. M., Gunasekaran, A., & Khan, M. (2018). Exploration of social sustainability in healthcare supply chain. *Journal of Cleaner Production*, *203*, 977-989.

Im, G., & Straub, D. (2015). The critical role of external validity in advancing organizational theorizing. *Communications of the Association for Information Systems*, *37*(1), 911-964.

Imenda, S. (2014). Is there a conceptual difference between theoretical and conceptual frameworks?. *Journal of Social Sciences*, *38*(2), 185-195.

Irani, Z., Sharif, A. M., & Love, P. E. (2009). Mapping knowledge management and organizational learning in support of organizational memory. *International Journal of Production Economics*, *122*(1), 200-215.

Isbell, D. R., Brown, D., Chen, M., Derrick, D. J., Ghanem, R., Arvizu, M. N. G., ... & Plonsky, L. (2022). Misconduct and questionable research practices: The ethics of quantitative data handling and reporting in applied linguistics. *The Modern Language Journal*, *106*(1), 172-195.

Ivanov, D. (2020). Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case. *Transportation Research Part E: Logistics and Transportation Review*, *136*, 101922.

Ivanov, D. (2021). Exiting the COVID-19 pandemic: After-shock risks and avoidance of disruption tails in supply chains. *Annals of Operations Research*, 335, 1627-1644.

Ivanov, D. (2023). Two views of supply chain resilience. *International Journal of Production Research*, DOI: 10.1080/00207543.2023.2253328.

Ivanov, D., & Das, A. (2020). Coronavirus (COVID-19/SARS-CoV-2) and supply chain resilience: A research note. *International Journal of Integrated Supply Management*, *13*(1), 90-102.

Ivanov, D., & Dolgui, A. (2020). Viability of intertwined supply networks: extending the supply chain resilience angles towards survivability. A position paper motivated by COVID-19 outbreak. *International journal of production research*, *58*(10), 2904-2915.

Ivanov, D., & Dolgui, A. (2021). OR-methods for coping with the ripple effect in supply chains during COVID-19 pandemic: Managerial insights and research implications. *International Journal of Production Economics*, *232*, 107921.

Ivanov, D., Blackhurst, J., & Das, A. (2021). Supply chain resilience and its interplay with digital technologies: Making innovations work in emergency situations. *International Journal of Physical Distribution & Logistics Management*, *51*(2), 97-103.

Ivanov, D., Dolgui, A., & Sokolov, B. (2018). Scheduling of recovery actions in the supply chain with resilience analysis considerations. *International Journal of Production Research*, *56*(19), 6473-6490.

Ivanov, D., Sokolov, B., & Dolgui, A. (2014). The Ripple effect in supply chains: trade-off 'efficiency-flexibility-resilience'in disruption management. *International Journal of Production Research*, *52*(7), 2154-2172.

Jain, R., & Dupas, P. (2022). The effects of India's COVID-19 lockdown on critical non-COVID health care and outcomes: Evidence from dialysis patients. *Social Science & Medicine*, *296*, 114762.

Jain, V., Kumar, S., Soni, U., & Chandra, C. (2017). Supply chain resilience: model development and empirical analysis. *International Journal of Production Research*, *55*(22), 6779-6800.

James, E. H., Wooten, L. P., & Dushek, K. (2011). Crisis management: Informing a new leadership research agenda. *Academy of Management Annals*, *5*(1), 455-493.

Janes, F. R. (1988). Interpretive structural modelling: a methodology for structuring complex issues. *Transactions of the Institute of Measurement and Control*, *10*(3), 145-154.

Jaques, T. (2012). Crisis leadership: A view from the executive suite. *Journal of Public Affairs*, *12*(4), 366-372.

Jewett, R. L., Mah, S. M., Howell, N., & Larsen, M. M. (2021). Social cohesion and community resilience during COVID-19 and pandemics: A rapid scoping review to inform the United Nations research roadmap for COVID-19 recovery. *International Journal of Health Services*, *51*(3), 325-336.

Junaid, M., Zhang, Q., Cao, M., & Luqman, A. (2023). Nexus between technology enabled supply chain dynamic capabilities, integration, resilience, and sustainable performance: An empirical examination of healthcare organizations. *Technological Forecasting and Social Change*, *196*, 122828.

Jüttner, U., Peck, H., & Christopher, M. (2003). Supply chain risk management: outlining an agenda for future research. *International Journal of Logistics: research and applications*, *6*(4), 197-210.

Kähkönen, A. K., Evangelista, P., Hallikas, J., Immonen, M., & Lintukangas, K. (2023). COVID-19 as a trigger for dynamic capability development and supply chain resilience improvement. *International Journal of Production Research*, *61*(8), 2696-2715.

Kapoor, M., Nidhi Kaur, K., Saeed, S., Shannawaz, M., & Chandra, A. (2023). Impact of COVID-19 on healthcare system in India: A systematic review. *Journal of Public Health Research*, *12*(3), DOI: 10.1177/22799036231186349.

Karniouchina, K., Sarangee, K., Theokary, C., & Kübler, R. (2022). The Impact of the COVID-19 pandemic on restaurant resilience: Lessons, generalizations, and ideas for future research. *Service Science*, *14*(2), 121-138.

Kembro, J., Näslund, D., & Olhager, J. (2017). Information sharing across multiple supply chain tiers: A Delphi study on antecedents. *International Journal of Production Economics*, *193*, 77-86.

Keskinocak, P., & Savva, N. (2020). A review of the healthcare-management (modeling) literature published in manufacturing & service operations management. *Manufacturing & Service Operations Management*, *22*(1), 59-72.

Ketokivi, M. A., & Schroeder, R. G. (2004). Perceptual measures of performance: fact or fiction?. *Journal of operations management*, *22*(3), 247-264.

Ketokivi, M., & Mahoney, J. T. (2020). Transaction cost economics as a theory of supply chain efficiency. *Production and Operations Management*, *29*(4), 1011-1031.

Khan, M., Hussain, M., Gunasekaran, A., Ajmal, M. M., & Helo, P. T. (2018). Motivators of social sustainability in healthcare supply chains in the UAE—Stakeholder perspective. *Sustainable Production and Consumption*, *14*, 95-104.

Khavarian-Garmsir, A. R., Sharifi, A., & Moradpour, N. (2021). Are high-density districts more vulnerable to the COVID-19 pandemic?. *Sustainable Cities and Society*, *70*, 102911.

Kim, J. Y., Howard, M., Cox Pahnke, E., & Boeker, W. (2016). Understanding network formation in strategy research: Exponential random graph models. *Strategic Management Journal*, *37*(1), 22-44.

Klebe, L., Felfe, J., & Klug, K. (2021). Healthy leadership in turbulent times: The effectiveness of health-oriented leadership in crisis. *British Journal of Management*, *32*(4), 1203-1218.

Klebe, L., Felfe, J., & Klug, K. (2022). Mission impossible? Effects of crisis, leader and follower strain on health-oriented leadership. *European Management Journal*, *40*(3), 384-392.

Klein, R., Rai, A., & Straub, D. W. (2007). Competitive and cooperative positioning in supply chain logistics relationships. *Decision Sciences*, *38*(4), 611-646.

Kline, R. B. (2011). Principles and practice of structural equation modeling. New York: Guilford Press.

Kock, N. (2011). Using WarpPLS in e-collaboration studies: Mediating effects, control and second order variables, and algorithm choices. *International Journal of e-Collaboration (IJeC)*, *7*(3), 1-13.

Kock, N. (2019). Factor-based structural equation modeling with WarpPLS. *Australasian Marketing Journal*, *27*(1), 57-63.

Kock, N., & Gaskins, L. (2014). The mediating role of voice and accountability in the relationship between Internet diffusion and government corruption in Latin America and Sub-Saharan Africa. *Information Technology for Development*, *20*(1), 23-43.

Kock, N., & Hadaya, P. (2018). Minimum sample size estimation in PLS-SEM: The inverse square root and gamma-exponential methods. *Information Systems Journal*, *28(1), 227-261*.

König, A., Graf-Vlachy, L., Bundy, J., & Little, L. M. (2020). A blessing and a curse: How CEOs' trait empathy affects their management of organizational crises. *Academy of Management Review*, *45*(1), 130-153.

Koronis, E., & Ponis, S. (2018). Better than before: the resilient organization in crisis mode. *Journal of Business Strategy*, *39*(1), 32-42.

Kovács, G., & Falagara Sigala, I. (2021). Lessons learned from humanitarian logistics to manage supply chain disruptions. *Journal of Supply Chain Management*, *57*(1), 41-49.

Kovács, G., & Spens, K. (2009). Identifying challenges in humanitarian logistics. *International Journal of Physical Distribution & Logistics Management*, *39*(6), 506-528.

Kovács, G., Sigala, I. F. (2021). Lessons learned from humanitarian logistics to manage supply chain disruptions. *Journal of Supply Chain Management*, *57*(1), 41-49.

Krczal, E., & Behrens, D. A. (2024). Trust-building in temporary public health partnerships: a qualitative study of the partnership formation process of a Covid-19 test, trace and protect service. *BMC Health Services Research*, *24*(1), 467.

Krosnick, J. A. (1991). Response strategies for coping with the cognitive demands of attitude measures in surveys. *Applied Cognitive Psychology*, *5*(3), 213-236.

Küffner, C., Münch, C., Hähner, S., & Hartmann, E. (2022). Getting back into the swing of things: The adaptive path of purchasing and supply management in enhancing supply chain resilience. *Journal of Purchasing and Supply Management*, *28*(5), 100802.

Kwak, D. W., Rodrigues, V. S., Mason, R., Pettit, S., & Beresford, A. (2018). Risk interaction identification in international supply chain logistics: Developing a holistic model. *International Journal of Operations & Production Management*, *38*(2), 372-389.

Kwon, I. W. G., Kim, S. H., & Martin, D. G. (2016). Healthcare supply chain management; strategic areas for quality and financial improvement. *Technological Forecasting and Social Change*, *113*, 422-428.

Laganà, I. R., & Colapinto, C. (2022). Multiple criteria decision-making in healthcare and pharmaceutical supply chain management: a state-of-the-art review and implications for future research. *Journal of Multi-Criteria Decision Analysis*, *29*(1-2), 122-134.

Lal, A., Ashworth, H. C., Dada, S., Hoemeke, L., & Tambo, E. (2022). Optimizing pandemic preparedness and response through health information systems: lessons learned from Ebola to COVID-19. *Disaster Medicine and Public Health Preparedness*, *16*(1), 333-340.

Larsen, K. R. (2003). A taxonomy of antecedents of information systems success: variable analysis studies. *Journal of Management Information Systems*, *20*(2), 169-246.

Lavie, D. (2006). The competitive advantage of interconnected firms: An extension of the resource-based view. *Academy of Management Review*, *31*(3), 638-658.

Leach, M., MacGregor, H., Scoones, I., & Wilkinson, A. (2021). Post-pandemic transformations: How and why COVID-19 requires us to rethink development. *World Development*, *138*, 105233.

Leavitt, A., & Robinson, J. J. (2017, February). The role of information visibility in network gatekeeping: Information aggregation on Reddit during crisis events. In *Proceedings of the 2017 ACM conference on computer supported cooperative work and social computing* (pp. 1246-1261).

Lee, H. L. (2004). The triple-A supply chain. *Harvard Business Review*, *82*(10), 102-113.

Lee, H., Kim, M. S., & Kim, K. K. (2014). Interorganizational information systems visibility and supply chain performance. *International Journal of Information Management*, *34*(2), 285-295.

Lee, S. M., & Rha, J. S. (2016). Ambidextrous supply chain as a dynamic capability: building a resilient supply chain. *Management Decision*, *54*(1), 2-23.

Lee, S. M., Lee, D., & Schniederjans, M. J. (2011). Supply chain innovation and organizational performance in the healthcare industry. *International Journal of Operations & Production Management*, *31*(11), 1193-1214.

Lee, S. T. (2023). Vaccine diplomacy: nation branding and China's COVID-19 soft power play. *Place Branding and Public Diplomacy*, *19*(1), 64.

Levy, D. L. (2005). Offshoring in the new global political economy. *Journal of Management Studies*, *42*(3), 685-693.

Li, Y. Y., Hong, I. H., & Yang, S. J. S. (2023). A public-private collaboration model of supply chain resilience to unpredictable disruptions: an exploratory empirical case study of medical mask production and distribution. *Production Planning & Control*. DOI: 10.1080/09537287.2023.2173104.

Liang, H., Saraf, N., Hu, Q., & Xue, Y. (2007). Assimilation of enterprise systems: the effect of institutional pressures and the mediating role of top management. *MIS Quarterly*, 31 (1), 59-87.

Lichtenthaler, U., & Lichtenthaler, E. (2009). A capability-based framework for open innovation: Complementing absorptive capacity. *Journal of Management Studies*, *46*(8), 1315-1338.

Littlefield, R. S., & Quenette, A. M. (2007). Crisis leadership and Hurricane Katrina: The portrayal of authority by the media in natural disasters. *Journal of Applied Communication Research*, *35*(1), 26-47.

Liu, J. H. (2021). Majority world successes and European and American failure to contain COVID-19: Cultural collectivism and global leadership. *Asian Journal of Social Psychology*, *24*(1), 23-29.

Liu, W., Yan, X., Si, C., Xie, D., & Wang, J. (2020). Effect of buyer-supplier supply chain strategic collaboration on operating performance: evidence from Chinese companies. *Supply Chain Management: An International Journal*, *25*(6), 823-839.

Lotty, M. (2021). Reflections on navigating the PhD journey as a social work practitioner. *Qualitative Social Work*, *20*(3), 851–865.

Love, P. E., Ika, L., Matthews, J., & Fang, W. (2021). Shared leadership, value and risks in large scale transport projects: Re-calibrating procurement policy for post COVID-19. *Research in Transportation Economics*, *90*, 100999.

Lusiantoro, L., & Pradiptyo, R. (2022). Rebuilding disrupted supply chains: How can a self-organised social group facilitate supply chain resilience?. *International Journal of Operations & Production Management*, *42*(10), 1544-1575.

MacKenzie, S. B., & Podsakoff, P. M. (2012). Common method bias in marketing: Causes, mechanisms, and procedural remedies. *Journal of Retailing*, *88*(4), 542-555.

MacKenzie, S. B., Podsakoff, P. M., & Podsakoff, N. P. (2011). Construct measurement and validation procedures in MIS and behavioral research: Integrating new and existing techniques. *MIS Quarterly*, 35(2),293-334.

Madan, A., Bindal, S., & Gupta, A. K. (2021). Social distancing as risk reduction strategy during COVID-19 pandemic: A study of Delhi-NCT, India. *International Journal of Disaster Risk Reduction*, *63*, 102468.

Magableh, G. M. (2021). Supply chains and the COVID-19 pandemic: A comprehensive framework. *European Management Review*, *18*(3), 363-382.

Malhotra, M. K., & Grover, V. (1998). An assessment of survey research in POM: from constructs to theory. *Journal of Operations Management*, *16*(4), 407-425.

Malik, M. A. (2022). Fragility and challenges of health systems in pandemic: Lessons from India's second wave of coronavirus disease 2019 (COVID-19). *Global Health Journal*, *6*(1), 44-49.

Malone, D. W. (1975). An introduction to the application of interpretive structural modeling. *Proceedings of the IEEE*, *63*(3), 397-404.

Malone, M., Ferguson, P., Rogers, A., Mackenzie, I. S., Rorie, D. A., & MacDonald, T. M. (2022). When innovation outpaces regulations: The legal challenges for direct-to-patient supply of investigational medicinal products. *British Journal of Clinical Pharmacology*, *88*(3), 1115-1142.

Mandal, A., & Deshmukh, S. G. (1994). Vendor selection using interpretive structural modelling (ISM). *International Journal of Operations & Production Management*, *14*(6), 52-59.

Mandal, S. (2017). The influence of dynamic capabilities on hospital-supplier collaboration and hospital supply chain performance. *International Journal of Operations & Production Management*, *37*(5), 664-684.

Mandal, S. (2017). The influence of organizational culture on healthcare supply chain resilience: moderating role of technology orientation. *Journal of Business & Industrial Marketing*, *32*(8), 1021-1037.

Mandal, S. (2017a). The influence of dynamic capabilities on hospital-supplier collaboration and hospital supply chain performance. *International Journal of Operations & Production Management*, *37*(5), 664-684.

Mandal, S. (2017b). The influence of organizational culture on healthcare supply chain resilience: moderating role of technology orientation. *Journal of Business & Industrial Marketing*, 32(8), 1021-1037.

Mandal, S. (2018). Influence of human capital on healthcare agility and healthcare supply chain performance. *Journal of Business & Industrial Marketing*, *33*(7), 1012-1026.

Mandal, S., & Jha, R. R. (2018). Exploring the importance of collaborative assets to hospital-supplier integration in healthcare supply chains. *International Journal of Production Research*, *56*(7), 2666-2683.

Marques, L., Martins, M., & Araújo, C. (2020). The healthcare supply network: current state of the literature and research opportunities. *Production planning & control*, *31*(7), 590-609.

Martin, P. R., & Patterson, J. W. (2009). On measuring company performance within a supply chain. *International Journal of Production Research*, *47*(9), 2449-2460.

Marty,J., & Ruel, S. (2024). Why is "supply chain collaboration" still a hot topic? A review of decades of research and a comprehensive framework proposal. *International Journal of Production Economics*, 109259.

Mathivathanan, D., Mathiyazhagan, K., Rana, N. P., Khorana, S., & Dwivedi, Y. K. (2021). Barriers to the adoption of blockchain technology in business supply chains: a total interpretive structural modelling (TISM) approach. *International Journal of Production Research*, *59*(11), 3338-3359.

Mathur, B., Gupta, S., Meena, M. L., & Dangayach, G. S. (2018). Healthcare supply chain management: literature review and some issues. *Journal of Advances in Management Research*, *15*(3), 265-287.

Maxwell, J. A. (2012). Qualitative research design: An interactive approach. Sage publications.

McCauley, C. D., & Palus, C. J. (2021). Developing the theory and practice of leadership development: A relational view. *The Leadership Quarterly*, *32*(5), 101456.

McKenna, H. P. (1994). The Delphi technique: a worthwhile research approach for nursing?. *Journal of Advanced Nursing*, *19*(6), 1221-1225.

McKone-Sweet, K. E., Hamilton, P., & Willis, S. B. (2005). The ailing healthcare supply chain: a prescription for change. *Journal of Supply Chain Management*, *41*(1), 4-17.

Mehta, S., Saxena, T., & Purohit, N. (2020). The new consumer behaviour paradigm amid COVID-19: permanent or transient?. *Journal of Health Management*, *22*(2), 291-301.

Melnyk, S. A., & Handfield, R. B. (1998). May you live in interesting times… the emergence of theory-driven empirical research. *Journal of Operations Management*, *16*(4), 311-319.

Melnyk, S. A., Lummus, R. R., Vokurka, R. J., Burns, L. J., & Sandor, J. (2009). Mapping the future of supply chain management: a Delphi study. *International Journal of Production Research*, *47*(16), 4629-4653.

Meredith, J. (1993). Theory building through conceptual methods. *International Journal of Operations & Production Management*, *13*(5), 3-11.

Michalski, M., Montes-Botella, J. L., & Narasimhan, R. (2018). The impact of asymmetry on performance in different collaboration and integration environments in supply chain management. *Supply Chain Management: An International Journal*, *23*(1), 33-49.

Min, H. (2023). Assessing the impact of a COVID-19 pandemic on supply chain transformation: an exploratory analysis. *Benchmarking: An International Journal*, *30*(6), 1765-1781.

Min, S., Zacharia, Z. G., & Smith, C. D. (2019). Defining supply chain management: in the past, present, and future. *Journal of Business Logistics*, *40*(1), 44-55.

Mingers, J. (2003). A classification of the philosophical assumptions of management science methods. *Journal of the Operational Research Society*, *54*, 559-570.

Mirza, M., Verma, M., Sahoo, S. S., Roy, S., Kakkar, R., & Singh, D. K. (2023). India's Multi-Sectoral Response to Oxygen Surge Demand during COVID-19 Pandemic: A Scoping Review. *Indian Journal of Community Medicine*, *48*(1), 31-40.

Mirzabeiki, V., & Aitken, J. (2023). Panarchy-based transformative supply chain resilience: the role of supply chain capital. *International Journal of Operations & Production Management*, *43*(1), 99-139.

Mitchell, V. W. (1991). The Delphi technique: An exposition and application. *Technology Analysis & Strategic Management*, *3*(4), 333-358.

Moons, K., Waeyenbergh, G., & Pintelon, L. (2019). Measuring the logistics performance of internal hospital supply chains–a literature study. *Omega*, *82*, 205-217.

Moreira, A., Alves, C., Machado, J., & Santos, M. F. (2023). An Overview of Omnichannel Interaction in Health Care Services. *Mayo Clinic Proceedings: Digital Health*, *1*(2), 77-93.

Morgan, R. M., & Hunt, S. D. (1994). The commitment-trust theory of relationship marketing. *Journal of Marketing*, *58*(3), 20-38.

Morgan, T. R., Gabler, C. B., & Manhart, P. S. (2023). Supply chain transparency: Theoretical perspectives for future research. *The International Journal of Logistics Management*, *34*(5), 1422-1445.

Morris, M., Seguin, M., Landon, S., McKee, M., & Nolte, E. (2022). Exploring the role of leadership in facilitating change to improve cancer survival: an analysis of experiences in seven high income countries in the International Cancer Benchmarking Partnership (ICBP). *International Journal of Health Policy and Management*, *11*(9), 1756.

Moshtari, M. (2016). Inter-organizational fit, relationship management capability, and collaborative performance within a humanitarian setting. *Production and Operations Management*, *25*(9), 1542-1557.

Munir, M., Jajja, M. S. S., & Chatha, K. A. (2022). Capabilities for enhancing supply chain resilience and responsiveness in the COVID-19 pandemic: exploring the role of improvisation, anticipation, and data analytics capabilities. *International Journal of Operations & Production Management*, *42*(10), 1576-1604.

Murphy, E., & Dingwall, R. (2007). Informed consent, anticipatory regulation and ethnographic practice. *Social Science & Medicine*, *65*(11), 2223-2234.

Mutch, C. (2015). Leadership in times of crisis: Dispositional, relational and contextual factors influencing school principals' actions. *International Journal of Disaster Risk Reduction*, *14*, 186-194.

Nandi, S., Sarkis, J., Hervani, A., & Helms, M. (2021). Do blockchain and circular economy practices improve post COVID-19 supply chains? A resource-based and resource dependence perspective. *Industrial Management & Data Systems*, *121*(2), 333-363.

Näslund, D., Kale, R., & Paulraj, A. (2010). Action research in supply chain management—a framework for relevant and rigorous research. *Journal of Business Logistics*, *31*(2), 331-355.

Nayak, S. (2022). Migrant workers in the coal mines of India: precarity, resilience and the pandemic. *Social Change*, *52*(2), 203-222.

Newbert, S. L. (2007). Empirical research on the resource-based view of the firm: an assessment and suggestions for future research. *Strategic Management Journal*, *28*(2), 121-146.

Ngai, E. W., Tao, S. S., & Moon, K. K. (2015). Social media research: Theories, constructs, and conceptual frameworks. *International Journal of Information Management*, *35*(1), 33-44.

Nikookar, E., & Yanadori, Y. (2022). Preparing supply chain for the next disruption beyond COVID-19: managerial antecedents of supply chain resilience. *International Journal of Operations & Production Management*, *42*(1), 59-90.

Noort, B. A., Buijs, P., & Roemeling, O. (2023). Outsourcing the Management of Reusable Medical Devices in a Chain-Wide Care Setting: Mixed Methods Feasibility Study. *Interactive journal of medical research*, *12*(1), e41409.

Ntontis, E., Blackburn, A. M., Han, H., Stöckli, S., Milfont, T. L., Tuominen, J., ... & Vestergren, S. (2023). The effects of secondary stressors, social identity, and social support on perceived stress and resilience: findings from the COVID-19 pandemic. *Journal of Environmental Psychology*, *88*, 102007.

Nunnally, J. (1978). Psychometric Theory. McGraw-Hill, New York, NY.

Nyaga, G. N., Whipple, J. M., & Lynch, D. F. (2010). Examining supply chain relationships: do buyer and supplier perspectives on collaborative relationships differ?. *Journal of Operations Management*, *28*(2), 101-114.

Omar, A., Davis-Sramek, B., Fugate, B. S., & Mentzer, J. T. (2012). Exploring the complex social processes of organizational change: supply chain orientation from a manager's perspective. *Journal of Business Logistics*, *33*(1), 4-19.

Orlando, B., Tortora, D., Pezzi, A., & Bitbol-Saba, N. (2022). The disruption of the international supply chain: Firm resilience and knowledge preparedness to tackle the COVID-19 outbreak. *Journal of International Management*, *28*(1), 100876.

Ozawa, S., Paina, L., & Qiu, M. (2016). Exploring pathways for building trust in vaccination and strengthening health system resilience. *BMC Health Services Research*, *16*, 131-141.

Pace, C. R. (1939). Factors influencing questionnaire returns from former university students. *Journal of Applied Psychology*, *23*(3), 388-397.

Pamucar, D., Torkayesh, A. E., & Biswas, S. (2023). Supplier selection in healthcare supply chain management during the COVID-19 pandemic: a novel fuzzy rough decision-making approach. *Annals of Operations Research*, *328*(1), 977-1019.

Panter-Brick, C. (2014). Health, risk, and resilience: Interdisciplinary concepts and applications. *Annual Review of Anthropology*, *43*, 431-448.

Panwar, R., Pinkse, J., & De Marchi, V. (2022). The future of global supply chains in a post-COVID-19 world. *California Management Review*, *64*(2), 5-23.

Parkhe, A. (1993). "Messy" research, methodological predispositions, and theory development in international joint ventures. *Academy of Management Review*, *18*(2), 227-268.

Pattyn, V., Matthys, J., & Hecke, S. V. (2021). High-stakes crisis management in the Low Countries: Comparing government responses to COVID-19. *International Review of Administrative Sciences*, *87*(3), 593-611.

Paul, S. K., & Chowdhury, P. (2021a). A production recovery plan in manufacturing supply chains for a high-demand item during COVID-19. *International Journal of Physical Distribution & Logistics Management*, *51*(2), 104-125.

Paul, S. K., Chowdhury, P., Moktadir, M. A., & Lau, K. H. (2021). Supply chain recovery challenges in the wake of COVID-19 pandemic. *Journal of Business Research*, *136*, 316-329.

Pavlov, A., Ivanov, D., Dolgui, A., & Sokolov, B. (2017). Hybrid fuzzy-probabilistic approach to supply chain resilience assessment. *IEEE Transactions on Engineering Management*, *65*(2), 303-315.

Peleg, K., Bodas, M., Hertelendy, A. J., & Kirsch, T. D. (2021). The COVID-19 pandemic challenge to the All-Hazards Approach for disaster planning. *International Journal of Disaster Risk Reduction*, *55*, 102103.

Peng, D. X., & Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management*, *30*(6), 467-480.

Pennycook, G., Epstein, Z., Mosleh, M., Arechar, A. A., Eckles, D., & Rand, D. G. (2021). Shifting attention to accuracy can reduce misinformation online. *Nature*, *592*(7855), 590-595.

Peteraf, M. A. (1993). The cornerstones of competitive advantage: a resource-based view. *Strategic Management Journal*, *14*(3), 179-191.

Peters, E., Knight, L., Boersma, K., & Uenk, N. (2023). Organizing for supply chain resilience: a high reliability network perspective. *International Journal of Operations & Production Management*, *43*(1), 48-69.

Petter, S., Straub, D., & Rai, A. (2007). Specifying formative constructs in information systems research. *MIS Quarterly*, 31 (4), 623-656.

Pettit, T. J., Croxton, K. L., & Fiksel, J. (2019). The evolution of resilience in supply chain management: a retrospective on ensuring supply chain resilience. *Journal of Business Logistics*, *40*(1), 56-65.

Pfeffer, J. (1987). A resource dependence perspective on intercorporate relations. *Intercorporate relations: The structural analysis of business*, *1*(1), 25-55.

Pfohl, H. C., Gallus, P., & Thomas, D. (2011). Interpretive structural modeling of supply chain risks. *International Journal of Physical Distribution & Logistics Management*, *41*(9), 839-859.

Plowman, D. A., Solansky, S., Beck, T. E., Baker, L., Kulkarni, M., & Travis, D. V. (2007). The role of leadership in emergent, self-organization. *The Leadership Quarterly*, *18*(4), 341-356.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879-903.

Podsakoff, P. M., Podsakoff, N. P., Williams, L. J., Huang, C., & Yang, J. (2024). Common method bias: it's bad, it's complex, it's widespread, and it's not easy to fix. *Annual Review of Organizational Psychology and Organizational Behavior*, *11*, 17-61.

Polater, A., Bektas, C., & Demirdogen, S. (2014, May). An investigation of government and private hospitals' supply chain management. In *2014 International Conference on Advanced Logistics and Transport (ICALT)* (pp. 115-119). IEEE.

Ponomarov, S. Y., & Holcomb, M. C. (2009). Understanding the concept of supply chain resilience. *The International Journal of Logistics Management*, *20*(1), 124-143.

Poulin, E. (2003). Benchmarking the hospital logistics process A potential cure for the ailing health care sector. *CMA MANAGEMENT*, *77*(1), 20-23.

Prasanna, S. R., & Haavisto, I. (2018). Collaboration in humanitarian supply chains: an organisational culture framework. *International Journal of Production Research*, *56*(17), 5611-5625.

Priem, R. L., & Butler, J. E. (2001). Is the resource-based "view" a useful perspective for strategic management research?. *Academy of Management Review*, *26*(1), 22-40.

Pring, E. T., Malietzis, G., Kendall, S. W., Jenkins, J. T., & Athanasiou, T. (2021). Crisis management for surgical teams and their leaders, lessons from the COVID-19 pandemic; A structured approach to developing resilience or natural organisational responses. *International Journal of Surgery*, *91*, 105987.

Pujawan, I. N., & Bah, A. U. (2022). Supply chains under COVID-19 disruptions: literature review and research agenda. In *Supply Chain Forum: An International Journal*, 23(1), 81-95.

Purohit, J. K., Mittal, M. L., Mittal, S., & Sharma, M. K. (2016). Interpretive structural modeling-based framework for mass customisation enablers: An Indian footwear case. *Production Planning & Control*, *27*(9), 774-786.

Queiroz, M. M., Ivanov, D., Dolgui, A., & Fosso Wamba, S. (2022). Impacts of epidemic outbreaks on supply chains: mapping a research agenda amid the COVID-19 pandemic through a structured literature review. *Annals of Operations Research*, *319*(1), 1159-1196.

Queiroz, M. M., Wamba, S. F., Jabbour, C. J. C., & Machado, M. C. (2022). Supply chain resilience in the UK during the coronavirus pandemic: A resource orchestration perspective. *International Journal of Production Economics*, *245*, 108405.

Raassens, N., Haans, H., & Mullick, S. (2022). Surviving the hectic early phase of the COVID-19 pandemic: a qualitative study to the supply chain strategies of food service firms in times of a crisis. *The International Journal of Logistics Management*, *33*(3), 877-900.

Radnor, Z. J., Holweg, M., & Waring, J. (2012). Lean in healthcare: the unfilled promise?. *Social Science & Medicine*, *74*(3), 364-371.

Rai, A., Patnayakuni, R., & Seth, N. (2006). Firm performance impacts of digitally enabled supply chain integration capabilities. *MIS Quarterly*, 30 (2), 225-246.

Raj, T., Shankar, R., & Suhaib, M. (2008). An ISM approach for modelling the enablers of flexible manufacturing system: the case for India. *International Journal of Production Research*, *46*(24), 6883-6912.

Rameshan, P. (2024). Leadership behaviour in Covid-19 crisis response: A personal strategy proposition. *IIM Kozhikode Society & Management Review*, *13*(1), 44-69.

Ravichandran, T., Lertwongsatien, C., & Lertwongsatien, C. (2005). Effect of information systems resources and capabilities on firm performance: A resource-based perspective. *Journal of Management Information Systems*, *21*(4), 237-276.

Remus, U., & Wiener, M. (2010). A multi-method, holistic strategy for researching critical success factors in IT projects. *Information Systems Journal*, *20*(1), 25-52.

Riggio, R. E., & Newstead, T. (2023). Crisis leadership. Annual Review of Organizational Psychology and Organizational Behavior, 10, 201-224.

Robert, L. P., Denis, A. R., & Hung, Y. T. C. (2009). Individual swift trust and knowledge-based trust in face-to-face and virtual team members. *Journal of Management Information Systems*, *26*(2), 241-279.

Robinson, C. J., & Malhotra, M. K. (2005). Defining the concept of supply chain quality management and its relevance to academic and industrial practice. *International Journal of Production Economics*, *96*(3), 315-337.

Roscoe, S., Aktas, E., Petersen, K. J., Skipworth, H. D., Handfield, R. B., & Habib, F. (2022). Redesigning global supply chains during compounding geopolitical disruptions: the role of supply chain logics. *International Journal of Operations & Production Management*, *42*(9), 1407-1434.

Rossetti, C. L., Handfield, R., & Dooley, K. J. (2011). Forces, trends, and decisions in pharmaceutical supply chain management. *International Journal of Physical Distribution & Logistics Management*, *41*(6), 601-622.

Rossiter, J. R. (2008). Content validity of measures of abstract constructs in management and organizational research. *British Journal of Management*, *19*(4), 380-388.

Rouyre, A., & Fernandez, A. S. (2019). Managing knowledge sharing-protecting tensions in coupled innovation projects among several competitors. *California Management Review*, *62*(1), 95-120.

Rozhkov, M., Ivanov, D., Blackhurst, J., & Nair, A. (2022). Adapting supply chain operations in anticipation of and during the COVID-19 pandemic. *Omega*, *110*, 102635.

Rungtusanatham, M. J., Choi, T. Y., Hollingworth, D. G., Wu, Z., & Forza, C. (2003). Survey research in operations management: historical analyses. *Journal of Operations management*, *21*(4), 475-488.

Ruparel, N., Bhardwaj, S., Seth, H., & Choubisa, R. (2023). Systematic literature review of professional social media platforms: Development of a behavior adoption career development framework. *Journal of Business Research*, *156*, 113482.

Ryan, J. C., & Tipu, S. A. (2022). Business and management research: Low instances of replication studies and a lack of author independence in replications. *Research Policy*, *51*(1), 104408.

Sá, M. M. D., Miguel, P. L. D. S., Brito, R. P. D., & Pereira, S. C. F. (2020). Supply chain resilience: the whole is not the sum of the parts. *International Journal of Operations & Production Management*, *40*(1), 92-115.

Sabahi, S., & Parast, M. M. (2020). Firm innovation and supply chain resilience: a dynamic capability perspective. *International Journal of Logistics Research and Applications*, *23*(3), 254-269.

Sadeghi, K., Ojha, D., Kaur, P., Mahto, R. V., & Dhir, A. (2024). Explainable artificial intelligence and agile decision-making in supply chain cyber resilience. *Decision Support Systems*, *180*, 114194.

Sadiq, A. A., Kapucu, N., & Hu, Q. (2021). Crisis leadership during COVID-19: The role of governors in the United States. *International Journal of Public Leadership*, *17*(1), 65-80.

Sahay, B. S. (2003). Understanding trust in supply chain relationships. *Industrial Management & Data Systems*, *103*(8), 553-563.

Salunke, S., Weerawardena, J., & McColl-Kennedy, J. R. (2011). Towards a model of dynamic capabilities in innovation-based competitive strategy: Insights from project-oriented service firms. *Industrial Marketing Management*, *40*(8), 1251-1263.

Salvato, C., & Vassolo, R. (2018). The sources of dynamism in dynamic capabilities. *Strategic Management Journal*, *39*(6), 1728-1752.

Sangal, S., Nigam, A., & Sharma, S. (2024). Integrating blockchain capabilities in an omnichannel healthcare system: A dual theoretical perspective. *Journal of Consumer Behaviour*, *23*(2), 440-452.

Santos, L. C., Reul, L. M. A., & Gohr, C. F. (2023). A graph-theoretic approach for assessing the leanness level of supply chains. *Supply Chain Management: An International Journal*, *28*(1), 74-89.

Sarstedt, M., Hair, J. F., Ringle, C. M., Thiele, K. O., & Gudergan, S. P. (2016). Estimation issues with PLS and CBSEM: Where the bias lies!. *Journal of Business Research*, *69*(10), 3998-4010.

Sarstedt, M., Radomir, L., Moisescu, O. I., & Ringle, C. M. (2022). Latent class analysis in PLS-SEM: A review and recommendations for future applications. *Journal of Business Research*, *138*, 398-407.

Sarstedt, M., Ringle, C. M., & Hair, J. F. (2021). Partial least squares structural equation modeling. In *Handbook of market research* (pp. 587-632). Cham: Springer International Publishing.

Sarstedt, M., Ringle, C. M., Cheah, J. H., Ting, H., Moisescu, O. I., & Radomir, L. (2020). Structural model robustness checks in PLS-SEM. *Tourism Economics*, *26*(4), 531-554.

Sathiya, V., Nagalakshmi, K., Jeevamalar, J., Babu, R. A., Karthi, R., Acevedo-Duque, Á., ... & Ramabalan, S. (2023). Reshaping healthcare supply chain using chain-of-things technology and key lessons experienced from COVID-19 pandemic. *Socio-Economic Planning Sciences*, *85*, 101510.

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., ... & Jinks, C. (2018). Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality & quantity*, *52*, 1893-1907.

Saunders, M. N., & Bezzina, F. (2015). Reflections on conceptions of research methodology among management academics. *European Management Journal*, *33*(5), 297-304.

Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students (8th Edition)*. Pearson Education, London.

Sawyerr, E., & Harrison, C. (2023). Resilience in healthcare supply chains: a review of the UK's response to the COVID19 pandemic. *International Journal of Physical Distribution & Logistics Management*, *53*(3), 297-329.

Sawyerr, E., & Harrison, C. (2023). Resilience in healthcare supply chains: a review of the UK's response to the COVID19 pandemic. *International Journal of Physical Distribution & Logistics Management*, *53*(3), 297-329.

Sazvar, Z., Tafakkori, K., Oladzad, N., & Nayeri, S. (2021). A capacity planning approach for sustainable-resilient supply chain network design under uncertainty: A case study of vaccine supply chain. *Computers & Industrial Engineering*, *159*, 107406.

Scala, B., & Lindsay, C. F. (2021). Supply chain resilience during pandemic disruption: evidence from healthcare. *Supply Chain Management: An International Journal*, *26*(6), 672-688.

Schiffling, S., Hannibal, C., Fan, Y., & Tickle, M. (2020). Coopetition in temporary contexts: Examining swift trust and swift distrust in humanitarian operations. *International Journal of Operations & Production Management*, *40*(9), 1449-1473.

Schilke, O., Hu, S., & Helfat, C. E. (2018). Quo vadis, dynamic capabilities? A content-analytic review of the current state of knowledge and recommendations for future research. *Academy of management annals*, *12*(1), 390-439.

Schneller, E., Smeltzer, L. R., & Burns, L. R. (2006). Strategic management of the health care supply chain. *Jossey-bass*

Scholten, K., & Schilder, S. (2015). The role of collaboration in supply chain resilience. *Supply Chain Management: An International Journal*, *20*(4), 471-484.

Scholten, K., Stevenson, M., & van Donk, D. P. (2020). Dealing with the unpredictable: supply chain resilience. *International Journal of Operations & Production Management*, *40*(1), 1-10.

Schreiner, M., Kale, P., & Corsten, D. (2009). What really is alliance management capability and how does it impact alliance outcomes and success?. *Strategic Management Journal*, *30*(13), 1395-1419.

Schumacher, R., Glew, R., Tsolakis, N., & Kumar, M. (2021). Strategies to manage product recalls in the COVID-19 pandemic: an exploratory case study of PPE supply chains. *Continuity & Resilience Review*, *3*(1), 64-78.

Schuster, T., & Holtbrügge, D. (2014). Resource dependency, innovative strategies, and firm performance in BOP markets. *Journal of Product Innovation Management*, *31*, 43-59.

Seeger, M. W., Sellnow, T. L., & Ulmer, R. R. (2003). *Communication and organizational crisis*. Greenwood Publishing Group.

Seidl, R., Spies, T. A., Peterson, D. L., Stephens, S. L., & Hicke, J. A. (2016). Searching for resilience: addressing the impacts of changing disturbance regimes on forest ecosystem services. *Journal of Applied Ecology*, *53*(1), 120-129.

Sengupta, M., Roy, A., Ganguly, A., Baishya, K., Chakrabarti, S., & Mukhopadhyay, I. (2021). Challenges encountered by healthcare providers in COVID-19 times: an exploratory study. *Journal of Health Management*, *23*(2), 339-356.

Sengupta, S., & Jha, M. K. (2021). Risks and resilience: COVID-19 response and disaster management policies in India. *India Review*, *20*(2), 121-141.

Senna, P., Reis, A., Dias, A., Coelho, O., Guimaraes, J., & Eliana, S. (2023). Healthcare supply chain resilience framework: antecedents, mediators, consequents. *Production Planning & Control*, *34*(3), 295-309.

Senna, P., Reis, A., Marujo, L. G., Ferro de Guimarães, J. C., Severo, E. A., & dos Santos, A. C. D. S. G. (2023). The influence of supply chain risk management in healthcare supply chains performance. *Production Planning & Control*, 1-16.

Seuring, S., Brandenburg, M., Sauer, P. C., Schünemann, D. S., Warasthe, R., Aman, S., ... & Khalid, R. U. (2022). Comparing regions globally: impacts of COVID-19 on supply chains–a Delphi study. *International Journal of Operations & Production Management*, *42*(8), 1077-1108.

Shah, R., Goldstein, S. M., Unger, B. T., & Henry, T. D. (2008). Explaining anomalous high performance in a health care supply chain. *Decision Sciences*, *39*(4), 759-789.

Shahbazi, M., & Bunker, D. (2024). Social media trust: Fighting misinformation in the time of crisis. *International Journal of Information Management*, *77*, 102780.

Sharma, V. K., & Kumar, H. (2023). Enablers driving success of artificial intelligence in business performance: A TISM-MICMAC approach. *IEEE Transactions on Engineering Management*, *71*, 4665-4675.

Shen, Z. M., & Sun, Y. (2023). Strengthening supply chain resilience during COVID-19: A case study of JD. com. *Journal of Operations Management*, *69*(3), 359-383.

Shiri, D., Akbari, V., & Salman, F. S. (2024). Online algorithms for ambulance routing in disaster response with time-varying victim conditions. *OR Spectrum*, 1-35. DOI: 10.1007/s00291-024-00744-4.

Shumaker, S. A., & Brownell, A. (1984). Toward a theory of social support: Closing conceptual gaps. *Journal of social issues*, *40*(4), 11-36.

Simo, G., & Bies, A. L. (2007). The role of nonprofits in disaster response: An expanded model of cross-sector collaboration. *Public Administration Review*, *67*, 125-142.

Sindhwani, R., Chakraborty, S., Behl, A., & Pereira, V. (2022). Building resilience to handle disruptions in critical environmental and energy sectors: Implications for cleaner production in the oil and gas industry. *Journal of Cleaner Production*, *365*, 132692.

Singh, K., Kondal, D., Mohan, S., Jaganathan, S., Deepa, M., Venkateshmurthy, N. S., ... & Eggleston, K. (2021). Health, psychosocial, and economic impacts of the COVID-19 pandemic on people with chronic conditions in India: a mixed methods study. *BMC Public Health*, *21*, 1-15.

Singh, R. K., & Gupta, A. (2020). Framework for sustainable maintenance system: ISM–fuzzy MICMAC and TOPSIS approach. *Annals of Operations Research*, *290*(1), 643-676.

Sinha, K. K., & Kohnke, E. J. (2009). Health care supply chain design: toward linking the development and delivery of care globally. *Decision Sciences*, *40*(2), 197-212.

Sirmon, D. G., Hitt, M. A., Arregle, J. L., & Campbell, J. T. (2010). The dynamic interplay of capability strengths and weaknesses: investigating the bases of temporary competitive advantage. *Strategic Management Journal*, *31*(13), 1386-1409.

Skipworth, H., Delbufalo, E., & Mena, C. (2020). Logistics and procurement outsourcing in the healthcare sector: A comparative analysis. *European Management Journal*, *38*(3), 518-532.

Smart, C., & Vertinsky, I. (1977). Designs for crisis decision units. *Administrative Science Quarterly*, 22 (4), 640-657.

Snowdon, A. W., & Saunders, M. J. (2022). Supply chain capacity to respond to COVID-19 in Newfoundland and Labrador: An integrated leadership strategy. *Healthcare Management Forum*, 35 (2), 71-79.

Sodhi, M. S., & Tang, C. S. (2021). Supply chain management for extreme conditions: Research opportunities. *Journal of Supply Chain Management*, *57*(1), 7-16.

Sodhi, M. S., Tang, C. S., & Willenson, E. T. (2023). Research opportunities in preparing supply chains of essential goods for future pandemics. *International Journal of Production Research*, *61*(8), 2416-2431.

Sommer, S. A., Howell, J. M., & Hadley, C. N. (2016). Keeping positive and building strength: The role of affect and team leadership in developing resilience during an organizational crisis. *Group & Organization Management*, *41*(2), 172-202.

Soni, U., Jain, V., & Kumar, S. (2014). Measuring supply chain resilience using a deterministic modeling approach. *Computers & Industrial Engineering*, *74*, 11-25.

Sorooshian, S., Tavana, M., & Ribeiro-Navarrete, S. (2023). From classical interpretive structural modeling to total interpretive structural modeling and beyond: A half-century of business research. *Journal of Business Research*, *157*, 113642.

Sotoudeh-Anvari, A. (2022). The applications of MCDM methods in COVID-19 pandemic: A state of the art review. *Applied Soft Computing*, *126*, 109238.

Sousa, R., & Voss, C. A. (2008). Contingency research in operations management practices. *Journal of Operations Management*, *26*(6), 697-713.

Sushil. (2012). Interpreting the interpretive structural model. *Global Journal of Flexible Systems Management*, *13*, 87-106.

Sushil. (2019). Efficient interpretive ranking process incorporating implicit and transitive dominance relationships. *Annals of Operations Research*, *283*(1), 1489-1516.

Sushil, & Dinesh, K. K. (2022). Structured literature review with TISM leading to an argumentation based conceptual model. *Global Journal of Flexible Systems Management*, *23*(3), 387-407.

Spekman, R. E., Kamauff, J. W., & Myhr, N. (1998). An empirical investigation into supply chain management: a perspective on partnerships. *Supply Chain Management: An International Journal*, *3*(2), 53-67.

Spiegler, V. L., Naim, M. M., & Wikner, J. (2012). A control engineering approach to the assessment of supply chain resilience. *International Journal of Production Research*, *50*(21), 6162-6187.

Spieske, A., Gebhardt, M., Kopyto, M., & Birkel, H. (2022). Improving resilience of the healthcare supply chain in a pandemic: Evidence from Europe during the COVID-19 crisis. *Journal of Purchasing and Supply Management*, *28*(5), 100748.

Srinivasan, R., & Swink, M. (2018). An investigation of visibility and flexibility as complements to supply chain analytics: An organizational information processing theory perspective. *Production and Operations Management*, *27*(10), 1849-1867.

Statsenko, L., Jayasinghe, R. S., & Soosay, C. (2024). Supply network resilience capabilities: a social–ecological perspective. *Supply Chain Management: An International Journal*, *29*(1), 1-26.

Stephens, K. K., Jahn, J. L., Fox, S., Charoensap-Kelly, P., Mitra, R., Sutton, J., ... & Meisenbach, R. J. (2020). Collective sensemaking around COVID-19: Experiences, concerns, and agendas for our rapidly changing organizational lives. *Management Communication Quarterly*, *34*(3), 426-457.

Surana, A., Kumara*, S., Greaves, M., & Raghavan, U. N. (2005). Supply-chain networks: a complex adaptive systems perspective. *International Journal of Production Research*, *43*(20), 4235-4265.

Sushil. (2012). Interpreting the interpretive structural model. *Global Journal of Flexible Systems Management*, *13*, 87-106.

Sutrop, M., Parder, M. L., & Juurik, M. (2020). Research ethics codes and guidelines. In *Handbook of research ethics and scientific integrity* (pp. 67-89). Cham: Springer International Publishing.

Sutton, R. I., & Staw, B. M. (1995). What theory is not. *Administrative Science Quarterly*, 40 (3), 371-384.

Tabaklar, T., Halldórsson, Á., Kovács, G., & Spens, K. (2015). Borrowing theories in humanitarian supply chain management. *Journal of Humanitarian Logistics and Supply Chain Management*, *5*(3), 281-299.

Tabish, S. A. (2020). COVID-19 pandemic: Emerging perspectives and future trends. *Journal of Public Health Research*, *9*(1), 19-26. DOI: 10.4081/jphr.2020.1786.

Taherkhani, A. H., Heravi, G., & AminShokravi, A. (2022). Developing a framework to enhance the seismic resilience of the electricity distribution system feeding the healthcare system. *International Journal of Disaster Risk Reduction*, *71*, 102801.

Tatham, P., & Kovács, G. (2010). The application of "swift trust" to humanitarian logistics. *International Journal of Production Economics*, *126*(1), 35-45.

Tavana, M., Nazari-Shirkouhi, S., & Farzaneh Kholghabad, H. (2021). An integrated quality and resilience engineering framework in healthcare with Z-number data envelopment analysis. *Health care management science*, *24*, 768-785.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509-533.

Tenenhaus, M., Vinzi, V. E., Chatelin, Y. M., & Lauro, C. (2005). PLS path modeling. *Computational Statistics & Data Analysis*, *48*(1), 159-205.

Teo, T. S., Srivastava, S. C., & Jiang, L. I. (2008). Trust and electronic government success: An empirical study. *Journal of Management Information Systems*, *25*(3), 99-132.

Teo, W. L., Lee, M., & Lim, W. S. (2017). The relational activation of resilience model: How leadership activates resilience in an organizational crisis. *Journal of Contingencies and Crisis Management*, *25*(3), 136-147.

Tippong, D., Petrovic, S., & Akbari, V. (2022). A review of applications of operational research in healthcare coordination in disaster management. *European Journal of Operational Research*, *301*(1), 1-17.

Tiwari, M., Bryde, D. J., Stavropoulou, F., & Malhotra, G. (2024). Understanding the evolution of flexible supply chain in the business-to-business sector: a resource-based theory perspective. *International Studies of Management & Organization*. DOI: 10.1080/00208825.2024.2324245.

Tiwari, M., Bryde, D.J., Stavropolou, F., Dubey, R., Kumari, S., & Foropon, C. (2024). Modelling supply chain Visibility, digital Technologies, environmental dynamism and healthcare supply chain Resilience: An organisation information processing theory perspective, *Transportation Research Part E: Logistics and Transportation Review*, 188, 103613.

Tortorella, G. L., Fogliatto, F. S., Saurin, T. A., Tonetto, L. M., & McFarlane, D. (2022). Contributions of Healthcare 4.0 digital applications to the resilience of healthcare organizations during the COVID-19 outbreak. *Technovation*, *111*, 102379.

Tortorella, G. L., Fogliatto, F. S., Saurin, T. A., Tonetto, L. M., & McFarlane, D. (2022). Contributions of Healthcare 4.0 digital applications to the resilience of healthcare organizations during the COVID-19 outbreak. *Technovation*, *111*, 102379.

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, *14*(3), 207-222.

Tsai, T. Y., & Urmetzer, F. (2024). A decisional framework for manufacturing relocation: Consolidating and expanding the reshoring debate. *International Journal of Management Reviews*, *26*(2), 254-284.

Tseng, M. L., Ha, H. M., Lim, M. K., Wu, K. J., & Iranmanesh, M. (2022). Sustainable supply chain management in stakeholders: supporting from sustainable supply and process management in the healthcare industry in Vietnam. *International Journal of Logistics Research and Applications*, *25*(4-5), 364-383.

Turenne, C. P., Gautier, L., Degroote, S., Guillard, E., Chabrol, F., & Ridde, V. (2019). Conceptual analysis of health systems resilience: a scoping review. *Social Science & Medicine*, *232*, 168-180.

Ungar, M. (2018). Systemic resilience. *Ecology and society*, *23*(4). DOI: 10.5751/ES-10385-230434.

Unlu, A., Kapucu, N., & Sahin, B. (2010). Disaster and crisis management in Turkey: a need for a unified crisis management system. *Disaster Prevention and Management: An International Journal*, *19*(2), 155-174.

Usdin, L. (2014). Building resiliency and supporting distributive leadership post-disaster: Lessons from New Orleans a decade (almost) after Hurricane Katrina. *International Journal of Leadership in Public Services*, *10*(3), 157-171.

Vadlamannati, K. C., & Jung, Y. S. (2023). The political economy of vaccine distribution and China's Belt and Road Initiative. *Business and Politics*, *25*(1), 67-88.

Van Hoek, R. (2020). Research opportunities for a more resilient post-COVID-19 supply chain–closing the gap between research findings and industry practice. *International Journal of Operations &*

Villani, E., Greco, L., & Phillips, N. (2017). Understanding value creation in public-private partnerships: A comparative case study. *Journal of Management Studies*, *54*(6), 876-905.

Villena, V. H., Lu, G., Gomez-Mejia, L. R., & Revilla, E. (2018). Is top management team-supply chain manager interaction the missing link? An analysis of risk-bearing antecedents for supply chain managers. *International Journal of Operations & Production Management*, *38*(8), 1640-1663.

Venkatesh, V. (2021). Road to success: A guide for doctoral students and junior faculty members in the behavioral and social sciences. (Available at: https://vtechworks.lib.vt.edu/items/13595eb6-0490-4920-8d9d-5f7e3d59d989).

Vivek, S. D., Banwet, D. K., & Shankar, R. (2008). Analysis of interactions among core, transaction and relationship-specific investments: The case of offshoring. *Journal of Operations Management*, *26*(2), 180-197.

Wacker, J. G. (1998). A definition of theory: research guidelines for different theory-building research methods in operations management. *Journal of Operations Management*, *16*(4), 361-385.

Wadhwa, S., Mishra, M., Chan, F. T., & Ducq, Y. (2010). Effects of information transparency and cooperation on supply chain performance: a simulation study. *International Journal of Production Research*, *48*(1), 145-166.

Wagner, S. M., & Kemmerling, R. (2010). Handling nonresponse in logistics research. *Journal of Business Logistics*, *31*(2), 357-381.

Wagner, S. M., & Neshat, N. (2010). Assessing the vulnerability of supply chains using graph theory. *International Journal of Production Economics*, *126*(1), 121-129.

Wang, E. T., & Wei, H. L. (2007). Interorganizational governance value creation: coordinating for information visibility and flexibility in supply chains. Decision Sciences, 38(4), 647-674.

Wang, H., Qi, H., & Ran, B. (2022). Public–private collaboration led by private organizations in combating crises: evidence from China's fighting against COVID-19. *Administration & Society*, *54*(1), 3-28.

Warfield, J. N. (1973). On arranging elements of a hierarchy in graphic form. *IEEE Transactions on Systems, Man, and Cybernetics*, SMC-3 (2), 121-132.

Warfield, J. N. (1974). Toward interpretation of complex structural models. IEEE Transactions on Systems, Man, and Cybernetics, SMC-4 (5), 405-417.

Warfield, J. N. (1976). Implication structures for system interconnection matrices. *IEEE Transactions on Systems, Man, and Cybernetics*, SMC-6 (1), 18-24.

Weick, K. E. (1995). What theory is not, theorizing is. *Administrative Science Quarterly*, *40*(3), 385-390.

Westman, W. E. (1986). Resilience: concepts and measures. In *Resilience in Mediterranean-type ecosystems* (pp. 5-19). Dordrecht: Springer Netherlands.

Wever, M., Wognum, P. M., Trienekens, J. H., & Omta, S. W. F. (2012). Supply chain-wide consequences of transaction risks and their contractual solutions: Towards an extended transaction cost economics framework. *Journal of Supply Chain Management*, *48*(1), 73-91.

Whetten, D. A. (1989). What constitutes a theoretical contribution?. *Academy of Management Review*, *14*(4), 490-495.

WHO (2020). WHO Director-General's opening remarks at the media briefing on COVID- 19, 11 March 2020. Geneva, Switzerland. https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020.

WHO (2021). COVID-19 and the social determinants of health and health equity: evidence brief. https: https://iris.who.int/bitstream/handle/10665/348333/9789240038387-eng.pdf?sequence=1

Wieland, A. (2021). Dancing the supply chain: Toward transformative supply chain management. *Journal of Supply Chain Management*, *57*(1), 58-73.

Wieland, A., & Durach, C. F. (2021). Two perspectives on supply chain resilience. *Journal of Business Logistics*, *42*(3), 315-322.

Wieland, A., & Wallenburg, C. M. (2013). The influence of relational competencies on supply chain resilience: a relational view. *International Journal of Physical Distribution & Logistics Management*, *43*(4), 300-320.

Wiles, R., Charles, V., Crow, G., & Heath, S. (2006). Researching researchers: lessons for research ethics. *Qualitative Research*, *6*(3), 283-299.

Williams, T. A., Gruber, D. A., Sutcliffe, K. M., Shepherd, D. A., & Zhao, E. Y. (2017). Organizational response to adversity: Fusing crisis management and resilience research streams. *Academy of Management Annals*, *11*(2), 733-769.

Williamson, O. E. (2008). Outsourcing: Transaction cost economics and supply chain management. *Journal of Supply Chain Management*, *44*(2), 5-16.

Wilson, S. (2020). Pandemic leadership: Lessons from New Zealand's approach to COVID-19. *Leadership*, *16*(3), 279-293.

Wu, L., Chuang, C. H., & Hsu, C. H. (2014). Information sharing and collaborative behaviors in enabling supply chain performance: A social exchange perspective. *International Journal of Production Economics*, *148*, 122-132.

Wu, Y. L., Shao, B., Newman, A., & Schwarz, G. (2021). Crisis leadership: A review and future research agenda. *The Leadership Quarterly*, *32*(6), 101518.

Xu, X., Sethi, S. P., Chung, S. H., & Choi, T. M. (2023). Reforming global supply chain management under pandemics: The GREAT-3Rs framework. *Production and Operations Management*, *32*(2), 524-546.

Yadav, D. K., & Barve, A. (2015). Analysis of critical success factors of humanitarian supply chain: An application of Interpretive Structural Modeling. *International Journal of Disaster Risk Reduction*, *12*, 213-225.

Yan, B., Zhang, X., Wu, L., Zhu, H., & Chen, B. (2020). Why do countries respond differently to COVID-19? A comparative study of Sweden, China, France, and Japan. The American Review of Public Administration, 50(6-7), 762-769.

Yanamandra, R. (2018). Development of an integrated healthcare supply chain model. Supply Chain Forum: An International Journal, 19(2), 111-121.

Yaroson, E. V., Breen, L., Hou, J., & Sowter, J. (2021). Advancing the understanding of pharmaceutical supply chain resilience using complex adaptive system (CAS) theory. *Supply Chain Management: An International Journal*, *26*(3), 323-340.

Ye, F., Ke, M., Ouyang, Y., Li, Y., Li, L., Zhan, Y., & Zhang, M. (2024). Impact of digital technology usage on firm resilience: a dynamic capability perspective. *Supply Chain Management: An International Journal*, *29*(1), 162-175.

Ye, Y., Jiao, W., & Yan, H. (2020). Managing relief inventories responding to natural disasters: Gaps between practice and literature. *Production and Operations Management*, *29*(4), 807-832.

Yildiz, H. E., Murtic, A., & Zander, U. (2024). Re-conceptualizing absorptive capacity: The importance of teams as a meso-level context. *Technological Forecasting and Social Change*, *199*, 123039.

Yin, W., Ran, W., & Zhang, Z. (2024). A configuration approach to build supply chain resilience: From matching perspective. *Expert Systems with Applications*, 123662.

Yılmaz, Ö. F., Yeni, F. B., Yılmaz, B. G., & Özçelik, G. (2023). An optimization-based methodology equipped with lean tools to strengthen medical supply chain resilience during a pandemic: A case study from Turkey. *Transportation Research Part E: Logistics and Transportation Review*, *173*, 103089.

Yu, W., Jacobs, M. A., Chavez, R., & Yang, J. (2019). Dynamism, disruption orientation, and resilience in the supply chain and the impacts on financial performance: A dynamic capabilities perspective. *International Journal of Production Economics*, *218*, 352-362.

Yuan, R., Luo, J., Liu, M. J., & Yu, J. (2022). Understanding organizational resilience in a platform-based sharing business: The role of absorptive capacity. *Journal of Business Research*, *141*, 85-99.

Zafari, K., Biggemann, S., & Garry, T. (2020). Mindful management of relationships during periods of crises: A model of trust, doubt and relational adjustments. *Industrial Marketing Management*, *88*, 278-286.

Zamiela, C., Hossain, N. U. I., & Jaradat, R. (2022). Enablers of resilience in the healthcare supply chain: A case study of US healthcare industry during COVID-19 pandemic. *Research in Transportation Economics*, *93*, 101174.

Zamiela, C., Hossain, N. U. I., & Jaradat, R. (2022). Enablers of resilience in the healthcare supply chain: A case study of US healthcare industry during COVID-19 pandemic. *Research in Transportation Economics*, *93*, 101174.

Zamiela, C., Hossain, N. U. I., & Jaradat, R. (2022). Enablers of resilience in the healthcare supply chain: A case study of US healthcare industry during COVID-19 pandemic. *Research in Transportation Economics*, *93*, 101174.

Zamiela, C., Hossain, N. U. I., & Jaradat, R. (2022). Enablers of resilience in the healthcare supply chain: A case study of US healthcare industry during COVID-19 pandemic. *Research in Transportation Economics*, *93*, 101174.

Zhang, J., Xie, C., Wang, J., Morrison, A. M., & Coca-Stefaniak, J. A. (2020). Responding to a major global crisis: the effects of hotel safety leadership on employee safety behavior during COVID-19. *International Journal of Contemporary Hospitality Management*, *32*(11), 3365-3389.

Zhang, Q., & Cao, M. (2018). Exploring antecedents of supply chain collaboration: Effects of culture and interorganizational system appropriation. *International journal of Production economics*, *195*, 146-157.

Zhao, G., Vazquez-Noguerol, M., Liu, S., & Prado-Prado, J. C. (2024). Agri-food supply chain resilience strategies for preparing, responding, recovering, and adapting in relation to unexpected crisis: A cross-country comparative analysis from the COVID-19 pandemic. *Journal of Business Logistics*, *45*(1), e12361.

Zheng, J., Bakker, E., Knight, L., Gilhespy, H., Harland, C., & Walker, H. (2006). A strategic case for e-adoption in healthcare supply chains. *International Journal of Information Management*, *26*(4), 290-301.

Zhou, J., Hu, L., Yu, Y., Zhang, J. Z., & Zheng, L. J. (2024). Impacts of IT capability and supply chain collaboration on supply chain resilience: empirical evidence from China

in COVID-19 pandemic. *Journal of Enterprise Information Management*, *37*(2), 777-803.

APPENDIX I ETHICAL APPROVAL CONFIRMATION

Approval reference number 23/LBS/015

UREC minimal Risk Registration <MinimalRiskUREC@ljmu.ac.uk>
Fri 8/4/2023 3:04 PM

To:UREC minimal Risk Registration <MinimalRiskUREC@ljmu.ac.uk>;Tiwari, Manisha <M.Tiwari1@2021.ljmu.ac.uk>

Cc:Dubey, Rameshwar <R.Dubey@ljmu.ac.uk>

Dear Manisha

Manisha Tiwari, PGR - Impacts of pandemic outbreaks on Healthcare Supply Chains: Lessons from COVID-19 in Developing nations. (Dubey Rameshwar)

Thank you for registering your study as minimal risk.

UREC approval reference number: 23/LBS/015

Approval is given on the understanding that:

- The study is conducted in accordance with the Minimal Ethical Risk Guiding Principles
- Any adverse reactions/events which take place during the course of the project are reported to the Committee immediately by emailing researchethics@ljmu.ac.uk;
- Any unforeseen ethical issues arising during the course of the project will be reported to the Committee immediately emailing researchethics@ljmu.ac.uk;
- The LJMU logo is used for all documentation relating to participant recruitment and participation e.g. poster, information sheets, consent forms, questionnaires. The study consent forms, data, information etc. will be accessible on request to a student's supervisory team and/or to responsible members of Liverpool John Moores University for monitoring, auditing and data authenticity purposes.
- Where any substantive amendments are proposed to the protocol or study procedures that change the associated risk from minimal to low risk (use the decision tool to establish the associated risk), the investigators must complete an ethics application form describing all aspects of the study and submit for ethical review and approval as required.
- Where relevant appropriate gatekeeper / management permission must be obtained prior to the study commencing at the study site concerned.

Please note that approval is given for a period of five years from the date granted and therefore the expiry date for this project will be five years from today. An application for extension of approval must be submitted if the project continues after this date.

Best wishes
UREC

APPENDIX II PRE-TESTING QUESTIONNAIRE FOR RELIABILITY AND VALIDITY TEST

Title: Request for Participation in Questionnaire Validation

Dear Participant,

I hope you are doing well.

I am Manisha Tiwari, a full-time Doctoral student at Liverpool John Moores University in the UK, working under Professor Rameshwar Dubey, Professor David Bryde and Dr. Foteini Stavropoulou.

I am requesting your participation in the pretesting of a questionnaire which will be implemented to conduct a doctoral research study titled "Impacts of Pandemic Outbreaks on Healthcare Supply Chains: Lessons from COVID-19 in Developing Nations".

Your expertise will ensure a robust questionnaire is floated to collect the data. So, please review the attached questionnaire and share your thoughts, suggestions, or concerns. I would greatly appreciate your support in this endeavour, as it will advance our understanding of Healthcare Supply Chain Resilience.

Many thanks in advance for your valuable time and consideration.

I am including the following documents for you to look over.

1. Cover Letter

2. Letter of Consent

3. Survey and Interview Questionnaire

Best Regards,
Manisha Tiwari
Doctoral Scholar in Supply Chain Management
Liverpool John Moores University
United Kingdom
Contact: +44-7435853243
email: M.Tiwari1@2021.LJMU.AC.UK, Manishat106@gmail.com

APPENDIX III ISM RESEARCH QUESTIONNIARE

Introduction

My name is Manisha Tiwari, and I am a full-time doctoral student at Liverpool John Moores University in the UK. My research aims to investigate the impact of pandemic outbreaks on healthcare supply chains. As a part of my doctoral research, I am conducting an independent study to identify the factor that have contributed to the resilience of healthcare supply chains during the COVID-19 crisis.

I would greatly appreciate your voluntary participation in this study to better understand the situation. Please note that your information will be handled con1dentially and anonymously and will not be shared with any third party. Thank you for considering taking part in this research.

Objective:

I have conducted an extensive literature review and identi1ed a list of factors that need to be ranked based on your experience and perception. To achieve this, I have created a 1ve-point Likert scale and would appreciate it if you could rank these factors on a scale of one to 1ve. I will use these factors as a preliminary step to understand their complex interaction using a graph-theoretic approach.

This survey is divided into 3 sections: Section 1 – Introduction

Section 2 – Personal Pro1le

Section 3 – Instruction and Questions

Personal Profile

This section is the demographic pro1le of the respondents

1. What is your name? *

2. What is your designation? *

3. What is the name of your organisation? *

4. How many years of work experience do you have? * *Mark only one oval.*

0	-	5	Years
5	-	10	Years
10	-	15	Years
15	-	20	Years

20 Years and above

How many years of work experience do you have? * *Mark only one oval.*

0	-	5	Years
5	-	10	Years
10	-	15	Years
15	-	20	Years

20 Years and above

Ranking of the Factors- Instruction

I have created a 1ve-point Likert scale and would appreciate it if you could rank these factors on a scale of one to 1ve by circling the relevant number that best represents your opinion on how these factors contribute to building resilience in the Healthcare Supply Chain:

(1) Strongly Disagree

(2) Disagree
(3) Not sure
(4) Agree

(5) Strongly Agree

1. Information sharing among stakeholders *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

2. Trust *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

3. Top management support *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

4. Transparency in the process and communication *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

5. Visibility of Information related to supply and demand *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

6. Mutual respect *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

7. Family support *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

8. Government support *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

9. Interdependence *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

10. Use of digital technologies *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

11. Financial support *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

12. Inventory management *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

13. Agility *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

14. Adaptability *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

15. Accessibility *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

16. Affordability *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

17. Awareness *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

18 Alignment *

Mark only one oval.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Not sure*	*Agree*	Strongly Agree

APPENDIX IV PLS-SEM RESEARCH SURVEY

Introduction - Research on "Impacts of Pandemic Outbreaks on Healthcare Supply Chains: Lessons from COVID-19 in Developing Nations"

I am Manisha Tiwari, a full-time doctoral student at Liverpool John Moores University, in the UK. As a postgraduate student, I am conducting an independent study for my doctoral research titled "*Impacts of Pandemic Outbreaks on Healthcare Supply Chains: Lessons from COVID-19 in Developing Nations*." This study focuses on gaining insights into building healthcare supply chain resilience in response to the COVID-19 crisis, which has signi8cantly impacted the healthcare industry. The study explores how healthcare supply chains can be strengthened and made more resilient to ensure that critical medical equipment and supplies can be delivered eSciently and effectively to those in need, even during time of crisis. The information collected from this study will be used for academic purposes only, and your participation would be greatly appreciated. Your insights and experiences can help inform strategies to improve healthcare supply chain resilience and contribute to ongoing efforts to address the impact of the COVID-19 pandemic. Thank you for considering participating in this critical research study.

This survey is divided into 4 sections: Section 1 – Introduction

Section 2 – Informed Consent
Section 3 – Personal Pro8le
Section 4 – Instruction and Survey Questions

Click Next to go to the next section.

* Indicates required question

Informed Consent

Participation in this study is voluntary, and you can withdraw anytime. The study will involve 8lling out basic demographic information and surveys on the constructs used in the theoretical model. This survey will not take more than 15 minutes to complete. Rest assured that your participation will remai anonymous, and your details will not be shared with anyone under any circumstances. Your participation is valuable and greatly appreciated.

I have read the above information. By participating in this survey, I indicate that I am voluntarily participating in this study and I give my consent to answer this survey.

I agree with the above statement. *

Mark only one oval.

Agree

Personal Profile

This section is the demographic pro8le of the respondents. Participants are free to skip the optional questions.

1. What is your name? *
2. What is your designation? *
3. What is the name of your organisation? (Optional)
4. What is your E-mail address?
5. How many years of work experience do you have? * *Mark only one oval.*

0 - 5 Years
5 - 10 Years
10 - 15 Years
15 - 20 Years
20 Years and above

Instruction

Listed below are information visibility, trust, collaboration, crisis leadership, and healthcare supply chain resilience. Using the Likert scale below from 1 to 7, please indicate your preference for each statement by circling the relevant number.

(1) Strongly Disagree

(2) Disagree
(3) Somewhat Disagree
(4) Neither Agree Nor Disagree

(5) Somewhat Agree

(6) Agree
(7) Strongly Agree

1. Our organisation maintains a comprehensive record of relevant information to make crucial decisions.

Mark only one oval.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

2. Our organisation stores pertinent information on organisational matters. *

Mark only one oval.

1 2 3 4 5 6 7
Strongly Disagree Strongly Agree

3. My organisation provides us with information that has societal benefits. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

4. My organisation only shares information with us when it is socially responsible. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

5. My organisation ensures that relevant data can be acquired when it is needed. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

6. My organisation provides enough background for people to understand the information provides.

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

7. My organisation provides information in a structured and organised manner. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

8. We employees trust each other in times of emergencies. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

9. We employees get along quickly and exchange good rapport. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

10. We employees trust our organisational policies and leaders. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

11. Team members soon have a understanding of the prevailing situations, and it is easy t communicate with each other.

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

12. I trust my team members and feel safe while exchanging relevant data. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

13. Our organisation's set objectives were met. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

14. Our members are satisfied with the overall performance of the team collaboration during the pandemic.

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

15. Our organisation is satisfied with our collaborative efforts during the pandemic. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

16. My association with my team members has been a highly successful one. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

17. My manager continuously interacted with me and my team members to discuss the problems. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

18. My manager regularly communicated with me during the pandemic and provided much-needed moral support. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

19. During the pandemic, my manager immediately took measures to handle the shortage of PPEs to protect the staff and the patients. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

20. During the pandemic, my manager communicated carefully with the various stakeholders to avoid exchanging wrong information or inaccurate data. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

21. During the pandemic, my manager coordinated with different healthcare units and suppliers to closely monitor the inventory of PPEs and other critical items. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

22. During the pandemic, the availability of PPEs and other critical items needed to suppo healthcare staff and patients improved significantly. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

23. During the pandemic, our suppliers responded quickly and effectively to the fluctuating needs of the PPEs and other items. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

24. The shortages of the PPEs and necessary items were quickly restored. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

25. We have quickly expanded our capacities to accommodate more patients. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

26. We have developed capabilities to deal with such disruptions during the pandemic in the supply chain of PPEs and necessary items needed for the normal functioning of the healthcare units. *

Mark only one oval.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

APPENDIX V CONSENT FORM

Letter of Consent

You have been invited to take part in a research study that focuses on building resilience in the Healthcare Supply Chain. The aim of this study is to collect your valuable responses based on your experience in your organisation. This form is a part of the "informed consent" process, which enables you to understand the study and make an informed decision about participating.

The study is conducted by a doctoral student Ms. Manisha Tiwari from Liverpool John Moores University, UK purely for academic purposes.

Background Information

The purpose of the study is to understand the Impacts of pandemic outbreaks on Healthcare Supply Chains and how to build resilient healthcare supply chains to mitigate the risks or disruptions we face from COVID-19 in Developing nations.

Procedures

If you agree to be in this study, you will be asked to:

- Complete a demographic questionnaire that includes seven questions.
- You will be asked to complete a survey which will take approximately 25 minutes.

Voluntary nature of the study

This study is entirely voluntary. I (the researcher), completely respect your decision to participate in the study or not. I and my research team will not treat you differently if you decide not to participate in the study. Additionally, this study is entirely anonymous, no one will know whether you participated in the research. If you decide to join the study now, you can change your mind later. You can leave at any stage of the study. Moreover, I want to clarify that the survey is entirely voluntary. Hence, we do not pay for participation in the survey as the investigation is not a part of a sponsored project or for commercial use.

Privacy

Any information shared by the participant will be treated anonymously. Under any circumstance, the researcher or the University/Institute will not use the personal information for any purposes outside the study. The data will be kept for a certain period as per the policy of the Institute/University.