Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

Supply Chain Information Visibility and Its Impact on Decision-Making: An Integrated Model in the Pharmaceutical Industry

A dissertation presented in the partial fulfilment of the requirements for the degree of

Doctor of Philosophy

In

Management

At Massey University, Albany, Auckland,

New Zealand

Nguyen Thi Thanh Hoa

2021

Abstract

Supply chain information visibility (SCIV) has been largely recognized as a key issue in pharmaceutical supply chain management. In recent years, there has been growing concern regarding the exponential growth and ubiquity of supply chain information as the result of the application of advanced technologies. Thus, the topic of visibility of information flow across a supply chain has attracted interest in both practice and academia.

Despite the existence of considerable literature on SCIV, the concept is still under-theorized. The lack of a clear understanding of the characteristics of SCIV has made it difficult to evaluate the effectiveness of SCIV and, consequently, hinders the improvement of SCIV (McIntire, 2014). Second, recent research identifies the potential of SCIV for operational performance through supporting managerial decision-making but also points out challenges and risks. In addition, there is a dearth of behavioral empirical research on supply chain management topics with which to achieve an increase in theory-building research in the field. This research addresses these gaps in the literature and investigates how SCIV across the pharmaceutical supply chain is perceived by pharmaceutical supply chain practitioners who are involved in supply chain decision-making, and how the decision-makers make use of SCIV in their supply chain decision-making process.

This study adopted an exploratory, and qualitative approach to address two research questions: "How do supply chain professionals perceive SCIV in the pharmaceutical supply chain?" and "How do supply chain professionals make informed supply chain decisions?" The constructivist grounded theory methodology was used to guide the data gathering and analysis. The data were mainly drawn from semi-structured interviews with supply chain practitioners in New Zealand-based pharmaceutical firms, working at different levels of the supply chain, including manufacturers and distributors.

Based on the findings a theoretical model was developed, the Pharmaceutical Supply Chain Information-based Decision-Making Model. The model explains the behavioral supply chain decision-making process in the pharmaceutical supply chain, based on the existence of a given level of SCIV. The empirical findings suggest that SCIV is achieved both within and outside of the pharmaceutical firms and that human relational factors tend to be more beneficial than technological factors in developing SCIV. The importance of this finding is that it addresses a frequently asked question in recent literature about what constitutes SCIV and how to successfully build information visibility in a supply chain.

Moreover, this research contributes to the behavioural supply chain management research literature by introducing a theoretical model of pharmaceutical supply chain information-based decision-making, which is grounded in the field data. The model offers significant theoretical insight into information-based decision-making in the pharmaceutical supply chain context based on empirical data, which has been largely overlooked in the supply chain management discipline. The empirical findings suggest that supply chain practitioners make information-based decisions in which they conduct an informative engaging mechanism with technological tools, with relevant stakeholders, and with themselves. Thus, the decision-making process involves extensive data analysis along with the crucial support of experience-based intuition and relevant stakeholders' engagement. Another key contribution of this study is the identification of the constructive aspect of political behaviour in the supply chain decision-making process in which relevant stakeholders when invited to engage in the process tend to positively contribute and buy into the decision.

Finally, this thesis provides significant practical implications and suggest directions for future research. Supply chain practitioners may benefit from the study by utilizing the study's results to develop supply chain information visibility in their firms. In addition, the theoretical model of the information-based decision-making process explicates a useful step-by-step approach

for supply chain practitioners to follow in making effective supply chain operational decisions. Recommendations for further research are provided, especially the recommendations for further studies that are crucially needed to assist firms to counter the pharmaceutical supply chain disruption risks caused by the Covid-19 pandemic.

Acknowledgements

I would like to take this opportunity to express my sincere gratitude and appreciation to all the people who have kindly supported me throughout the long PhD journey. First and foremost, I would like to express my most sincere gratitude to my primary supervisor Associate Professor David Pauleen, whose kindness, wise advice, and insightful feedback have given me great encouragement and guidance throughout my journey. I appreciate that you are always patient and caring. I could not finish my PhD without your consistent support and compassionate mentoring.

I am thankful to Dr Taskin Nazim for his ongoing assistance, guidance, and detailed feedback on all my documents. I am also grateful for your family's caring.

I would like to acknowledge the guidance of my co-supervisor Associate Professor Shane Scahill. He is a great motivator, and his empathy and encouragement are of great value to me. I am indebted for his help in the stage of data collection. Without his strong network, I could not have got quality data for my study.

I would like to express my sincere appreciation to my co-supervisor Dr Ali Intezari Harsini to whom I am particularly indebted for the thesis writing stage. You were always available when I had doubts and gave me great encouragement. You gave me constructive feedback and provided a dedicated review of the drafts. You also helped fine-tune my writing.

I would like to thank my co-supervisor Dr Kasuni Weerasinghe. I appreciate your friendship and encouragement when I am in need. You have always listened to and given me valuable advice during my PhD journey. I would also like to thank Associate Professor Lynn Jeffrey, who was my primary supervisor in the first year of my study. I am thankful for your scholarly guidance and mentoring.

I appreciate the involvement of all the participants of this study, who have been very generous to spare their precious time to take part in interviews. Without their help, I would not have been able to gather data to complete my study.

My greatest gratitude goes to my parents (Mr Hoa and Ms Muc) and my sister who always love me unconditionally and support me in all my pursuits. Most of all, I owe the gratitude to my supportive, and patient husband Do Khoa, and my sweet son Duc Minh. You both are my profound source of inspiration throughout my PhD journey.

I would like to thank my PhD colleagues and the academic and staff of the School of Management, who have been kind to support me whenever I approached them. I am thankful for my friends for their time and support like family members when I was away from home: Hieu, Minh, Thu, Dung, Thao, Duc, Melika, and Jimmy.

Last but not least, I am indebted to the Vietnam International Cooperation Department (VIED), for funding my PhD study.

Table of Contents

List of Figures

List of Tables

Abbreviations

Auto-ID: Automatic Identification Technologies

ERP: Enterprise Resource Planning

IOIS: Inter-organizational Information System

Medsafe: New Zealand Medicines and Medical Devices Safety Authority

MNC: Multinational Corporation

Pharmac: New Zealand Pharmaceutical Management Agency

SCIV: Supply Chain Information Visibility

SCM: Supply Chain Management

Chapter 1: Introduction

1.1. Chapter Overview

This chapter sets the context for the thesis. Following an explanation of the research background and the pharmaceutical industry as the context, the research problems and research questions are presented. This is followed by the research significance and the research paradigm. Then, the thesis structure is outlined.

1.2. Research Background

In the context of rapidly changing and competitive business environments; effective supply chain management (SCM) is recognized as the critical determinant for the success of organizations (Lambert & Cooper, 2000; Simatupang, Wright, & Sridharan, 2002; Singh & Benyoucef, 2013). Mentzer et al. (2001, p. 8) define SCM as "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, to improve the long-term performance of the individual companies and the supply chain as a whole". With globalization, supply chains are becoming increasingly complex and vulnerable, and firms are more aware of the need to have better supply chain visibility (Barratt & Barratt, 2011; Brandon-Jones, Squire, Autry, & Petersen, 2014; Christopher & Lee, 2004; Kaipia & Hartiala, 2006b; Kim, Ryoo, & Jung, 2011; Lee & Whang, 2000; Mubarik et al., 2021; Somapa, Cools, & Dullaert, 2018; Swift, Guide Jr., & Muthulingam, 2019; Wei & Wang, 2010; Zhang, Goh, & Meng, 2010). Supply chain visibility is considered "an important determinant of supply chain competitiveness" (Kim et al., 2011, p. 668).

Supply chain visibility refers to "the capability of a supply chain player to have access to or to provide the required timely information from/to relevant supply chain partners for better

decision support" (Goh, De Souza, Zhang, He, & Tan, 2009, p. 2549). More specifically, it refers to the visibility of demand and inventory information across the supply chain (Barratt & Barratt, 2011; Brandon-Jones et al., 2014; Handfield, 2017; Messina, Barros, Soares, & Matopoulos, 2020; Sodhi & Tang, 2019). *While much literature has studied supply chain visibility in terms of the visibility of information flow (Goh et al., 2009; Handfield, 2017; Sodhi & Tang, 2019; Somapa et al., 2018; Williams, Roh, Tokar, & Swink, 2013), and the focus of this study is on information flow, henceforth the term "supply chain information visibility" (SCIV) is used instead of supply chain visibility to better emphasize the visibility of information flow in SCM addressed in this research.* SCIV about customer demands and inventory levels at a given time enhances operational efficiency and planning (Caridi, Crippa, Perego, Sianesi, & Tumino, 2010). In particular, improved visibility increases the accuracy of demand forecast, accelerates the adjustment of production plans to match changing demands, improves delivery performance, and reduces the amount of inventory in all levels of the supply chain (Somapa et al., 2018). In addition, SCIV from first-tier suppliers to end customers, so-called end-to-end visibility may help to mitigate the supply chain disruptions to the flows of materials and products through responsive decision-making to enhance supply chain resilience (the capacity to survive, adapt, and grow in the face of turbulent change) (Brandon-Jones et al., 2014; Mubarik et al., 2021; Wei & Wang, 2010; Yang, Xie, Yu, & Liu, 2021).

However, other studies find that SCIV does not guarantee a positive impact on business performance. Holcomb, Ponomarov, and Manrodt (2011) argue that only a few visibility factors significantly affect the market share, return on assets, and competitive position of firms. Also, Kim et al. (2011) find mixed results that from the suppliers' view, SCIV positively influences supply chain performance; however, from the buyer's view visibility does not influence the performance. Williams et al. (2013) and Wong, Lai, Cheng, and Lun (2015) posit that SCIV alone does not directly influence business performance unless the visible

information is effectively utilized. As such, there is a significant call for further studies to explore the relationship between SCIV and supply chain efficiency (Somapa et al., 2018).

In the supply chain context, organizations rely on experienced practitioners to make decisions to optimize specific objectives including optimizing the efficiency of any operations and processes, as related to competitiveness or costs (Gunessee & Subramanian, 2020; Ivanov, Tsipoulanidis, & Schönberger, 2019). Research on SCM has often been made based on assumed rules and interactions between rational decision-makers representing companies (Handfield, 2017). Rational decision-makers are thoughtful, well-reasoned, and thus grounded on logical analysis to make optimal decisions (Gunessee & Subramanian, 2020; Mantel, Tatikonda, & Liao, 2006). This normative decision-making would lead to the desired supply chain outcomes because of the optimal choices (Ivanov et al., 2019). However, extant literature shows that decision-makers tend to deviate from the optimal choices, resulting in unnecessary costs and operational inefficiencies (Perera, Fahimnia, & Tokar, 2020). It is because the extant SCM research has neglected many aspects of human behavior that underlie the supply chain operations, while supply chains are systems involving the complex motives, desires, wishes, or interactions of and between individual people (Handfield, 2017; Kaufmann, Meschnig, & Reimann, 2014; Perera et al., 2020). Thus, it is highlighted the critical impact of human decision-makers on supply chain operations, and the importance of understanding human behavior by integrating it in SCM studies (Carter, Kaufmann, & Wagner, 2017; Handfield, 2017; Stanczyk, Foerstl, Busse, & Blome, 2015).

Accordingly, to better understanding how SCIV influences supply chain efficiency, it is necessary to examine the human behavioral issues that underlie this relationship. However, to the best knowledge of the researcher, there is a paucity of behavioral studies in this research area.

Moreover, in the extant literature, SCIV is assumed to play a vital role in managing the pharmaceutical supply chain for two reasons (Chowdhury, Paul, Kaisar, & Moktadir, 2021; Klueber & O'Keefe, 2013; Papert, Rimpler, & Pflaum, 2016; Xu, Elomri, Kerbache, & Omri, 2020). First, the pharmaceutical supply chain is very complex, since pharmaceuticals are vital products and availability, and the accessibility of them are important issues for both companies and governments (Yousefi & Alibabaei, 2015). The pharmaceutical supply chain should provide medicines in the right quantity, with the acceptable quality, to the right place and customers, at the right time and with optimum cost to be consistent with the health system's objectives and also it should make benefits for its stockholders (Jaberidoost, Nikfar, Abdollahiasl, & Dinarvand, 2013). As such, the pharmaceutical supply chain is a highly regulated industry that is subject to a wide variety of institutional and regulatory pressures. These pressures challenge the supply chain members to ensure and prove correct pharmaceuticals manufacturing and handling practices throughout the entire chain. Consequently, pharmaceutical supply chains are forced to enhance SCIV (Papert et al., 2016; Zhang et al., 2010).

Second, the ongoing development of automatic identification (Auto-ID) technologies (such as bar codes, radio frequency identification, sensors) and the evolution of communication and localization technologies (such as XML, ebXML, EDI, Bluetooth, WiFi, WiMax) have become solutions for SCIV enhancements through the ability to capture and share real-time or near real-time data across the supply chain (Delen, Hardgrave, & Sharda, 2007; Musa, Gunasekaran, & Yusuf, 2014). In the pharmaceutical industry, the current regulations have forces supply chain members to capture and share the granular information of products and materials moving along the supply chain to prove the correct product manufacturing and handling (Musa et al., 2014; Zhang, Goh, & Meng, 2011). Therefore, SCIV based on Auto-ID technologies and

communication technologies is becoming crucial in pharmaceutical supply chain management (Ivanov & Dolgui, 2020; Klueber & O'Keefe, 2013; Musa et al., 2014; Papert et al., 2016). Given the important roles of SCIV, however, there is a dearth of empirical evidence of specific requirements for SCIV's characteristics and its implications in the pharmaceutical supply chain context. It is necessary to mention that the significance of studies exploring SCIV implications in the pharmaceutical supply chain has been enhanced due to the severe effects of the Covid-19 pandemic. Pharmaceutical supply chain actors are exposed to various disruptions. A supply chain disruption refers to "*the combination of an unintended and unexpected triggering event that occurs somewhere in the upstream supply chain (the supply network), the inbound logistics network, or the purchasing (sourcing) environment, and a consequential situation, which presents a serious threat to the normal course of business operations of the focal firm*" (Bode & Macdonald, 2017, p. 838). Specifically, the Covid-19 pandemic has brought the long-standing vulnerability of the pharmaceutical supply chain into sharp focus (Miller, Young, Dobrow, & Shojania, 2021). In the wake of the pandemic, the availability and production of pharmaceuticals are drastically reduced, while the demand for medications significantly increased (Kumar, Luthra, Mangla, & Kazançoğlu, 2020). The disruptions of the supply of medications needed to fight them and the supply of other critical pharmaceuticals have made negative consequences for public health (Keskinocak & Ozkaya, 2020; Miller et al., 2021). Under this circumstance, the researchers have called for empirical studies exploring strategies to encounter the effects of the pandemic, including supply chain visibility (Chowdhury et al., 2021). Several studies have posited that it is vital for pharmaceutical supply chains to enhance end-to-end visibility for quickly controlling the disruptions and supporting responsive decision-making (Ivanov & Dolgui, 2020; Xu et al., 2020; Yang et al., 2021). Building on the anecdotal evidence, empirical studies of implications of SCV in the pharmaceutical are crucially needed.

1.3. Research Problems and Research Questions

SCIV studies have often sought to develop theories that can explain as broad a range of phenomena as possible (Handfield, 2017). However, this focus on generalized theories may have led researchers to ignore "research that explains the peculiarities and context associated with industry-specific supply chains" (Handfield, 2017, p. 8). There are specific supply chains that do have unique characteristics that merit a different research approach such as oil and gas, hospital and patient care, financial services, food, and pharmaceuticals to achieve the best knowledge (Handfield, 2017).

As discussed in section 1.2, SCIV is considered to play a vital role in managing the pharmaceutical supply chain (Klueber & O'Keefe, 2013; Papert et al., 2016). However, conceptualizations of SCIV vary widely and lack clarity in the literature (Brandon-Jones et al., 2014; Caridi, Moretto, Perego, & Tumino, 2014; Somapa et al., 2018). Moreover, to the best of the researcher's knowledge, given the variety of studies that focus on defining SCIV significance, there is a paucity of empirical research on SCIV implications in the pharmaceutical supply chain. In response to the call for empirical SCM research that takes the unique peculiarities and industry-specific context into consideration (Handfield, 2017), this study examines supply chain practitioners' perceptions of the SCIV concept and its implications in the pharmaceutical supply chain context.

Particularly, in the extant SCIV literature, despite the availability of various SCIV definitions, there is a lack of a clear definition of the characteristics of SCIV in the pharmaceutical supply chain that might detain SCIV from further development and implementation across the entire supply chain (McIntire, 2014; Somapa et al., 2018). Therefore, the study examines how practitioners perceive supply chain information visibility in the pharmaceutical supply chain.

In addition, in the extant SCIV literature, supply chain information visibility has been defined as the capability to have access to or to provide the required timely information from/to relevant

supply chain partners for better decision support (Goh et al., 2009). SCIV is a desired capability in SCM that may affect performance through improving operational efficiency and reducing the effects of disruptions. It is known, however, that the specific impact of SCIV might be different from one firm to another (Holcomb et al., 2011; Kim et al., 2011; Williams et al., 2013). One of the reasons for such differences lies in the link between SCIV and the decision-making process.

Several studies have posited that SCIV itself does not necessarily influence business performance unless the visible information is effectively utilized to support the decision-making (Bode & Macdonald, 2017; Goswami, Engel, & Krcmar, 2013; Messina et al., 2020; Williams et al., 2013; Wong et al., 2015). Barratt and Oke (2007) explain that the first-order effects of SCIV are likely to be on decision-making processes and that improvements in business performance are likely to be the outcome of better-informed decision-making processes. SCIV allows decision-makers in the supply chain to understand what is going on across the supply chain, and allows them to interpret information and rapidly make better-informed decisions that in turn, leading to improved business performance (Barratt & Barratt, 2011; Bode & Macdonald, 2017; Handfield, 2017; Swift et al., 2019). While the lack of SCIV leads to negative effects because the supply chain decision-makers make decisions without having a detailed understanding of what is happening in the rest of the chain (Jain & Benyoucef, 2008).

However, there is an opposite opinion that information visibility does not guarantee good decisions because of human behavioral issues (Handfield, 2017; Williams et al., 2013). Golicic, Davis, McCarthy, and Mentzer (2002) warn that extremely high levels of visibility of information across the supply chain might lead to information overload because the organizations have access to more information than they are used to managing. In addition, the overwhelming information available across the supply chain potentially increases the level of

supply chain decision-making complexity (Manuj & Sahin, 2011). The information overload might lead to confusion and additional uncertainty as the decision-makers struggle with decisions regarding which information is important and how to interpret it (Bartlett, Julien, & Baines, 2007; Golicic et al., 2002). When individuals in organizations have too much information, they might face cognitive burdens when it comes to processing information during the decision-making process, resulting in sub-optimal decisions and thus ineffective performance (Cantor & Macdonald, 2009; Koka & Prescott, 2002).

Aside from a few anecdotes, however, the link between SCIV and quick, better-informed decision-making is assumed rather than tested. Therefore, it is an important call for unpacking the decision-making process and for a better understanding of how SCIV supports decision-making in the pharmaceutical supply chain. Consequently, this exploratory research investigates how supply chain professionals perceive SCIV and how they make operational decisions with the available information in the pharmaceutical supply chain context. Accordingly, this research addresses two main research questions:

1. How do supply chain professionals perceive information visibility in the pharmaceutical supply chain?
2. How do supply chain professionals make informed supply chain decisions?

The decisions investigated in this study are primarily operational supply chain decisions. In the supply chain context, the operational decision-making includes inventory management, demand forecasting, procurement, scheduling, and routing decisions (Gunessee & Subramanian, 2020). Operational supply chain decision-making is traditionally assumed to be a rational process based on objective criteria and rational decision models (Handfield, 2017; Knemeyer & Naylor, 2011). This view neglects many aspects of human behavior, company culture, and cognitive biases in the decision-making process (Handfield, 2017) because it is the individuals (and not firms or inter-firms) who determine to share and use information in making

supply chain decisions (Gunessee & Subramanian, 2020; Mantel et al., 2006; Zaheer & Trkman, 2017). Therefore, in this study, the operational decision becomes the context for understanding behavioral pharmaceutical supply chain decision-making.

1.4. Research Objective and Significance

The objective of this study is to use empirical data to develop a theoretical model that explains the contribution of SCIV to information-based decision-making. Particularly, this study aims to investigate how pharmaceutical supply chain practitioners perceive SCIV and how they "actually" make operational decisions that are traditionally rational decision-making. The model will conceptualize SCIV in the pharmaceutical supply chain, and how practitioners in the pharmaceutical supply chain utilize information visibility to make information-based operational decisions. The model is grounded in the pharmaceutical supply chain in New Zealand.

The significance of the present study can be summarised in the following ways.

First, this study attempts to contribute to the SCM literature by investigating SCIV from the perspective of practitioners in the pharmaceutical supply chain who are responsible for making operational supply chain decisions. The SCIV construct thus is developed from empirical data. As such, SCIV emerges as a multi-level construct encompassing the internal and external SCIV with the defined characteristics. The external SCIV refers to a firm having SCIV of its external environment including customers and suppliers, while internal visibility refers to having SCIV within a firm boundary. This finding adds empirical evidence to the prior theoretical studies that have largely neglected the internal SCIV.

This research contributes to the behavioral operations management research literature by introducing a theoretical model, which is grounded in the field data (Figure 6.2). The theoretical model emerging from this research describes the behavioral supply chain decision-making

process in the pharmaceutical supply chain, based on the existence of a given level of SCIV. It describes how supply chain practitioners incorporate visible information in the supply chain decision-making process at the individual level instead of at the firm level or decision level in the extant supply chain decision-making literature. The pharmaceutical supply chain information-based decision-making is a bounded rationality decision-making process in which the individual decision-maker is bounded in their ability to acquire and process information and contextual realities. Supply chain practitioners make information-based decisions in which they conduct an informative engaging mechanism with technological tools, with relevant stakeholders, and with themselves. Thus, the decision-making process involves extensive data analysis along with the crucial support of experience-based intuition and relevant stakeholders' engagement. Another key contribution of this study is the identification of the constructive aspect of political behaviour in the supply chain decision-making process in which relevant stakeholders when invited to engage in the process tend to positively contribute and buy into the decision.

As for the practical implications of this study, the conceptualization of the SCIV construct encompassing internal and external visibility provides a guideline for the pharmaceutical supply chain actors in their SCIV implementation and development. They need to build SCIV on both internal and external levels realize SCIV benefits in supply chain operations. Particularly, building exception visibility is of vital importance for effectively managing risks in the pharmaceutical supply chain. Furthermore, the descriptive model of pharmaceutical supply chain information-based decision-making is hoped to serve as a useful guide to inform the decision-makers in practice of the approach to make informed pharmaceutical supply chain decisions. Especially, when making a decision with limited information, better supply chain decisions can be made if the decision-maker engages multiple stakeholders and encourage

constructive perspectives and discussion to make sure the decision-makers aren't missing any important information and ideas.

1.5. Structure of the Dissertation

This section presents the structure of this dissertation. The dissertation contains seven chapters that are grouped into five parts (Table 1.1). Part 1 introduces an overview of the study and presents a review of the extant literature. Part 2 describes the research methodology. Part 3 presents and discusses the findings. And Part 4 concludes the study with implications, limitations, and suggestions for future research. The seven chapters are outlined as follows:

Part 1: Introduction and Literature Review

Part 1 consists of two chapters; the Introduction and the Literature Review chapters.

Chapter 1 provides an overview of the research background, research context, and the research problems and questions. The chapter also discusses the research objectives and significance and provides the thesis structure.

Chapter 2 first presents an overview of the literature search and review method. This is followed by a review of the supply chain management and the supply chain information visibility (SCIV) literature. Then, management decision-making theories and the different aspects of the decision-making process are elaborated. Finally, a review of the managerial pharmaceutical supply chain is presented. As such, the chapter addresses the gaps that emerged from the review of the SCIV and decision-making literature.

Part 2: Research Methodology

Part 2 includes the Methodology chapter.

Chapter 3 presents the research methodology. The chapter explains the research philosophy first and the research method. In the research method section, the constructive grounded theory, as well as the data collection and analytical process are described. This is followed by an

explanation of the scientific rigor of the study. The ethical considerations of this research are also discussed.

Part 3: Findings and Discussion

Part 3 consists of three chapters. Chapter 4 and chapter 5 present the empirical findings that address RQ1 and RQ2, respectively. Chapter 6 discusses the findings and introduces the Pharmaceutical Supply Chain Information-based Decision-making.

Chapter 4 presents the findings to address Research Question 1: How do supply chain professionals perceive the SCIV state in the pharmaceutical supply chain? In this chapter, the findings of the information-based decision-making process and its aspects are presented. The aspects include *engaging with technological tools, engaging with relevant stakeholders,* and *engaging with self.*

Chapter 5 reports the findings to address Research Question 2: How do supply chain professionals make informed supply chain decisions? In this chapter, the findings of the three phases of the information-based decision-making process are presented. The three phases include *informing, option generating* and *aligning.*

Chapter 6 discusses the findings that have been presented in Chapter 4 and Chapter 5. The chapter discusses two levels of information visibility: internal and external. The chapter also introduces the emergent model of Pharmaceutical SC Information-based Decision-making is introduced.

Part 4: Conclusion

Part 4 consists of one chapter concluding the dissertation.

Chapter 7 presents the conclusions of the study. This chapter provides an overview of the research project and highlights the theoretical contributions and managerial implications of the study. The limitations of the study are then underscored, and some directions for future research are presented. Table 1.1 outlines the structure of the dissertation.

Table 1.1. Structure of The Dissertation

Part 1: Introduction and Literature Review
Chapter 1: Introduction Reviews the context of the study and outlines the research objectives and research questions.
Chapter 2: Literature Review – Supply Chain Information Visibility and Decision-Making Reviews the concept of SCIV and managerial decision-making theories. It also includes an introduction to the pharmaceutical supply chain context.
Part 2: Research Design
Chapter 3: Research Methodology Adopts a philosophical stance and presents the research design.
Part 3: Findings and Discussion
Chapter 4: Findings – RQ 1 Presents the findings to address the Research Question 1.
Chapter 5: Findings – RQ 2 Presents the findings to address the Research Question 2.
Chapter 6: Discussion Presents and discusses the empirical findings and develops a novel theoretical model.
Part 4: Conclusion
Chapter 7: Conclusion Addresses the research objectives and presents theoretical and practical implications.

1.6. Chapter Summary

This chapter outlined the main research backgrounds, research problems, and objectives as well as the research questions of the study. This chapter also explained the significance of this study. These sections were followed by the introduction of definitions for the terms that are used throughout the study. This chapter also presented the structure of the thesis and provided a representation of the structure. In the next chapter, the main theoretical underpinnings adopted for the study are discussed.

Chapter 2: Literature Review - Supply Chain Information Visibility and Decision-making

2.1. Chapter Overview

This chapter introduces two bodies of literature: supply chain management and decision-making theory. Supply chain management and decision-making theory are both well-established and widely researched fields, and each research field has a distinct origin and research focus. This chapter begins with an overview of the supply chain literature. The second section reviews SCIV. The third section reviews decision-making theory literature. The fourth section introduces the empirical domain of supply chain management in New Zealand. The last section presents the conclusion of this chapter. Thus, the objective of the chapter is to:

- Examine the literature on supply chain management, with a focus on supply chain information visibility, and managerial decision-making theories.
- Introduce the empirical domain of supply chain management in New Zealand.
- Identify critical knowledge gaps in the literature.

2.2. Literature Search and Review Method

An initial exploratory search of the literature was conducted to define the scope of the literature. The sources used included electronic databases (Scopus, Business Source Complete, Web of Science, Google Scholar, and Google Books) and Massey University library. The following keywords were used in the literature search:

1. Supply chain visibility, information visibility.
2. Information sharing, information quality, information flow, information integration.
3. Information technology, Information systems in supply chain management.
4. Pharmaceutical supply chain, pharmaceutical firms.

5. Supply chain management in New Zealand.
6. Decision-making theory, decision-making process, data-driven decision-making.
7. Decision types, supply chain decisions.

These keywords were applied separately and in combination to search the literature in electronic databases and identify references in which keywords were used in any of the data fields, including title, abstract, and keywords. The language used was English. The abstract of each reference was read to establish its relevance to the study.

In the initial search and review, references were found in multiple bodies of literature, including organizational and individual decision-making theories, information sharing, supply chain information systems, pharmaceutical supply chain management, and others. Considering the wide range of literature, it was necessary to consider inclusion and exclusion criteria to establish a clear scope of this study.

As discussed in section 1.4., this study aims to fill the gap in the literature of SCIV and behavioral decision-making, by broadening the understanding of the interaction between SCIV and individual decision-making process. Accordingly, criteria were set to include mainly the references in supply chain management and decision-making theory.

2.3. Supply Chain Management and The Pharmaceutical Supply Chain

2.3.1. Supply Chain Management Definition

Perera, Hurley, Fahimnia, and Reisi (2019, p. 574) define a supply chain as “a network of stakeholders (e.g., retailers, manufacturers, suppliers) who collaborate to satisfy customer demand. This involves the movement of materials, money and information/data flow across the supply chain”. Pedroso and Nakano (2009, p. 379) consider a supply chain to involve “all operations undertaken by the stakeholders to source, produce, process, store, and/or transport goods or services to end customers”. This includes all activities from the acquisition of raw

materials upstream in the supply chain, through to manufacturing and warehousing, and eventually to the logistics to deliver products to retailers and consumers.

The concept of supply chain management (SCM) starts to develop in literature as a scholarly study in the early 1990s (Arshinder, Kanda, & Deshmukh, 2008). The original view of the supply chain has an intra-organizational focus and concentrated primarily on the integration of internal functions of the firm (Flynn, Huo, & Zhao, 2010). The scope of supply chain management has broadened over time to focus on inter-organizational issues (Koufteros, Vonderembse, & Jayaram, 2005). Mentzer et al. (2001, p. 8) define SCM as "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, to improve the long-term performance of the individual companies and the supply chain as a whole".

SCM consists of internal and external management level (Chen & Paulraj, 2004b) (Figure 2.1). The internal level of SCM encompasses the planning and control management of materials and information flows through different processes within a firm, whereas the external level of SCM refers to management of a series of relationships among firms working together and mutually sharing information, risks, and rewards (Chen & Paulraj, 2004b).

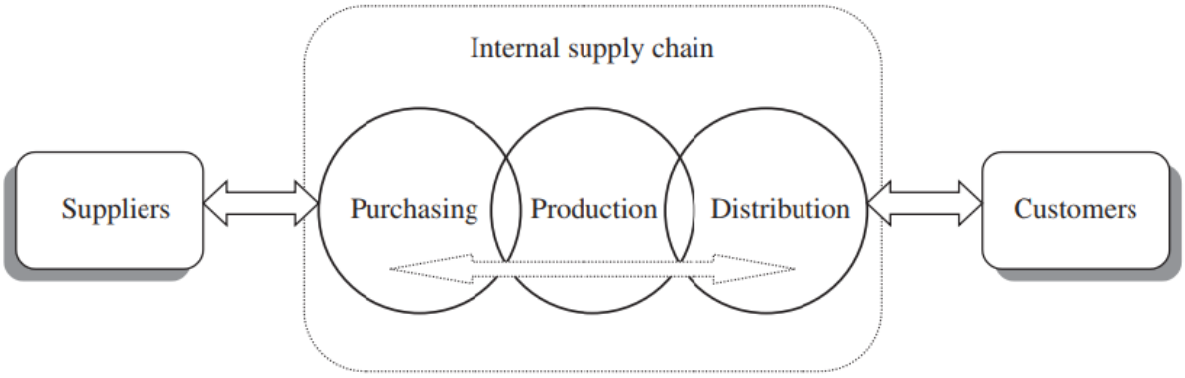

Figure 1.1: A Firm's Supply Chain (Chen & Paulraj, 2004b, p. 132)

2.3.2. Supply Chain Management in New Zealand

New Zealand, or Aotearoa in Te Reo Māori (the Māori language), is an island country in the southwestern Pacific Ocean. New Zealand is a relatively small and geographically isolated country. Small and medium-sized businesses make up most businesses in New Zealand. Overall, 97% of businesses in New Zealand are small with less than 20 employees. 70% of New Zealand firms have zero employees. The small business sectors employ 29% of the New Zealand workforce and contribute over a quarter of New Zealand's GDP (Ministry of Businesses, Innovation, and Employment, 2017). The economy mainly relies on the export market as the domestic market is rather limited. Maintaining good relationships with customers from different countries and satisfying their requirements are the key factors to influence the success of their businesses (Luo, Shi, & Venkatesh, 2018). Moreover, due to its geographical isolation, the level of supply chain integration and information management affects the responsiveness to market demand (Basnet, Childerhouse, Foulds, & Martin, 2006). An efficient logistics service facilitates New Zealand organizations to deliver goods to the customers on time, in both domestic and overseas markets (Luo et al., 2018).

Supply chain management research is limited and still in its infancy in New Zealand apart from some literature on supply chain integration within New Zealand settings (Basnet, 2003; Basnet & Wisner, 2012; Boehme, Childerhouse, Deakins, & Towill, 2011; Clare, Shadbolt, & Reid, 2002; Luo et al., 2018; Msimangira & Venkatraman, 2014; Vilasini, Neitzert, Rotimi, & Windapo, 2012). Basnet et al. (2006) pointed out that to advance supply chain management practices in New Zealand, more research in this field needs to be undertaken.

A study by Closs and Mollenkopf (2004) identified distinct features of the New Zealand context involving New Zealand's societal norms that are carried over into SCM, such as a consensus style of leadership; evidence of standard operating procedures (SOPs), forecasting, and other models; and supplier relationships aimed at reducing supply chain uncertainty; also

a prevalent silo approach to managing the organization. Regarding the uptake of the supply chain management concept in practice, Wilson and Sankaran (2001) reported that New Zealand's local manufacturers are lagging behind their overseas counterparts in many key areas of supply chain management. Basnet (2003) supported these findings by highlighting that the latest theoretical supply chain developments are poorly understood and reported an equally disappointing uptake in New Zealand firms. Basnet (2003) used a postal survey of New Zealand manufacturers to benchmark their SCM practices. The top three key issues hindering SCM were: suppliers' geographical distance, lack of sophisticated information systems, lack of ability in managing inventories throughout the entire supply chain. The geographical isolation of New Zealand from global markets provides a significant challenge to SCM activities. Even when there is a strong motivation for a New Zealand firm to adopt SCM, the small size of New Zealand firms often makes it very difficult to pull all the supply chain members into the implementation (Basnet et al., 2006).

Among the limited number of SCM studies in New Zealand, most of them studied supply chain integration, especially on the internal level, and factors that influenced supply chain excellence. Basnet et al. (2006) pointed out that there have been constant theoretical findings and developments which have enabled organizations to improve supply chain performance internationally. However, such developments are poorly understood and matched by an equally disappointing uptake in New Zealand. Similarly, Boehme, Childerhouse, and Corner (2007) report poor supplier relationship management practices by many New Zealand companies, resulting in weak linkages with key suppliers. In another study of Australian and New Zealand logistics competence, Mollenkopf and Dapiran (2005) concluded that firms in these countries tend to be working on their internal logistics/supply chain processes and generally lack externally orientated capabilities. Basnet and Wisner (2012) concluded that line manager encouragement and joint accountability among internal departments for shared goals are the

two main factors that enhance internal supply chain integration. Meanwhile, they found that informal interaction and enterprise-wide computer systems (ERP) did not have any significant effect on internal supply chain integration and suggested the effect of ERP systems on internal integration needs to be studied further. Boehme, Childerhouse, Deakins, and Corner (2008) concluded that New Zealand organizations face high uncertainties and therefore are weakly internally and externally integrated. Six common root causes for the low level of integration have been identified: poor knowledge management, functional silos, weak operation processes, multiple independent information systems, human resources, and lack of strategic supplier relationship management.

In the same vein, Luo et al. (2018) explored factors enabling supply chain excellence and found that human factors outweighed information systems' influence on achieving excellence. Luo et al. (2018) further explained that New Zealand firms do not rely on information systems to help them achieve supply chain integration while previous studies in other contexts suggested the significance of both human factor and information systems adoption to achieve comprehensive supply chain integration (Chen & Paulraj, 2004a; Koçoğlu, İmamoğlu, İnce, & Keskin, 2011; Prajogo & Olhager, 2012). According to Luo et al. (2018), there are two reasons that explain this contradiction. First, most New Zealand firms rely more on personal communication (via cell phone or email) to organize cooperative schedules and information sharing. Therefore, advanced information systems do not bring significant change to their business and supply chain integration. Second, New Zealand firms generally have limited resources (financial resources and human resources). As a result, they do not have enough financial resources to invest in advanced systems. Also, most New Zealand firms have already been used and set with traditional business processes, so that they are reluctant to change from traditional to advanced SCM style. As a result, a large number of owners and senior managers

are lacking the ideas and motivation to go for advanced information systems to achieve supply chain integration and excellence (Luo et al., 2018).

Improved SCM capability is critical to many New Zealand firms, which are often distant from their suppliers and markets, in their efforts to compete in ever more demanding business environments (Childerhouse, 2011; Luo et al., 2018). New Zealand supply chain managers along with their external partners are being confronted with growing competition, pervasive change, relentless advances in technology, ever-shorter life cycles, and alterations to the openness of markets (Luo et al., 2018). Technological advances and economic development have increased market opportunities but also created more national and international competitors and, increasingly, greater expectations from customers (Childerhouse, 2011). Thus, further study in supply chain management in the context of New Zealand is highly required to contribute to improvement in SCM excellence (Childerhouse, 2011). Basnet et al. (2006) pointed out that, to advance supply chain management practices in New Zealand, more research in this field needs to be undertaken.

2.3.3. The Pharmaceutical Supply Chain

The pharmaceutical supply chain can be defined as ‘‘the integration of all activities associated with the flow and transformation of drugs from raw materials through to the end-user, as well as the associated information flows, through improved supply chain relationships to achieve a sustainable competitive advantage’’ (Uthayakumar & Priyan, 2013, p. 52). According to Burns (2002), the pharmaceutical supply chain can be conceptualized as composed of five main actors: (a) health care producers: manufacturing and service companies, including pharmaceutical and biotechnology manufacturers, medical device makers, medical suppliers, and information technology firms; (b) health care product intermediaries: wholesalers, mail order distributors, and group purchasing organizations; (c) health care providers: hospitals,

physicians, integrated delivery networks and pharmacies; (d) health care fiscal intermediaries: insurers, health maintenance organizations and pharmacy benefit managers; (e) purchasers: government, employers, individuals, and employer coalitions.

Pharmaceuticals play a crucial role in the healthcare industry due to the significant costs of the products and their storage and control requirements. They can be expensive to purchase and distribute. Effective management of pharmaceuticals is required to ensure 100% product availability at the right time, at the right cost, in good condition to the right customers. The pharmaceutical industry refers to the complexities of processes, operations, and organizations involved in the discovery, development, manufacture, and distribution of drugs and medications (Shah, 2004). Generally, pharmaceutical products can be expensive to purchase and distribute, but shortages of essential medicines, improper use of medicines, and spending on unnecessary or low-quality medicines also have high cost-wasted resources and preventable illness and death (Priyan & Uthayakumar, 2014).

According to Shah (2004), the pharmaceutical supply chain is very complex and carries high responsibility in ensuring that the right drug reaches the right people at the right time and in the right condition to fight against disease and suffering. Medical products are relevant to patients' lives; therefore, the pharmaceutical industry is highly regulated (Papert et al., 2016). The pharmaceutical industry is subject to many regulatory pressures – such as drugs coming off patent, competition from generic drugs, acquisitions, and mergers of corporate entities within the industry, compliance requirements from regulatory agencies, and volatile non-technical issues (such as forecasting and demand planning) (Shah, 2004). Thus pharmaceutical firms are challenged to carry redundant inventory in the supply chain to ensure a fill rate close to 100% while suffer from the risk of high costs for warehousing and product write-off (Priyan & Uthayakumar, 2014). On the supply side, pharmaceutical companies have a limited qualified supplier pool. Consequently, pharmaceutical firms are exposed to risks if they want to change

a supplier. Moreover, if the suppliers are geographically spread, they are also vulnerable to changes in policies and regulations in those countries. On the demand side, they must strive to become more responsive to the changing needs of consumers (Shah, 2004).

Product perishability is a critical issue in pharmaceutical supply chains (Priyan & Uthayakumar, 2014). Pharmaceutical supply chains must comply with good pharmaceuticals manufacturing and handling practices for assurance of quality and 100% availability (Jaberidoost et al., 2013; Papert et al., 2016; Shah, 2004). According to Uthayakumar and Priyan (2013), pharmaceuticals are required to be manufactured, stored, and distributed to the prescribed standards, or else they will become ruined. Other concerns with pharmaceuticals are the cost of expired products and the consequences of neglected dispensing outdated items to patients that could have potentially disastrous effects on both inpatient care and public relations (Priyan & Uthayakumar, 2014). The pharmaceutical supply chains concern with not only the regulatory compliance, product quality, and expiry but with being more responsive to the changing needs of consumers (Shah, 2004).

The increased complexity of supply chain networks, high customer expectations, shorter product, and technology life cycles, and an unstable environment have made pharmaceutical supply chains expose to enormous uncertainties and risks (Wang & Jie, 2020). Any risks (e.g. product discontinuity, product shortages, poor planning, demand uncertainty) could hamper the pharmaceutical supply chain in increased cost due to waste the resources and threatening the patients' life by disrupting access to medicines (Jaberidoost et al., 2013). The supply chain risks have hindered firms from achieving on-time delivery, increasing customer satisfaction, improving efficiency, and reducing costs to the degree that managing supply chain risks has become a top priority in many pharmaceutical firms (Wang & Jie, 2020).

Given the characteristics of the pharmaceutical supply chain, supply chain visibility is believed to be an important determinant of supply chain efficiency (Goh et al., 2009; Papert et al., 2016;

Xu et al., 2020; Yu & Goh, 2014; Zhang et al., 2010). The invisibility into the supply network can hamper a firm's capacity to respond to any supply disruption and to ensure supply continuity (Esper, 2021). Consequently, the pharmaceutical supply chain is the suitable context to explore the implications of supply chain information visibility.

2.3.4. Behavioral Operations Management

The field of behavioral operations management has emerged due to the growing call for understanding human behaviour in operation activities (Bendoly, Donohue, & Schultz, 2006; Perera et al., 2020). Behavioral operations management is a promising and emerging research domain within the field of operations management. Most behavioral operations research concerns the effects of cognitive biases, personal and social preferences, and cultural norms on decision-making in operations management. There have been some attempts to define the scope of behavioral operations research. Fahimnia, Pournader, Siemsen, Bendoly, and Wang (2019, p. 1128) listed some of the broader and more popular definitions are as follows.

- Behavioral operation is a multi-disciplinary branch of operations management that explicitly considers the effects of human behaviour in process performance, influenced by cognitive biases, social preferences, and cultural norms (Loch & Wu, 2007).
- Behavioral operation research is the study of attributes of human behaviour and cognition that impact the design, management, and improvement of operating systems, and the interaction between such attributes and operating systems and processes (Gino & Pisano, 2008).
- Behavioral operation is the study of potentially non-hyper-rational actors in operational contexts; at its simplest form, it must-have elements of both operations and behaviour (Croson, Schultz, Siemsen, & Yeo, 2013).

- Behavioral operation aims at understanding the decision-making of managers and using this understanding to generate interventions that improve supply chain operations (Katsikopoulos & Gigerenzer, 2013).

Human characteristics play an important role in determining the operational outcomes related to time, quality, and profitability (Bendoly, Croson, Goncalves, & Schultz, 2010). Meanwhile, the entire process involves humans including the workers who strive to improve the practices. Human beings are highly self-interested and rationally bounded in terms of ability and capacity to understand and process the information they have (Simon, 1955). People's judgments and choices are affected as a consequence of these cognitive limitations in the form of errors and biases (Fahimnia et al., 2019).

The research in operations management has been late to incorporate the human element into its works as the field has conventionally inherited a rational choice paradigm. The concepts of rationality and optimality are central to normative theories (Perera et al., 2019). Much of the extant literature fails to understand that operation management relates to more than just developing models and solution methods, but it is also to recognize that these models are heavily influenced by the humans that use them. This has led to the emergence of behavioral operations management as a sub stream of operations management. Behavioral operations management scrutinizes the indispensable human decision-makers associated with a system/process in operations management (Brocklesby, 2016; White, 2016).

Evidence suggests that operations management decisions are made by a human, and human decision-making is "bounded" in its ability to acquire and process information and that purely normative (rational) models and theories can lead to systematic errors in explaining and predicting human behaviour (Mantel et al., 2006; Thaler, 1980). Thus, investigating and understanding behavioral issues in multiple facets of decision-making has become an important research area (Hämäläinen, Luoma, & Saarinen, 2013), with theoretical constructs and

empirical phenomena drawn from fields such as cognitive psychology, social psychology, group dynamics, and system dynamics (Bendoly et al., 2010). A variety of research studies in operations management related problems including revenue management, supply chain management, product development, procurement, quality management, strategic sourcing, risk analysis, negotiations, auctions, bargaining systems, and process improvement have looked into its behavioral aspect (Croson et al., 2013).

Behavioral operations management is argued to be a bridge that connects academic operations management with the practitioners who use their models and approaches (Fahimnia et al., 2019). The industry often faces implementation challenges that usually exceed those illustrated in textbooks. Decision-making in such contexts is fertile ground for behavioral operations management research (Brocklesby, 2016). Becker (2016) highlights the need to expand the behavioral operations management literature using descriptive, methodological, and technological contributions. Contributions stemming from both a theoretical and empirical perspective are vital for academic and industry insights (Becker, 2016; Perera et al., 2019).

In addition, behavioral issues, especially in terms of behavioral decision-making, have significant relevance and importance for inter-organizational operational decision contexts that involves the collaboration of representatives from multiple parties including suppliers, intermediaries, third-party service providers, and customers, (i.e. human decision-makers at multiple firms) (Donohue, Özer, & Zheng, 2020; Fahimnia et al., 2019; Tokar, 2010). The practical nature and the vast amount of human interaction in inter-organizational context imply that these fields should be at the forefront of behavioral research. Thus, there is tremendous potential for realizing significant benefits to practice and developing rich theory in the SCM research area from the incorporation of behavioral research (Donohue et al., 2020).

2.4. Supply Chain Information Visibility

2.4.1. Defining Supply Chain Information Visibility

Supply chain information visibility (SCIV) is an emerging topic in both supply chain practice and academia (Goh et al., 2009; Goswami et al., 2013). It receives increasing attention as more companies realize its importance. However, conceptualizations of SCIV vary widely and lack clarity in the literature (Brandon-Jones et al., 2014; Caridi et al., 2014; Somapa et al., 2018).

It is important to note that, SCM includes the three flows of information, material, and financial flows of which information flow has become increasingly important in managing supply chain with the rapid development of information technologies and growing complexity of supply chains. Supply chain information flows can be divided into upstream flows, from retailers toward producers, and downstream flows, from producers toward retailers (Sahin & Robinson, 2002). Both upstream and downstream information flows are crucial for both simple and complex supply chains. The upstream flow may comprise information ranging from order details to the sharing of customer requirements and strategic decisions, whilst the downstream flow may comprise product details, product origin and destination, detailed shipment, and invoicing information (Sahin & Robinson, 2002). Information flow objectives include the desire for cost savings through inventory reduction, decreased order magnification, and reduced time delays in fulfilment (Lee & Whang, 1999). Also, Stenmark (2002) argued that data, information, and knowledge are interwoven. Thus, in this study, information is defined as not only information but also data with relevance and purpose and as the knowledge that can be articulated and easily transmitted across parties (i.e., explicit knowledge). This definition is in line with Kembro and Näslund (2014) who suggest that information sharing covers not only sharing information but also sharing data and knowledge that are up-to-date, relevant, and useful for the other partners in supply chains.

Early attempts to define SCIV take an information perspective. This perspective concerns the quality of the exchanged information in the supply chain (Somapa et al., 2018). Kaipia and Hartiala (2006a, p. 377) define SCIV as "[…] the sharing of all relevant information between supply chain partners, also over echelons in the chain," which emphasizes that SCIV only results from the sharing of meaningful information between all relevant supply chain actors. Williams et al. (2013, p. 543) perceive SCIV as the result of inter-organizational integration and referred to "the access to high-quality information that describes various factors of demand and supply". Williams et al. (2013) further emphasize that visibility pertains to the quality of specific types of information that is achieved from information sharing processes between supply chain partners. Barratt and Oke (2007, p. 1230) define SCIV as "the extent to which actors within a supply chain have access to or share the information which they consider as key or useful to their operations and which they consider will be of mutual benefit". Both Barratt and Oke (2007) and Williams et al. (2013) agree that, for shared information to provide visibility of a high quality, it must be accurate, timely, complete, and in a useful format. Wang and Wei (2007, p. 652) define SCIV as the degree to which supply chain partners have on-hand information related to demand and supply for planning and control. Thus, visibility is conceptualized as the outcome of inter-organizational information sharing and has a range of levels determined by the amount of useful information that is shared across the supply chain. Francis (2008) further describe which information should be shared to achieve SCIV. SCIV refers to "the identity, location, and status of entities transiting the supply chain, captured in timely messages about events, along with the planned and actual dates/times for these events" (Francis, 2008, p. 182).

Other studies define SCIV from an information systems perspective that underline the role of information systems as an enabler to acquire and distribute information among supply chain members (Somapa et al., 2018). Tohamy, Orlov, and Herbert (2003) propose SCIV as the

ability to access or view relevant data or information as it relates to logistics and the supply chain. Brusset (2016, p. 49) describe SCIV as "the abilities of an enterprise resource planning (ERP) system together with other supply chain management software, tracking and tracing of goods flows, reporting tools, and web collaborative platforms to track, report, and plan collaboratively amongst supply chain actors". Kim et al. (2011, p. 667) specifically propose inter-organizational information systems (IOIS) visibility as "the extent to which information/knowledge related to supply chain cooperation from partner firms is visible to the focal firm through the inter-organizational information system (IOIS)". According to Kim et al. (2011), IOIS provides a focal company with an electronic channel through which it can instantly see the information of supply chain partners without incurring significant costs for transactions. IOIS visibility allows channel partners to update about changes across the supply chain and to adapt flexibly to changing circumstances cooperatively. Musa et al. (2014) and Papert et al. (2016) emphasize the visibility of the object (e.g. an item, a package, a pallet, or a container) that moves through the supply chain using automatic identification technologies. Papert et al. (2016, p. 862) define SCIV as "resulting from gathering and sharing object information and from applying an appropriate Auto-ID technology". Papert et al. (2016) detail four dimensions of the object information include availability, identity, position, and status quo.

In addition, there has been an upsurge of academic interest in defining SCIV from the transformational perspective that refers to the use of shared information to create business value (Somapa et al., 2018). The first group relates to information from supply chain partners is shared and utilized to track, plan, and monitor the business operations for the improvement in operational efficiency. The second group indicates the use of shared information for the improvement in strategic competencies.

In business operations, information is considered useful if it creates “visibility that leads to meaningful operational benefits and enhanced business activities” Barratt and Barratt (2011, p. 515). From the transformational perspective, SCIV is a vital capability that enables a firm to improve the operational efficiency and reduces its exposures to risks (Sodhi & Tang, 2019).

There are numerous studies that define SCIV as having end-to-end visibility in which the information from supply chain partners is shared and utilized to track, plan, and monitor the supply chain operations for effectively managing risks . Tse and Tan (2012, p. 51) describe SCIV as “the visibility is gained by knowing what is going on in other parts of the chain such as finish goods inventory, pipeline inventory, order status, etc.”. Nooraie and Mellat Parast (2015, p. 192) define SCIV as “the capability of sharing on-time and accurate data on customer demand, amount and location of inventory, cost of transportation, and other logistics dimensions throughout an entire supply chain to detect and respond to both supply and demand risks”. By enabling end-to-end SCIV, many situations that could lead to disruptions in the supply chain can be identified and defused long before they reach a critical state (Nooraie & Mellat Parast, 2015). Brandon-Jones et al. (2014, p. 59) define end-to-end visibility as “having visibility of information flows concerning inventory and demand levels within the supply chain at a given time”, that in turn contributes to reducing the effects of supply chain disruptions. Similarly, Mubarik et al. (2021, p. 4) understand SCIV as “the acquisition and evaluation of supply chain information that helps in controlling supply chain disruption risks and improves decision-making”.

Moreover, there are studies that define SCIV as having end-to-end SCIV in which the information from supply chain partners is captured and distributed by using information systems to sense and respond to supply chain disruptions. define SCIV as having end-to-end SCIV in which the information from supply chain partners is shared and utilized to track, plan, and monitor the supply chain operations for effectively managing risks. The study of McCrea

(2005) describes SCIV as the ability to be alerted to exception events in supply chain execution (sense), and enable action based on this information (respond). Similarly, Vitasek (2006) describes SCIV as the software applications that permit monitoring events across a supply chain. These systems track and trace inventory globally on a line-item level and notify the user of significant deviations from plans. SCIV is also understood as a unified detailed view of inventory positions and in-transit shipments in the inter-firm logistics process and the alerts on critical events by using information systems (Rai, Pavlou, Im, & Du, 2012). More specifically, Rai et al. (2012) describe the information systems' functionality in capturing granular, detailed information on events and the status of stocks and flows of shipments in the interfirm logistics process, integrating information on buyer's inventory positions and flow of goods across multiple locations, and cascading alerts on exception events that have occurred or are expected to occur across the supply chain.

In addition to having risk management benefits, SCV is considered as a capability that improves supply chain decision-making. Handfield (2017, p. 4) define SCIV as "…Visibility allows individuals to see what is going on, and in an empowered ways, allows these individuals to interpret information and rapidly make decisions in response to data". Goh et al. (2009, p. 2549) conceptualize SCIV as "the capability of a supply chain player to have access to or to provide the required timely information/knowledge about the entities involved in the supply chain from/to relevant supply chain partners for better decision support". In the same vein, Goswami et al. (2013, p. 279) define SCIV as "having access to relevant information that can be used for various SC-related decision-making".

Table 2.1: Definition of Supply Chain Information Visibility

Author	Definition
Information Perspective	
Wang and Wei (2007, p. 652)	"The degree to which supply chain partners have on-hand information related to demand and supply for planning and control."
Kaipia and Hartiala (2006a)	"The sharing of all relevant and meaningful information between supply chain partners, also over echelons in the chain."
Williams et al. (2013, p. 543)	"The access to high-quality information describes various factors of demand and supply."
Tohamy et al. (2003) as cited in (Goh et al., 2009, p. 2548)	"The ability to access or view relevant data or information as it relates to logistics and the supply chain."
Barratt and Oke (2007, p. 1230)	"The extent to which actors within a supply chain have access to or share the information which they consider as key or useful to their operations and which they consider will be of mutual benefit."
Francis (2008, p. 182)	"The identity, location, and status of entities transiting the supply chain, captured in timely messages about events, along with the planned and actual dates/times for these events."
IT Perspective	
Brusset (2016, p. 49)	"Capability of integrated tools of Information Technology (IT) which enhances inter-organizational integration and coordination through information systems."

Kim et al. (2011, p. 667)	"The extent to which information/knowledge related to SC cooperation from partner firms are visible to the focal firm through the inter-organizational information system."
Jeyaraj and Sethi (2012, p. 4)	"The ability to access or view pertinent data or information as it relates to logistics and supply chain, regardless of the point in the supply chain where data exists."
Papert et al. (2016, p. 862)	"Result from information gathering and sharing and from applying an appropriate Auto-ID technology."
Transformational Perspective	
Brandon-Jones et al. (2014, p. 59)	"Information flows concerning inventory and demand levels within the supply chain at a given time."
Tse and Tan (2012, p. 51)	"The visibility is gained by knowing what is going on in other parts of the chain such as finish goods inventory, pipeline inventory, order status, etc."
Nooraie and Mellat Parast (2015, p. 192)	"The capability of sharing on-time and accurate data on customer demand, amount and location of inventory, cost of transportation, and other logistics dimensions throughout an entire supply chain to detect and respond to both supply and demand risks."
Mubarik et al. (2021, p. 4)	"The acquisition and evaluation of supply chain information that helps in controlling supply chain disruption risks and improves decision-making."
McCrea (2005)	The ability to be alerted to exceptions in supply chain execution (sense), and enable action based on this information (response). In essence, visibility is a sense and response system for the supply chain based on what is important in the business.

Vitasek (2006)	"Software applications that permit monitoring events across a supply chain. These systems track and trace inventory globally on a line-item level and notify the user of significant deviations from plans."
Rai et al. (2012, p. 239)	"A unified detailed view of inventory positions and in-transit shipments in the interfirm logistics process and the cascade alerts on critical events."
Handfield (2017, p. 4)	"The relative transparency of events, material flows to all key decision-makers in the extended supply chain. Visibility allows individuals to see what is going on, and in an empowered way, allows these individuals to interpret information and rapidly make decisions in response to data."
Goh et al. (2009, p. 2549)	"SCIV is the capability of a supply chain player to have access to or to provide the required timely information/knowledge about the entities involved in the supply chain from/to relevant supply chain partners for better decision support."
Goswami et al. (2013, p. 279)	"Having access to relevant information that can be used for various supply chain-related decision-making."
Zhang et al. (2011, p. 579)	"Inventory visibility is the capability of a supply chain actor or player to have access to or to provide the required timely information/knowledge about the inventory involved in the supply chain from/to relevant supply chain partners for better decision support."

The following section explores the diverse understanding of SCIV characteristics.

2.4.2. The Characteristics of Supply Chain Information Visibility

Prior studies described a variety of characteristics of SCIV, and they referred to different characteristics with a different interpretation. Therefore, the researcher of the current study has synthesized the previous characteristics of SCIV in the extant literature into three main groups based on studies of Goh et al. (2009) and Somapa et al. (2018): quality, connectivity, and utility of information (Table 2.2). Accordingly, quality refers to the extent to which the shared information meets the needs of the organization, connectivity refers to the extent to which information sharing across organizations is conducted (Goswami et al., 2013) and utility of information refers to the purpose of SCIV (Goh et al., 2009).

Table 2.2: Characteristics of Supply Chain Information Visibility

Author	Information Quality	Connectivity	Utility
Brandon-Jones et al. (2014)	Supply and Demand Data	Integrated Information System	Supply Chain Responsiveness
Kaipia and Hartiala (2006a)	Relevant and meaningful information		Operation Efficiency
Williams et al. (2013)	High-quality demand, supply, and market information: accurate, trusted, timely, useful, and in a readily usable format.	Information Systems	Operational Performance
Caridi et al. (2010)	Updated information and performance		Operational Efficiency

Tohamy et al. (2003)	Relevant information and data	Information System	
Wei and Wang (2010)	Mutual beneficial information		Supply Chain Performance
Barratt and Oke (2007)	Useful information: accurate, trusted, timely, useful, and in a readily usable format.		Operational Efficiency and Competitive Advantage
Wang and Wei (2007)	Demand and supply information		Planning and Control
Rai et al. (2012)	Granular information of inventory: in-transit shipment and exception events		Inventory Management/Exception Management
Francis (2008)	Granular information of entities (granular, identity and status) and events		
Rao (2004)	Inventory and demand information, unforeseen events		Inventory Management
Brusset (2016)		Combination of information technology tools	Supply Chain Agility

Kim et al. (2011)	Information/Knowledge for cooperation	IOIS	Operational Efficiency
Jeyaraj and Sethi (2012)	Granular Information	Information systems	
Papert et al. (2016)	Granular Information: identification, position, status quo.	Auto-ID technologies	
Christopher and Lee (2004)	Levels and flow of inventory		Inventory Management
Zhang et al. (2011)	Timely inventory information or knowledge		Inventory Management
Vitasek (2006)	Item-level inventory information	Monitoring software applications	Inventory Management
Musa et al. (2014)	Information of Product Lifecycle	Auto-ID Technology	Planning and Control Supply Chain Agility
Tse and Tan (2012)	Granular information of material quality and probability of risk		Product Quality Risk Management
Nooraie and Mellat Parast (2015)	End-to-end operation information		Risk Management
McCrea (2005)	Exception Events	Sense and Response System	Exception Management

Goswami et al. (2013)	Relevant Information	Information Systems	Decision-making Support
Goh et al. (2009)	Relevant, timely information or knowledge		Decision-making Support

Firstly, quality of information is defined as "the extent to which information shared between organizations meets the needs of the organizations" (Zhou & Benton Jr, 2007, p. 1351). It is reflected by several characteristics such as timeliness, relevancy, and completeness (Somapa et al., 2018), however different interpretations of each characteristic were found in the literature. Regarding the timeliness quality, it is described as the real-time and near real-time sharing of information enabled by the automatic identification (Auto-ID) technologies (Musa et al., 2014; Papert et al., 2016). However, the frequency of information communication "needs not to be real-time for meaningful and useful SCIV" and is rather "dependent on the nature of the business and its customers" (Francis, 2008, p. 182). As such, several studies did not specifically mention the timeliness of the information. In addition, although the previous studies mentioned the sharing of relevant information, they did not clearly explain the meaning of the term. It seems to refer to sharing the information for mutual benefits. Information completeness refers to the amount of and type of information that corresponds to the needs of the users or the pertinence of the information (Francis, 2008).

Different information requirements indicate the different types of information that are useful and relevant for each supply chain actor. For example, Francis (2008) mentioned the sharing of granular information such as identity, locations, the status of entities, and events associated with the movement of the products. Caridi et al. (2014) referred to functional-based information including four types: transactions/events, status, master information, and operational plans. While Musa et al. (2014) listed different types of required information related to product

lifecycle from its conception, manufacturing, distribution, delivery to the end customer, customer's experience of the product, and the product's end-of-life activities and processes". Moreover, Rai et al. (2012) mentioned that information on inventory positions and in-transit shipments should be made visible to supply chain actors.

Secondly, connectivity refers to the extent to which information sharing across organizations is conducted. The literature also supports the role of inter-organizational information sharing systems in facilitating information visibility in the supply chain. Kim et al. (2011) emphasize the critical role of inter-organizational information systems (IOIS) in facilitating automatic information-sharing between information systems of supply chain actors. Accordingly, they argue that both the extent of the partner's internal information system and inter-organizational information systems infrastructure compatibility influence the level of SCIV. Further, recent studies in SCIV literature describe the use of Auto-ID technologies to capture the granular details of information related to the flow of material across the supply chain and provide automatic alerts to the supply chain actors of any changes and disruptions that occur or are going to occur in the supply chain (Delen et al., 2007; Papert et al., 2016; Rai et al., 2012). The connectivity characteristics of SCIV are also found in Barratt and Barratt (2011) in which the medium that is used for sharing information between the focal company and its suppliers is the determinant of a distinctive SCIV (Somapa et al., 2018). Thus, practical transferring methods in the extant SCIV literature range from manual transfer (e.g. fax and emails) to fully connected IOIS systems (Kim et al., 2011).

The third set of SCIV, utility refers to the purpose of SCIV development. SCIV is useful if it leads to meaningful operational benefits and enhanced business activities (Barratt & Barratt, 2011). Most of the existing studies have explained the utility of information by linking it with certain operational activities such as product quality, demand forecasting, production planning, ordering process, inventory management, risk management, logistics performance, and quality

management (Barratt & Barratt, 2011; Bartlett et al., 2007; Caridi et al., 2014; McIntire, 2014; Nooraie & Mellat Parast, 2015; Pfahl & Moxham, 2014).

As mentioned, there are numerous definitions used in the literature, however, and the meaning of the concept of SCIV is still open to interpretation (Brandon-Jones et al., 2014; Caridi et al., 2014; Francis, 2008). In the following sections, the researcher introduces the significance of SCIV.

2.4.3. The Significance of Supply Chain Information Visibility

There is inconsistency in the extant literature on the importance of SCIV. On the one hand, SCIV has been found to have both strategic and operational importance (Barratt & Barratt, 2011; Barratt & Oke, 2007; Yu & Goh, 2014). On the other hand, in other studies, SCIV might not lead to positive impact on supply chain performance.

SCIV fosters a firm's profitability and sales performance (Swift et al., 2019). Some other studies have explained the utility of SCIV in several key business processes such as product design, demand forecasting, production planning, ordering process, inventory management, manufacturing execution, delivery or logistics performance, and quality management (Somapa et al., 2018). In demand management, SCIV helps to reduce demand amplification and uncertainty about the demand signal (the so-called bullwhip effect) because the demand forecasts of upstream members are constantly updated with the shared demand information from downstream members (Barratt & Barratt, 2011; Somapa et al., 2018). For example, Christopher and Lee (2004) state that SCIV enables immediate sharing of demand information to upstream partners and updating demand forecasts of the upstream partners. As a result, the demand forecast is more accurate, the gap between forecasted and actual demand is lowered and demand planning is more stable (Barratt & Barratt, 2011; Kaipia & Hartiala, 2006b; Wu, Iyer, & Preckel, 2016).

In addition, the visibility of information flow from suppliers to downstream supply chain through different ways of tracking, including that of the status and movement of materials and products, or of updated inventory level can lead to inventory reduction, shortening delivery lead time, and increasing delivery reliability (Delen et al., 2007; Musa et al., 2014; Papert et al., 2016; Somapa et al., 2018). Moreover, the use of Auto-ID technologies in capturing and transferring real-time data of objects that move through the supply chain helps in reducing supply chain inventory waste and lack of product availability caused by the bullwhip effect with the availability of the unified view of products from production planning and shipment at manufacturers, to storage and movement by freight forwarders and ocean carriers (Delen et al., 2007; Musa et al., 2014; Rai et al., 2012). Delivery performance (outbound logistics) can also improve through deploying different sorts of tracking technologies, including that of the status and movement of materials and products, or of the updated inventory level (Somapa et al., 2018). The tracked information contributes to shorten delivery lead time and increase delivery reliability (Bartlett et al., 2007; Delen et al., 2007; Rai et al., 2012). Subsequently, stockout opportunities can be reduced and product availability on the market can be ensured (Barratt & Barratt, 2011; Kaipia & Hartiala, 2006b).

In addition to having operational benefits, SCIV is "an important determinant of supply chain competitiveness" (Kim et al., 2011, p. 668) and creates strategic competencies in different ways (Somapa et al., 2018). Exchanging demand information from downstream to upstream supply chain partners reduces uncertainty in inter-organizational relationships, thus creating low incentives for opportunistic behaviour and enhancing the trust of the supplier-buyer relationship (Christopher & Lee, 2004; Kim et al., 2011; Wang & Wei, 2007). As such, a high level of IOIS visibility facilitates the long-term relationship between partners in a supply chain (Kim et al., 2011). From a resource-based viewpoint, trustworthy and effective supply chain

linkages are a valuable and rare resource that cannot simply be imitated by competitors (Barratt & Barratt, 2011; Barratt & Oke, 2007).

Evidence related to the need for SCIV to enhance supply chain resilience can be found in the literature (Brandon-Jones et al., 2014; Mubarik et al., 2021; Williams et al., 2013; Yang et al., 2021). Ponomarov and Holcomb (2009, p. 3) offer a comprehensive definition of the supply chain resilience as "the adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function." Brandon-Jones et al. (2014) find that SCIV is the specific capability that enhances supply chain resilience and robustness. In this case, supply chain resilience refers to the ability of a supply chain to return to normal operating performance, within an acceptable period of time, after being disturbed, while supply chain robustness refers to the ability of the supply chain to maintain its function despite internal or external disruptions (Brandon-Jones et al., 2014). Wang and Wei (2007) also assert that SCIV has a direct impact on achieving greater supply chain flexibility (i.e., the adaptability of firms in the supply chain to respond to an unexpected change in the transaction processes). Improved visibility provides an understanding of the company's own and its supply chain members' processes that allows a firm to elevate its supply chain readiness and response to the disruptions (Mubarik et al., 2021; Swift et al., 2019). In addition, having visibility of the upstream (supply-side) and downstream (demand-side) supply chain operations can support the firm to quickly discover and minimizes the impact of risks (Barratt & Barratt, 2011; Grötsch, Blome, & Schleper, 2013; Messina et al., 2020). Other current studies have highlighted that enhancing supply chain visibility in the supply chain through gathering, processing, and sharing information among the partners is one of the strategies to build supply chain resilience for managing the disruptions caused by the Covid-19 pandemic (Gunessee & Subramanian, 2020; Ivanov & Dolgui, 2020).

The literature review of SCIV significance showed that SCIV research needs to consider other industry perspectives because SCIV should be developed specifically for each type of industry to fit with their needs. Researchers have called for SCIV studies on different industry contexts to support the development of and our understanding of SCIV (Kim et al., 2011; Klueber & O'Keefe, 2013; Musa et al., 2014). Table 2.4 shows that SCIV has often been investigated in a limited number of industry contexts, and there was a lack of studies from the perspective of other contexts. Particularly, although there are SCIV studies conducted in the pharmaceutical industries, they are mainly analytical or theoretical (Klueber & O'Keefe, 2013; Papert et al., 2016; Zhang et al., 2010; Zhang et al., 2011). This thesis identifies the lack of empirical studies in diverse industry contexts in general, and the pharmaceutical industry particularly, as one of the research issues in the extant SCIV literature.

In contrast, opposed to the claimed benefits of SCIV, the significance of SCIV is questioned by some authors (Brusset, 2016; Kim et al., 2011). For example, Holcomb et al. (2011) find mixed results between SCIV and firm performance. Particularly, their study argues that only a few visibility factors significantly affect the market share, return on assets, and competitive position of firms. Williams et al. (2013) assert that SCIV does not alone appear to directly influence a firm's responsiveness, and identify that internal integration is the missing link in realizing the effects of SCIV on supply chain responsiveness. Especially, Kim et al. (2011) find mixed results that IOIS visibility from the supplier's perspective positively influences performance; however, IOIS visibility from the buyer's perspective does not influence the performance. Also, Brusset (2016) states that visibility capabilities, enabled by the combination of an information system (ERP) together with other supply chain management software, tracking and tracing of goods flows, reporting tools and web collaborative platforms, are not enough to enhance agility in a supply chain. It appears that the link between visibility and performance is not fully established.

Thus, more research on the implications of SCIV is called for, as a response to ambivalent results on the impact of SCIV on performance.

2.4.4. The Antecedents of Supply Chain Information Visibility

This section investigates the antecedents that enhance SCIV in prior studies. The antecedents are grouped into three sets: technological tools, relational factors, and environmental factors (Table 2.4).

2.4.4.1. Technological Factors

There are extensive studies that identify technological tools as the critical antecedents of SCIV (Goswami et al., 2013; Kim et al., 2011; Papert et al., 2016). Technological factors refer to SCM information systems that are deployed to facilitate capturing and sharing information across organizational boundaries (Rai et al., 2012; Somapa et al., 2018).

The effective information flows within and across organizations are essential to managing supply chain activities, and such activities are enabled with the SCM information systems (Büyüközkan & Göçer, 2018; Gunasekaran & Ngai, 2004; Tatoglu et al., 2016). SCM information systems refer to a wide combination of computer hardware, communication technology, and software designed to provide information and information processing capability to support the strategy, operations, management analysis, and decision-making functions in an organization's supply chain (Tarokh & Soroor, 2006). SCM information systems "store, process and deliver information relevant to an organization's supply chain, in such a way that the information is useful to those who wish to use it, including managers, staff, customers, and suppliers" (Tarokh & Soroor, 2006, p. 426). SCM information systems are utilized for logistics management, transportation management, strategic planning, warehousing, inventory, manufacturing, supplier management, and customer management (Somapa et al., 2018).

According to Tatoglu et al. (2016), numerous information systems were developed and adopted in SCM. The SCM information systems (see table 2.3) include both enterprise information systems that are primarily utilized within the domain of a single firm while they all support SCM, and inter-organizational information systems practices that are employed to specifically facilitate business activities across organizational boundaries (Alfalla-Luque & Medina-López, 2009; Somapa et al., 2018; Tatoglu et al., 2016). The enterprise information systems include material requirements planning (MRP), manufacturing resource planning (MRPII), enterprise resource planning (ERP), supplier relationships management (SRM), and customer relationships management (Alfalla-Luque & Medina-López, 2009; Tatoglu et al., 2016). The effective deployment of MRP, MRPII, and ERP facilitate reducing lead time in manufacturing and stock levels and improving planning and efficiency (Tatoglu et al., 2016). In addition, the inter-organizational information systems practices include the tools that are used for capturing and sharing information between the supply chain partners (Somapa et al., 2018; Tatoglu et al., 2016). Examples of the information systems practices include (a) RFID, mobile and wireless technologies for real-time data collection, sensor network technologies, and mobile applications, (b) integration technologies for real-time monitoring of events (e.g., Vendor-managed Inventory (VMI) integration, extensible markup language (XML), web services and EPOS, and (c) business process re-engineering tools for business process automation and supply chain integration (e.g., ERP systems) (Somapa et al., 2018). The effective utilization of these automatic identification and electronic transfer technologies could improve SCM performance (Griffiths, Phelan, Osman, & Furness, 2007; Papert et al., 2016; Tatoglu et al., 2016).

Table 2.3: Supply Chain Management Information Systems (Tatoglu et al., 2016, p. 185)

MRP - Material requirements planning	Manufacturing planning and control systems to coordinate the firm's order fulfilment
MRPII - manufacturing resource planning	

	processes by matching materials and resources available to market demand.
ERP - enterprise resource planning	An integrated application designed to address information fragmentation across firms' business, integrate intra- and inter-organizational information.
SCM - supplier relationships management	The systematic, enterprise-wide evaluation of suppliers' assets and capabilities in line with overall business strategy.
CRM - customer relationships management	A system that builds relationships with customers while customizing a prospective marketing strategy to enhance the value.
EDI - electronic data interchange	The computer-to-computer real-time exchange of data and documents.
Mobile and wireless technologies	Technologies for real-time data collection and exchange.
RFID - radio frequency identification	Refers to using transponders or tags affiliated with objects for identifying and tracking them through radio waves.

Bar Codes	The placement of computer-readable codes on items, and it enables efficient track and storage of information about products.

The extant SCIV literature identify the influence of automatic identification technologies that allow capturing the granular details of information related to the flow of products along the supply chain (Francis, 2008; Musa et al., 2014; Papert et al., 2016; Somapa et al., 2018), and the information systems that facilitate coordinating the flow of information between partners in the supply chain (Barratt & Barratt, 2011; Jeyaraj & Sethi, 2012; Kim et al., 2011; Somapa et al., 2018).

For example, numerous studies have pointed out that the utilization of automatic identification technologies (Auto-ID) such as barcode, two-dimensional multi-row barcode, matrix code, contact and non-contact magnetic devices, contact memory, and radio frequency identification system or RFIDs enables firms to capture information of all the events that occur during the movement of products in real-time, and analysing the recorded information, trace unusual events or inefficiencies in the process (Griffiths et al., 2007; Musa et al., 2014; Papert et al., 2016). Rai et al. (2012) describe IT functionality in SCV as the means for capturing granular information on the flows of shipments and the status of stocks across multiple locations as well as the alerts on exception events that have occurred or might occur. Delen et al. (2007) illustrate that the Auto-ID technologies facilitate continuously tracking of products from the distribution centre to retail stores and measuring the lead time associated with each movement.

In addition, several authors studied the role of the inter-organizational information systems (IOIS) in enhancing information visibility across organizational boundaries (Goswami et al., 2013; Kim et al., 2011; Somapa et al., 2018). Inter-organizational information systems (IOIS) that can be harnessed to share information across any information technology component with

other organizations at a lower cost and leverage the appropriate resources during the information-sharing process, leading to higher IOIS visibility (Kim et al., 2011; Weill & Vitale, 2002). If the information systems of supply chain partners are integrated, the integrated systems can allow information to flow automatically between enterprise information systems (Jeyaraj & Sethi, 2012; Kim et al., 2011). Accordingly, integrated information systems enable the automated transfer of accurate, timely, and transparent supply chain information and reduce the time needed to share knowledge and information, thus enhancing information visibility across a supply chain. Wang and Wei (2007) suggest that virtual integration referring to the extent to which information systems are linked and information is shared among different supply chain actors, thereby effectively creating a virtual supply chain (i.e., the external IS integration capability) is the critical antecedent of SCIV. Virtual integration supports high-quality information sharing between supply chain actors, which in turn, leads to information visibility across a supply chain. Barratt and Barratt (2011) also assert that the utilisation of information systems for sharing information between supply chain actors is the determinant of a distinctive supply chain information visibility.

Furthermore, Jeyaraj and Sethi (2012) point out that SCIV may be enabled and enhanced using information systems that can seamlessly integrate disparate organizational activities, the automation of information sharing with supply chain partners, and the institutionalisation of data sharing standards and translation maps using expertise from external agencies. According to Jeyaraj and Sethi (2012), the focal organisation needs to develop both internal and external information systems integration capabilities to develop supply chain information visibility. The enterprise (internal) information systems integrate the various internal departments and facilities of the organisation to enable data capture and transmission within the boundaries of the focal organization. While the external information systems integrate the focal organisation systems with its partners' systems that enable external-facing activities such as receiving

customer orders, sending procurement orders, customer relationship management, supplier relationship management, product lifecycle management, sourcing, invoicing, and collaborative planning (Jeyaraj & Sethi, 2012). A focal firm with internal information systems integration capability can provide seamless and consistent access and visibility to relevant supply chain partners (Bharadwaj, Bharadwaj, & Bendoly, 2007). Organisations with poor internal information systems integration often face difficulties in connecting their supply chain partners, causing a delay in collecting and exchanging information in a supply chain (Bharadwaj et al., 2007; Kim et al., 2011).

However, there are other studies that do emphasise that the mere deployment of various information systems does not necessarily enhance the level of SCIV. For example, in their study of SCIV antecedents, Barratt and Oke (2007) suggest that information technology tools do not necessarily facilitate the sharing of information that would produce distinctive visibility. Similarly, Brusset (2016) argues that the deployment of a combination of information technology tools in managing a supply chain cannot generate beneficial visibility for achieving an agile supply chain. The result of the adoption of the enterprise resource planning (ERP) systems with other supply chain management software, track & trace, reporting, and web collaborative tools and processes might all add substantially to the negative effect of "information overload" and take firms away from becoming more agile (Somapa et al., 2018).

Table 2.4: Summary of Previous Studies of Supply Chain Information Visibility

Study	Antecedent of SCIV			Performance	Theoretical Underpinnings	Method of Inquiry	Context
	Relational factor.	Technological factor	Environmental factor.				
Brandon-Jones et al. (2014)	Communication	Connectivity	Supply base complexity	Supply chain resilience and robustness	Contingent Resource-based View	Postal survey	UK. Mining, construction, or manufacturing. Manufacturing plants.
Barratt and Oke (2007)	Trust, commitment	Email, fax, information systems		Operation efficiency Competitive advantage	Resource-based View	Semi-structure interview	UK Consumer packaged goods.
Caridi et al. (2010)	Supply chain virtuality (Information-	Supply chain virtuality (Information-	Supply chain complexity	A set of assessment tools for	Contingent theory		Large multi-national firms of different industries (i.e., electronic

	based Collaboration)	based Collaboration		quantifying the benefits of SCIV on supply chain performance			devices, technology and consulting, home appliances, fashion manufacturing, automotive, cables, and oil-field services, and the aerospace industry).
Kim et al. (2011).	Recommend future research: relational and political factors might helpful	Internal IS integration, Inter-organizational information technology infrastructure compatibility		Supply chain performance.	Relational View	Mail survey	Korea. Small-to-medium firms in the telecommunication industry.

Lee, Kim, and Kim (2014)	Asset specificity, trust, complementary resources. Joint governance structures	Inter-organizational information system	Environment uncertainty	Supply chain performance	Relational view and Resource Dependence Theory (RDT)	Survey	Korea. Manufacturers in 3 manufacturing industries including electronics manufacturing, heavy shipbuilding, and automobile manufacturing.
Zhang et al. (2011)		Information systems				Experimental validation through a prototype system	Singapore. A manufacturer, 2 distributors, 3 pharmacies in pharmaceutical supply chain in
Papert et al. (2016)		Auto-ID-based solutions	Regulatory guide			Qualitative - multiple case studies	Germany. A drug manufacturer, different LSPs and TSPs,

							a wholesaler, and two pharmacies in Pharmaceutical SC.
Klueber and O'Keefe (2013)	Human capabilities.	Networkability	Regulation			Conceptual model & a case study.	Swiss. An aviation supply chain. Aviation industry.
Wang and Wei (2007)	Relational governance.	Virtual integration.		The supply chain offering flexibility	Transaction Cost Economics Theory	Cross-sectional mail survey.	Taiwan. Manufacturing firms.
Williams et al. (2013)	Internal integration.	Internal integration		Supply chain flexibility (responsiveness)	Information Processing Theory	Cross-sectional survey.	30 different countries, with the U.S., Canada, Europe (12.14%), the Asia-Pacific, Africa, and Latin America. More than 18 industries.

2.4.4.2. Relational Factors

While the extant literature supports the role of IT in facilitating information visibility in the supply chain, another stream of the literature recommends the role of relational factors to enhance SCIV (Barratt & Oke, 2007). Under the resource-based view and relational view, relationship-specific resource capabilities such as inter-organizational trust, commitment, coordination, joint governance, resource complementary, and asset specificity are found to be antecedents of SCIV. From the perspective of the resource-based view, the possession of information from supply chain partners can help an organization gain a competitive advantage (Barney, 1991). However, the sources for competitive advantages not only lie in the resources and capabilities developed within a firm but also in those that are embedded in a dyadic or network relationship of the firm (Dyer & Singh, 1998). Extended from the original resource-based view, the relational view advocated for firms to control the critical resources and capabilities abled by inter-firm routines under the relational view. Thus the dyadic and network capabilities that are enabled and maintained in a relationship can result in high performance (Klein & Rai, 2009). The SCIV capability may only be developed within a relationship with other supply chain partners and thus can result in the relational rents which are the supernormal profits jointly generated in an exchange relationship that cannot be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific alliance partners (Dyer & Singh, 1998).

The relational view asserts that relational rents are possible when partners combine or exchange knowledge and/or when they employ effective governance mechanisms that permit the realization of rents through a synergistic combination of assets, knowledge, or capabilities (Dyer & Singh, 1998). On this view, firms invest in developing and maintaining close and long-term relationships with supply chain partners to acquire the valuable partner-held resources and capabilities that they otherwise lack (Kim, Umanath, Kim, Ahrens, & Kim, 2012;

Lee et al., 2014). As such, Wang and Wei (2007) suggest that relational mechanisms that are employed to maintain long-term inter-organizational relationships with supply chain partners enhance SCIV.

In addition, from the transaction cost, economics theory and relational theory perspectives, the information from supply chain partners is usually sensitive and proprietary and supply chain members are not willing to share information with their suppliers or customers, even when they have the information systems and the capabilities for information sharing because of the possibility that a partner will behave opportunistically (Fawcett, Osterhaus, Magnan, Brau, & McCarter, 2007; Fawcett, Wallin, Allred, Fawcett, & Magnan, 2011). They are concerned about the information/knowledge loss of control. Once the information is transferred and assimilated into the recipient, it is difficult, if not impossible, for the source firm to control access and the subsequent use of the knowledge. The recipient firm may use knowledge for its benefits at the expense of the source firm and the entire supply chain perhaps by sharing it across competing supply channels. To manage this transaction risk, supply chain actors may not be willing to share proprietary information/knowledge (Kim et al., 2012; Malhotra, Gosain, & Sawy, 2005). The relational mechanisms constitute safeguards against the exploitation of transaction-specific assets and opportunistic behaviours as well as encourage the sharing of proprietary information resources (Lee et al., 2014; Wang & Wei, 2007). Firms are most likely to devote effort and resources to information exchange if their partners can be trusted and demonstrate a long-term commitment to the relationship (Moberg, Cutler, Gross, & Speh, 2002).

The results show that in a supply chain relationship, relational factors are important predictors of SCIV, that is, firms approach any supply chain partners with strong intentions to leverage valuable and complementary resources capability held by other supply chain partners to realize mutual gains.

2.5. Managerial Decision-making

This section elaborates on the development of decision-making theory in management studies.

2.5.1. Decision-making Theories

Decision-making refers to the act of choosing an option from a group of alternatives (Gunessee & Subramanian, 2020). In general, there are two branches of decision-making theory, including rational/normative decision theory and behavioral decision theory (French, Maule, & Papamichail, 2009). The rational approach of decision-making is based on mathematical models using empirical data. The rational decision-making approach refers to a normative process consisting of sequential steps that the decision-maker should take to achieve optimal decisions and thus gain desired objectives (French et al., 2009; Hutchinson & Gigerenzer, 2005). This is central to the traditional field of operation management where mathematical modelling is applied to management decision-making on the assumption that decision-makers act rationally to make the most optimal choice (French et al., 2009). The basic underlying assumptions are that all of the necessary information is available, that utility maximization is sought by the decision-maker, and that there is only one optimal solution (Simon, 1955).

The validity of rational decision theory is questioned in terms of the ability of people to act rationally (Liberman-Yaconi, Hooper, & Hutchings, 2010; Mantel et al., 2006). For instance, the rational approach assumes the availability of perfect information which is often difficult for the decision-maker to acquire (Tarter & Hoy, 1998). Furthermore, organizational goals are often complex and may conflict (Tarter & Hoy, 1998), thus, profit maximization was also not always the ultimate reason for choosing a particular option (Simon, 1997). Hence, an alternative to the normative approach has been developed, known as the behavioral approach.

In recent years, behavioral decision-making has drawn growing attention in business and management studies (Fahimnia et al., 2019; Subrahmanyam, 2008). This branch of decision

theory is described as behavioral or empirical and descriptive decision theory (French et al., 2009). The behavioral approach of decision theory examines how decisions are made in reality, regardless of their efficiency or practicality (Crowder, 2013). Various behavioral decision-making models such as bounded rationality, incrementalism, naturalistic decision-making, and cognitive heuristics (Crowder, 2013) are presented in the following sub-sections.

2.5.1.1. Incrementalism

Incrementalism was developed by Lindblom (1959), which involves a step-by-step process of incremental actions and keeps the strategy open to adjustment (Tarter & Hoy, 1998). The outcomes of each change are monitored, and feasible changes are made subsequently, and the process continues until a suitable solution is found (Tarter & Hoy, 1998). Other researchers describe incrementalism as a process of "muddling with a purpose" (Das & Teng, 1999). Thus, decisions are rarely made at a fixed point in time. Incrementalism is a way of avoiding serious mistakes, although this approach means that decision makers are unable to cope with problems presented by sudden or substantial paradigm shifts (McElhinney and Proctor, 2005).

Incrementalism differs from the normative and bounded rationality models (Crowder, 2013). For instance, with incrementalism, setting objectives and generating alternatives are not separate (Tarter and Hoy, 1998), whereas with both normative models and bounded rationality, alternatives are assessed sequentially in order (Simon, 1997). As such, incrementalism can be seen as a 'middle ground' lying between normative models and bounded rationality (Lindblom, 1959).

2.5.1.2. Naturalistic Decision-Making

Naturalistic decision-making emerged as a major theory in 1989, is an offshoot of traditional decision research (Klein, 2008). Whereas more traditional research has involved inexperienced people engaging in laboratory tasks where contextual or situational factors play a limited role, naturalistic decision-making emphasizes the involvement of experienced people in real life decision-making situations (Rudnicka, 2002). There are many situations that occur in natural

settings that are difficult to replicate artificially, such as stressful conditions, high stakes, danger, and varying levels of experience (Crowder, 2013); and existing theories did not adequately explain how decisions were made under these circumstances (Klein, 2008). Researchers, therefore, began to use cognitive field research methods and it was found that people behave differently in 'real world' situations than they do in 'laboratory' conditions (Crowder, 2013).

Because of its focus on the involvement of experienced people, and the study of decision-making in real-life settings, the processes and strategies of naturalistic decision-making differ from those revealed in traditional decision research (Klein, Orasanu, Calderwood, & Zsambok, 1993). It emphasizes that different cognitive strategies and processes are used when the decision situation is viewed as a temporally evolving one rather than a static event (Klein, 2008). Naturalistic decision-making focuses on how decision makers bring their experience to bear in making decisions. It acknowledges that problems most commonly addressed by experts tend to be highly complex and urgent, involving multiple iterations of action-feedback loops as the decision maker seek to obtain a better understanding of the problem and diminish the escalation of deleterious effects (Rudnicka, 2002). As such, the urgency and criticality of the decision situation require rapid decision-making, leaving little or no time for the assessment of multiple potential alternatives with a view to selecting the optimal one (Rudnicka, 2002).

2.5.1.3. Cognitive Heuristics

Cognitive heuristics are referred to as simple cognitive processes that contrast with the complex cognitive processes employed in expert decision-making (Dane & Pratt, 2007). Cognitive heuristics have been defined in the literature in different ways, including "simplifying strategies" (Payne, Bettman and Johnson, 1993, p. 2), "rules of thumb" (Greenberg and Baron, 2008, p. 400) or even simply as "shortcuts" (LeBoeuf and Shafir, 2005, p. 126). Cognitive heuristics reduce the decision maker's processing effort and time as they eliminate pieces of effortful information and therefore reduce complexity (Bazerman & Moore, 2013; Betsch &

Glöckner, 2010; Tversky & Kahneman, 1975). Essentially, cognitive heuristics are general rules acting as useful guidelines in searching for a path to the solution of a problem (Crowder, 2013). However, when heuristics are applied inappropriately, they can lead to biases that are reflected in the manager's decision (Bazerman & Moore, 2013; Betsch & Glöckner, 2010). The inappropriate application emerges from an unawareness of using a heuristic, a misinterpretation of the decision's context, or a lack of feedback from previous low-quality decisions (Bazerman & Moore, 2013).

2.5.1.4. Bounded Rationality

Bounded rationality is the main focus of this thesis. Bounded rationality was introduced by Herbert Simon in the 1950s and 1960s (Simon, 1955, 1992), is considered a foundational concept for behavioral decision theory as it describes how people are limited in their logical reasoning capabilities and subject to various biases in perception (Porac & Tschang, 2013). This approach addresses the human cognitive limits and sources of bias derived from contextual factors. In this approach, the decision-maker is considered to be bounded by restrictions such as the internal limitations of human cognition and aspects of the external environment including time, resource, and information constraints resulting in the acceptance of al satisficing solution that was good enough rather than utility maximization (R. Brown, 2004). As such, while rational decision-making requires the complete comparison of alternatives to select the best possible choice, bounded-rational decision-making describes that alternatives are often examined sequentially and the first satisfactory alternative is likely to be the one selected (Simon et al., 1992). The decision-makers tend to use simplifying heuristics to deal with complex problems (Simon, 1997). These heuristics enable the decision-maker to filter and assimilate the data. Heuristics are especially effective in decision-making when the decision process enters a grey area where there is no dominant best option (Mantel et al., 2006).

2.5.2. The Management Decision-making Process

In accomplishing the decisional tasks, decision-makers adopted different approaches in making decisions (Elbanna, 2006). At one end, Simon (1997) introduced bounded rationality which is described as the procedures to effectively choose actions with limitations in cognitive and political realities. Conversely, is an intuitive process as an affectively charged process, sometimes based on emotional inputs that arise from holistic associations (Dane & Pratt, 2007). Another school of thought views organizations as collections of individuals with different goals, thereby characterizing decision-making as a political process of negotiations and bargaining among the decision participants (Eisenhardt & Bourgeois, 1988; Ranganathan & Sethi, 2002). The different decision-making process approaches are discussed in detail in the following section.

2.5.2.1. Rationality

Rationality characterizes behaviour that is logical in pursuing goals (Dean & Sharfman, 1993). Researchers considered rationality as the central dimension of the decision-making process (Jones & McLeod, 1986; Ranganathan & Sethi, 2002; C. Saunders & Jones, 1990). Although decision-makers are intendedly rational, they are constrained by their cognitive capabilities and incomplete information, so that their actions may be less than completely rational (Simon, 1955). Given the historical evolution of rationality, scholars have developed some constructs of rationality that represent measures of the extent to which the decision-making process approximates the rational model of decision-making (Elbanna, 2006) (Table 2.5).

Table 2.5: Constructs and Conceptualizations of Rationality (Elbanna, 2006, p. 4)

Construct of Rationality	Conceptualization
Rationality	The reason for doing something and to judge a behaviour as reasonable is to be able to say that the behaviour is understandable within a given frame of reference.
Procedural rationality	The extent to which the decision process involves the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice.
Strategic rationality	An explicit (formal), systematic and analytical approach to decision-making
Decisional rationality	The extent to which decision-makers follow a systematic process in reaching carefully thought-out goals.
Comprehensiveness	The extent to which organizations attempt to be exhaustive or inclusive in making and integrating strategic decisions.
Availability and Pervasiveness	Availability captures the degree to which the available cues were known by the team when they made their decisions. High availability indicates that the team had a great deal of knowledge about the issue. Pervasiveness assesses to what extent all team members were informed of the available information.

To understanding how supply chain practitioners use available information in making supply chain decisions, this study follows the construct of procedural rationality. Dean and Sharfman (1993, p. 1071) define procedural rationality as "the extent to which the decision process involves the collection of information relevant to the decision and the reliance upon analysis

of this information in making the choice." As such, procedural rationality is characterized by "an attempt to collect the information necessary to form expectations about various alternatives, and the use of this information in the final decision" (Dean & Sharfman, 1993, p. 1071). Accordingly, decision processes with a high degree of procedural rationality are characterized by extensive deliberation, high levels of investigatory activity, extensive evaluation of alternatives, and the development of multiple criteria to screen alternatives (Kaufmann, Kreft, Ehrgott, & Reimann, 2012).

2.5.2.2. Intuition

Intuition is described as a traditional decision-making approach, and an alternative to rationality (Bonabeau, 2003). Intuitive decisions are fast, complex, and undemanding of cognitive capacity (Hodgkinson, Sadler-Smith, Burke, Claxton, & Sparrow, 2009; Kahneman & Klein, 2009). Intuition is often associated with having a hunch or a strong feeling of knowing what is going to occur without being able to explain the rationale behind it (Elbanna, 2006). Intuition is difficult to characterize because researchers have had widely different perspectives about what it is and how it works (Dane & Pratt, 2007). Therefore, the "conceptualizations of intuition vary widely and lack clarity" (Carter et al., 2017, p. 81).

Sadler-Smith and Shefy (2004) argue that intuition can be understood as a composite phenomenon involving the interplay between cognition (intuition-as-expertise) and affection (intuition-as-feeling). Khatri and Ng (2000, p. 66) propose three operational indicators of intuition, including (1) reliance on judgment, (2) reliance on experience and (3) the use of gut feeling. In addition, recent decision-making research in the SCM area contributes to this diversity about the intuition concept (Carter et al., 2017). Kaufmann et al. (2014) further operationalized the intuitive decision-making process into (1) automatic processing and (2) experience-based processing dimensions. "*Experience-based processing explicitly draws on*

past expertise and domain-specific knowledge stored in long-term memory and primarily acquired through associative learning, while automatic processing refers to the decision-making process that is fast, automatic, and undemanding of cognitive capacity (Kaufmann et al., 2014, p. 105)". Experience-based intuition offers the benefit of anticipatory thinking and of taking into account criteria for which little tangible information is available (Kaufmann et al., 2014; Salas, Rosen, & DiazGranados, 2010). Stanczyk et al. (2015) conceptualize two different intuition constructs: creative and justified intuition. However, they relate to the two sub-constructs in the study of Kaufmann et al. (2014). Creative intuition comprises the reliance on gut feelings (difficult to communicate), while justified intuition refers to the reliance on prior experience, which can be more easily documented, shared and discussed with others and, thus be formalized to a certain extent (Stanczyk et al., 2015). Recently, Carter et al. (2017) reconceptualize intuition as a multidimensional construct consisting of three aspects: experience-based, emotional, and automatic-processing dimensions. Table 2.6 provides detailed description of the above intuition conceptualization.

Table 2.6: Constructs and Conceptualizations of Intuition

Construct of Intuition	Conceptualization
Intuition.	"Intuition refers to the mental process based on gut feeling as opposed to explicit, systematic analysis, which yield an intuitive insight or judgment that is used as a basis for decision making (Elbanna, Child, & Dayan, 2013, p. 150)."
Intuition-as-expertise & Intuition-as-feeling.	"A composite phenomenon involving interplay between knowing (intuition-as-expertise) and sensing (intuition-as-feeling) (Sadler-Smith & Shefy, 2004, p. 76)."

Reliance on Judgment, Reliance on Experience The Use of "Gut Feeling".	*"Reliance on judgment*: Decision-makers use intuitive synthesis when decisions should be made fast, information is not adequate, and there is not precedent. Such situations call for judgment. *Reliance on experience*: Intuitive synthesis represents a form of experience which is based on a deep knowledge of problems related to a specific job or environment. *Use of 'gut-feeling'*: a process of feeling out the problem or trusting one's gut feeling (Khatri & Ng, 2000, p. 66)."
Experience-based Processing Automatic Processing.	"Experience-based processing explicitly draws from vast amounts of expertise and domain-specific knowledge stored in long-term memory and primarily acquired through associative learning. Automatic processing refers to the decision-making process that is fast, automatic, and undemanding of cognitive capacity (Kaufmann et al., 2014, p. 105)."
Creative intuition Justified intuition.	"Creative intuition to denote a usage of intuition that is based strongly on the more intrapersonal and difficult communicate gut-feeling component of intuition. Justified intuition identifies a usage of intuition that is based strongly on prior experience, which can be more easily documented, shared and discussed with others and, thus be formalized to a certain extent (Stanczyk et al., 2015, p. 174)."
Experience-based processing Emotional processing	"*Experience-based processing* refers to decision makers described how they recognized parallels to past decisions in making the current decision.

Automatic processing	*Emotional processing* includes positive and negative gut feelings in decision making. *Automatic processing* refers to the decision maker quickly makes a decision without awareness or knowledge of specific decision rules; the decision maker knows almost instantly how to decide (Carter et al., 2017)".

Most decision-making literature assumes that rational processes result in better outcomes than intuitive ones (Elbanna, 2006). However, intuitive processes help to speed up decision processes and are useful in solving complex problems (Dayan & Elbanna, 2011). Moreover, intuition is often an effective approach in decision-making in today's business environment, as decision-makers usually do not have timely, accurate, and complete information to make important business decisions (Stanczyk et al., 2015).

2.5.2.3. Political Behaviour

Political behaviour among decision-makers has long been identified as an aspect of decision-making and has attracted attention from researchers (Child & Tsai, 2005; Elbanna, 2006, 2018). Elbanna (2018, p. 618) defines political behaviour as "*intentional forms of behavior associated with the use of power and influence in order to serve the own interests of decision-makers or these of the organization*". Eisenhardt and Zbaracki (1992) consider organizations as political systems shaped by (1) conflicting interests and (2) varying power of internal parties (i.e., functions and departments). Organizations are formed by people with conflicting preferences and goals who believe that they will be affected by the decision outcome, which causes them to try to influence the decision process to satisfy their personal needs (Elbanna, 2006).

Many decision-making scholars have often viewed political behavior as the harm to the decision-making process (Dean & Sharfman, 1993; Elbanna, Di Benedetto, & Gherib, 2015;

Stanczyk et al., 2015). Political behavior that manifest in the decision procedures could distorts information, creates animosity and leads to poor performance (Bourgeois & Eisenhardt, 1988). Dean and Sharfman (1993) argue that, in the decision-making process, involved parties can use data collection and evaluation criteria as tools to manipulate decision outcomes to their interests which are usually conflicting.

On the contrary, there is a more holistic perspective of emerging research that suggests political behaviour can be both good and bad. As such, rather than positing that political behavior is inherently negative, destructive, or dysfunctional, political behavior can sometimes be constructive, positive, or functional (Elbanna, 2018; Elbanna, Kapoutsis, & Mellahi, 2017; Landells & Albrecht, 2017; Tsanis, 2013). When people from different departments, composing diverse functional areas, participated in the discussion in the decision-making process, the results could decrease uncertainty and enhance acceptance among involved parties (Elbanna, 2006). Moreover, political behaviour could ensure that all necessary aspects of the decision are evaluated (Elbanna, 2006). In their study of global sourcing decisions, Stanczyk et al. (2015) find mix effects of political behaviour on supply chain performance. On one hand, as long as there is no powerful player dominating a sourcing team, political behaviour allows firms to create beneficial effects on the decision process even misaligned goals are available among the participating functions. On the other hand, extant powerful stakeholders can leverage their position through assertive political behavior, leading to poor performance (Stanczyk et al., 2015).

2.5.3. Supply Chain Decision-making

In the supply chain context, decisions can be seen as strategic or operational (Ivanov et al., 2019). While strategic level decisions are concerned about issues that have a long-lasting effect on the firm, operational decisions relate to regular activities to match demand and supply

(Ivanov et al., 2019). Strategic supply chain decision-making includes sourcing, production, facility location and distribution and logistics decisions, while operational decision-making includes inventory management, demand forecasting, procurement, scheduling and routing decisions (Gunessee & Subramanian, 2020).

Supply chain complexity has made supply chain decision-making increasingly difficult and more likely to lead to undesirable outcomes (Manuj & Sahin, 2011) due to multi parties' involvement and conflicting interests and priorities (Liu, Leat, Moizer, Megicks, & Kasturiratne, 2013). Decision-making in the supply chain context is further complicated by the huge amount of information to be handled and shorter timeframes for making decisions (e.g. instead of having weeks or days, managers may now have minutes or seconds) (Hosack, Hall, Paradice, & Courtney, 2012; McAfee, Brynjolfsson, Davenport, Patil, & Barton, 2012). In addition, managers often suffer from poor and inaccurate information, delayed sharing of information, or even a lack of information (Patnayakuni, Rai, & Seth, 2006) due to physical distance (Christopher & Lee, 2004) or the fear of diminishing power (Simatupang et al., 2002). These issues lead to managers' exposure to the risk of making the wrong or ineffective decisions due to asymmetric information (Christopher & Lee, 2004) or "information overload" (e.g. a manager receives too much information than his capacity of absorbing) (Farhoomand & Drury, 2002). In consequence, the key to avoiding this kind of risk is making relevant information accessible to all the supply chain members; so that each member has better visibility of the global supply chain to make more informed decisions (Gartner, 2015; Goswami et al., 2013; Simatupang et al., 2002).

Decisions in SCM are subject to various conflicting criteria and multiple objectives must be considered in the decision process, and often, these criteria are conflicting in nature (Khan, Chaabane, & Dweiri, 2018). Furthermore, a group, rather than a single decision-maker, is often involved in the process (Beck & Hofmann, 2012; Khan et al., 2018). As such, researchers who

have been looking to make contributions to better understand how decisions are made or how behavioral factors might influence the success of these decisions must be willing to look for new ways to explore these issues.

2.5.3.1. Strategic Supply Chain Decision-making

For strategic decisions, the decision process involves many criteria resulting from the information collected through the different supply chain functions. Procedural rationality has long been recognized as an important information processing and decision-making approach, and as having a significant influence on decision outcomes (Dean & Sharfman, 1993, 1996; Kaufmann et al., 2012; Simon, 1978). In the context of SCM, procedural rationality is found to be an appropriate managerial decision-making approach. Kaufmann et al. (2012) demonstrated that highly procedural rational decision processes are positively related to higher decision quality; and advise practitioners to establish a rigorous, well-defined analytical process to make supplier choices, including an intentional search to find relevant information. Riedl, Kaufmann, Zimmermann, and Perols (2013) further claim that procedural rationality is effective in reducing uncertainty in supplier selection decisions; and the uncertainty reduction, in turn, improves the performance of the decisions. Stanczyk et al. (2015) add that procedural rationality positively contributes to the global sourcing decision-making processes.

Overall, empirical studies support the positive impact of procedural rationality on supply chain decision-making effectiveness. Kaufmann et al. (2012) demonstrated that highly procedural rational decision processes are positively related to higher decision quality; and advise practitioners to establish a rigorous, well-defined analytical process to make supplier choices, including an intentional search to find relevant information. Riedl et al. (2013) further claim that procedural rationality is effective in reducing uncertainty in supplier selection decisions; and the uncertainty reduction, in turn, improves the performance of the decisions. Stanczyk et

al. (2015) add that procedural rationality positively contributes to the global sourcing decision-making processes. It is hence deemed a suitable managerial decision-making approach in the supply chain context. Recent research found evidence for a certain complementarity between rationality and intuition in decision-making to achieve high levels of decision effectiveness (Kaufmann et al. 2014).

2.5.3.2. Operational Supply Chain Decision-making

Operational decision-making is an important part of supply chain management. The standard approach to operational supply chain decision making assumes that managers are rational – they gather all relevant information and use all necessary time and computational resources to process this information (Perera et al., 2020). However, it is pointed out that decision-makers tend to deviate from what is prescribed by quantitative (analytical and optimization) models, resulting in unnecessary costs and operational inefficiencies (Mantel et al., 2006; Perera et al., 2020).

Better integrating human behaviour into our understanding of the decision-making of supply chain practitioners in operation contexts continues to be an exciting avenue for research (Fahimnia et al., 2019; Katsikopoulos & Gigerenzer, 2013; Perera et al., 2020). It is of critical importance for practical activities to guide structuring and framing decision-making – both in day-to-day as well as in strategic contexts (Fahimnia et al., 2019). Thus, this study aims at understanding the supply chain practitioner's behaviour in their decision-making process and at using this understanding to generate interventions that improve the operation of the supply chain. Even with support from highly automated and supposedly objective systems, decision-making in supply chain management practice continues to be heavily influenced by human judgment. There is a human element that links data to decision-making, and better understanding this human element is a key objective for research in BOM (Fahimnia et al.,

2019). It is well known that, in practice, algorithms in inventory management, revenue management and forecasting often rely on human interventions to allow correcting for their inherent incompleteness (Kremer, Moritz, & Siemsen, 2011).

Based on summarising the issues shaping the recent SCIV literature and the gaps in knowledge, the following points summarise the outcome of the literature review and form the basis on which the research objectives were developed as shown in Table 2.7.

Table 2.7: Summary of the Literature

Outcome of the Literature	**References**
There is a lack of empirical research on SCIV in regulated industries.	Klueber and O'Keefe (2013), Papert et al. (2016), Swift et al. (2019).
There is disagreement in the empirical findings from previous research on the benefits of SCIV.	Williams et al. (2013), Kim et al. (2011), Somapa et al. (2018), Yu and Goh (2014), (Papert et al., 2016).
Establishing SCIV is a complex endeavor since it extends to several functions within an organization, while also crossing organizational boundaries. There is a lack of empirical study in explaining how to successfully develop SCIV.	Somapa et al. (2018), Klueber and O'Keefe (2013), Barratt and Barratt (2011), Musa et al. (2014).
There are exiciting opportunities to utilize behavioral operations management theory in SCM research to gain a greater understanding of the phenomenon across the supply chain, but also to support the theory advancement in the SCM discipline.	Handfield (2017), Tokar (2010), Kaufmann et al. (2014), Stanczyk et al. (2015).

2.7. Chapter Summary

This chapter provided a review of the supply chain management and managerial decision-making literature. The chapter also explained the empirical domain of supply chain management in New Zealand. Finally, the knowledge gap was summarised and presented in a table at the end of the chapter. The literature review showed that there is limited knowledge about SCIV in the New Zealand pharmaceutical industry. The review also showed that there are inconsistencies among scholars and practitioners about the characteristics of SCIV. The review further highlighted that there is a need for applying theory from other disciplines in SCM research to gain a greater understanding of the phenomenon across the supply chain.

Chapter 3: Research Methodology

3.1. Chapter Overview

As explained in Chapter 1, this study aims to develop a theoretical model that demonstrates the characteristics of SCIV and its enactment in the supply chain decision-making in the pharmaceutical industry. To achieve this, this study examines how supply chain managers in pharmaceutical companies make decisions with the available information. This chapter describes the research design, the rationale behind the design, and discusses the data gathering and analytical processes. This chapter is structured as follows. Section 3.2 introduces the research philosophy. Section 3.3, then explains the choice of research methodology which explains the details of the processes used in the study. It is followed by section 3.4 which addresses the rigor of this study. Section 3.5 discusses the research ethical considerations. The last section, 3.6 is the conclusion of the chapter.

3.2. Research Philosophy

There are different philosophies about the nature of social reality and how it should be examined, which correspond to different research methods. It is necessary to clarify the philosophical assumptions underlying the inquiry of a study (Creswell, 2013).

Particularly, the ontological beliefs about existence, and the epistemic relationship between the knower and the known, are essential determinants of how a phenomenon is approached by social researchers (Lincoln, Lynham, & Guba, 2011). This section addresses the ontology and epistemology that underpin the study as they inform the methodological framework, and guide how the research is designed to collect and analyze data (Denzin & Lincoln, 2008; Lincoln et al., 2011).

Ontology refers to the nature of reality as interpreted by the researcher, and thus makes assumptions about the reality of the studied phenomenon (Hudson & Ozanne, 1988). A researcher is considered subjectivist or objectivist dependent on how reality is interpreted. Objectivists assume that social and natural reality has an independent existence before human cognition, while subjectivists assume reality as an output of human cognitive processes (Johnson & Duberley, 2003). As such, subjectivists believe reality is constructed based on human experiences and there is nothing real that exists in its essence. Objectivists believe social reality is external to the researcher and therefore there is only one reality (Collis & Hussey, 2009). While subjectivism and objectivism are two extremes of ontological assumptions, social constructionism falls in between, closer to subjectivism (Bryman & Bell, 2015). From this perspective, social reality is subjective and constructed through interactions and interpretations of social actors in daily activities (Bryman & Bell, 2015). From a social constructionist perspective, social actors have an impact on the shaping of social phenomena and their meanings (Bryman & Bell, 2015).

The researcher believes that reality is constructed by individuals as opposed to being external to an individual. Accordingly, this study adopts the social constructionism paradigm as its ontological basis. Social constructionism is suitable for this research for two reasons. First, this study aims to develop an in-depth understanding of the supply chain practitioners' perception of SCIV and how SCIV is used in the supply chain decision-making process. Second, social constructionism allows the researcher to involve in in-depth conversations with participants, and as a result, her knowledge of the studied phenomenon is socially constructed through her interactions with the participants. Therefore, the aim and nature of this study fit well within social constructionism ontology, which then lays the foundation for the epistemological perspective of the research (Figure 3.1) (Bryman & Bell, 2015).

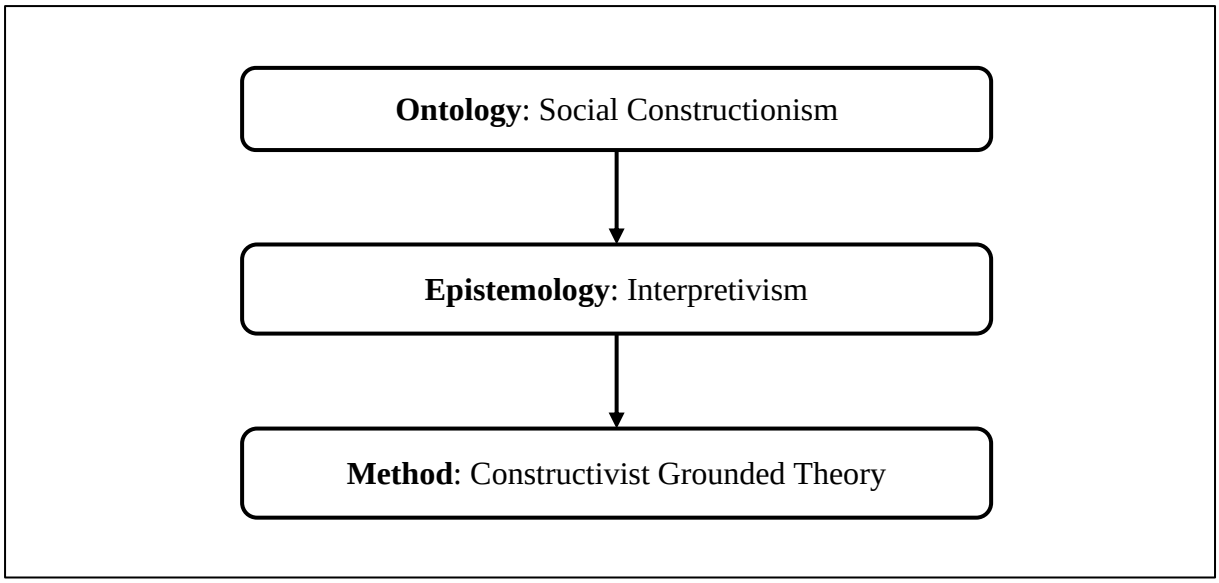

Figure 3.1: Research Philosophy

Epistemology is "a way of understanding and explaining how we know what we know" (Crotty, 1998, p. 3). Therefore, epistemological views relate to the nature of knowledge (Collis & Hussey, 2009). Based on social constructionism ontology, this study follows interpretivism as the epistemological approach. Interpretivism considers that knowledge is intentionally constituted or constructed through a person's lived experience and is underpinned by the belief that social reality is not objective (Collis & Hussey, 2009). Interpretivism investigate meaningful social action and the subjective perceptions of the people involved in a specific time and context (Hudson & Ozanne, 1988; Neuman, 2006).

Methodology refers to the approach taken to carry out the research and may consist of one or multiple methods which should align with the ontological and epistemological approach (Collis & Hussey, 2009). The participants of this study are assumed to be influenced by their previous experience, social setting, and organizational context. Therefore, the aim of this study is not to capture facts of an objective reality, but to explore and interpret the supply chain practitioners' perceptions within the pharmaceutical supply chain context of this research. Adopting the social constructionism approach, the researcher adopts the constructivist grounded theory

(Charmaz, 2006) that guides the data collection and analysis method. The research method is further discussed in the following section.

3.3. Research Method

This study aims to answer the following research questions:

1. How do supply chain professionals perceive the supply chain state in the pharmaceutical supply chain?
2. How do supply chain professionals make informed supply chain decisions?

Addressing these questions can provide a significant and in-depth understanding of SCIV from pharmaceutical practitioners' perspective and how the practitioners make use of visible information in their supply chain decision-making process in the industry.

To gain an in-depth and context-specific understanding of how SCIV is defined and incorporated into the supply chain decision-making processes, a qualitative-exploratory approach is adopted in this study. This approach allows the researcher to investigate the subjective views of the participants by understanding their perceptions and interpretations of their experiences and actions concerning SCIV and the decision-making process in the pharmaceutical supply chain.

The nature of this study is exploratory due to the lack of validated theories in the SCM field. According to Robson and McCartan (2016), an exploratory study is a valuable means through which the researcher aims to find out what is happening, seek insights, ask questions and assess phenomena in a new light. This is in line with the intention of this study, to develop insights into how supply chain practitioners perceive SCIV and their approaches to use SCIV in supply chain decision-making.

In addition, qualitative research is a broad methodological approach used to analyze text and other qualitative data obtained from the natural setting. A qualitative approach is particularly

helpful when the researcher seeks to understand a complex issue in detail by examining the perceptions of people, hearing their voices, and developing themes from them (Creswell, 2013). Drawing on the assumptions that the participants of this study are influenced by their previous experience, social setting, and organizational context, the qualitative approach (Denzin & Lincoln, 2011), which involves an interpretive and naturalistic approach, enables the researcher to explore and interpret the supply chain practitioners' views within the given context of this research is employed.

Particularly, in line with the qualitative-exploratory approach, this research follows the constructivist grounded theory (Charmaz, 2006, 2014) methods in conducting data collection and analysis. The constructivist grounded theory is suitable for studying individual processes, interpersonal relations, and the reciprocal effects between individuals and larger social processes (Charmaz, 2011, 2014). This is a rigorous qualitative approach that is based on the field study of a multifaceted phenomenon or process through a series of structured data collection and analysis steps (Charmaz, 2011). Particularly, the constructivist grounded theory provides both novice and experienced researchers with strategies to structure and organize data collection and analysis that enable them to conduct qualitative research efficiently and effectively (Gardner, McCutcheon, & Fedoruk, 2012). Also, constructivist grounded theory methods provide systematic procedures for shaping and handling rich qualitative materials. As such, the methods consist of guidelines that aid the researcher (a) to study social and social psychological processes, (b) to direct data collection, (c) to manage data analysis, and (d) to develop an abstract theoretical framework that explains the studied process (Charmaz, 2002).

By developing categories and concepts based on guidance in the constructivist grounded theory, the study seeks to offer a theoretical model to understand supply chain practitioners' perception of SCIV and how they use SCIV in their decision-making process. The following section addresses in detail the adopted method.

3.3.1. Constructivist Grounded Theory

In line with the ontological stance of this study, constructivist grounded theory (Charmaz, 2006) was used to gather and analyze data in this study. Methodologically, it is interpretivism in nature, meaning that the notion of shared reality is interpreted or discovered by the researcher and that "…reality arises from the interactive process and its temporal, cultural, and structural contexts" (Charmaz, 2000, p. 523). In constructivist grounded theory, no external truth is assumed for the researcher to discover; rather, the researcher has a dynamic and mutual interaction with the participants and creates the truth (Charmaz, 2014). This particular approach facilitates a researcher's understanding of how people negotiate and shape social structures; how a shared reality is created and how meaning is developed through the social interactions with other social actors within specific contexts (Gardner et al., 2012). As such, a constructivist grounded theory approach is selected primarily because the interpretivism epistemology enables an understanding of the supply chain practitioners' experiences, values, and feelings, and the co-construction and interpretation of their meanings and multiple realities (Charmaz, 2006, 2011). The constructivist grounded theory approach also seeks to answer the how questions, and to explain actions (Charmaz, 2011), which are the focus of this study; i.e. how supply chain practitioners perceive SCIV and incorporate visible information into their pharmaceutical supply chain decision-making.

The constructivist grounded theory provides a set of inductive methods for analyzing data. That means the researchers can start with individual cases, or experiences and develop progressively more abstract conceptual categories to synthesize, explain, and understand the data and to identify patterned relationships within it. Then, the researchers build their theoretical analysis on what has been discovered that is relevant in the actual contexts of the studied phenomena (Charmaz, 2002, 2006).

In addition, the purpose of the research is to propose a theoretical model of pharmaceutical supply chain information-based decision-making disclosing the knowledge embedded in SCM practice, since currently there is limited knowledge on the relationship between SCIV and decision-making. Charmaz (2006) outlines the importance of having a broader definition of the concepts of 'theory' when considering the development of a grounded theory and explains that an interpretive definition of theory emphasizes understanding rather than an explanation. An interpretive theory is shaped from the researcher's interpretation and analysis of the data and seeks an understanding of the social phenomena rather than an explanation of events (Charmaz, 2006).

Figure 3.2 illustrates the principles and the analytical process of constructivist grounded theory. These principles and the analytical process are discussed in the following sections under two headings: data collection and analytical process.

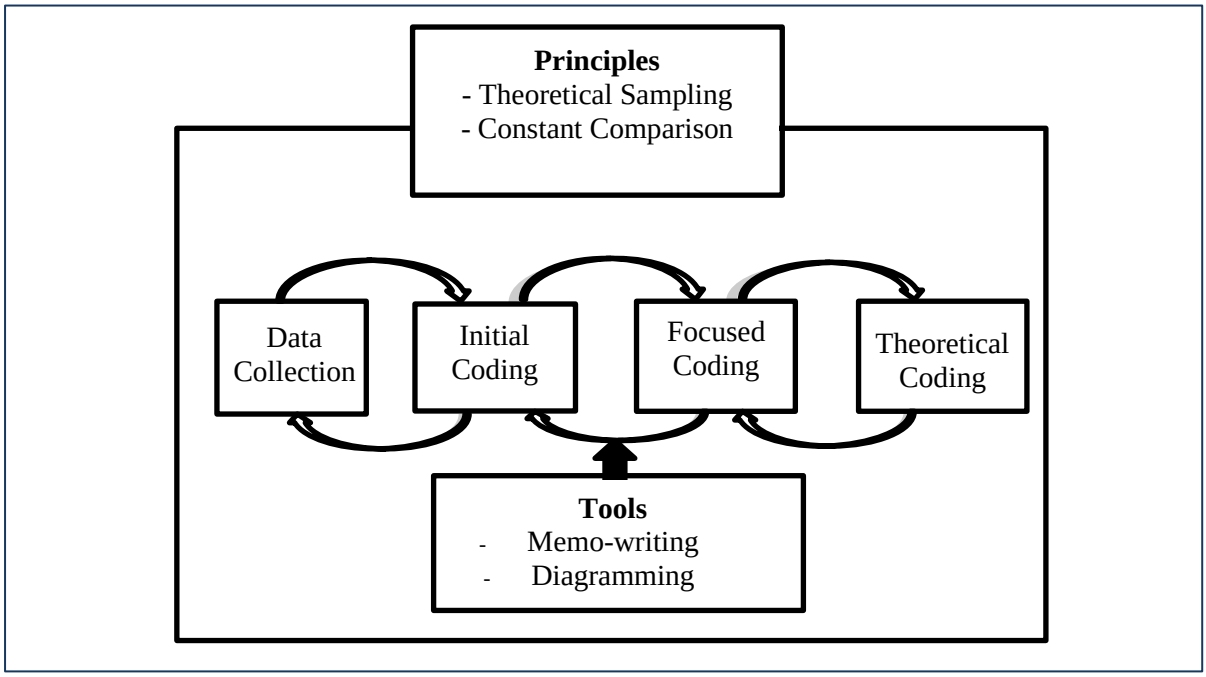

Figure 3.2: The Constructivist Grounded Theory

3.3.2. Data Collection

The objective of this study is to use empirical data to develop a theoretical model that explains the contribution of SCIV to information-based decision-making. The researcher conducted semi-structured interviews on a sample of supply chain professionals in the New Zealand pharmaceutical industry.

3.3.2.1.Theoretical Sampling

The participants were purposefully selected according to the criteria of theoretical sampling (Charmaz, 2006; Glaser, 1978). Theoretical sampling means that participants are selected based on the emerging analysis, and the theory is developed from data that is subsequently modified from the data obtained from the next participants. It is a prominent part of the iterative process, which guides the researcher later interviews and enables them to adjust and fill out emerging categories (Charmaz & Thornberg, 2020). The overall sample included 21 participants from a range of pharmaceutical firm's types in New Zealand. While this may be a small sample for a qualitative study, the constructivist grounded theory method states that data collection should cease when the data is determined to be sufficient to generate a credible theory (Charmaz, 2006).

The initial sample (interview participants) consists of pharmaceutical supply chain practitioners who can provide meaningful, relevant data about the phenomenon investigated. Initial participants were identified based on their job titles, job profiles, job experience, and willingness to participate (recruitment process explained in 3.3.2.2). This study recruited supply chain practitioners who are knowledgeable about operating and managing the pharmaceutical supply chains in New Zealand-based pharmaceutical firms. The participants held varying positions (including procurement manager, operation manager, and supply chain manager) in pharmaceutical firms with the global supply chain. The first group of interviewees

consisted of both senior practitioners in SCM (4 participants), and junior practitioners (2 participants) who had supply chain-related decision-making responsibilities in their firms at the time they participated in the study. Interviewing both experienced and novice practitioners could help get to the core of the phenomenon under the study by discovering categories and concepts that are common among a wide variety of informants in a given context (Manuj & Sahin, 2011). Therefore, both their views and experiences related to making supply chain decisions were equally important to develop a comprehensive and ecological understanding of the researched phenomenon.

Overall, three rounds of interviews were conducted. Round 1 was conducted with 6 participants). In the early analysis, the researcher identified that limited demand SCIV (supply chain customer information) was an emerging theme. However, the researcher realized that the participants did not explicitly explain the underlying context of this situation whilst they clearly explained why their firms have had limited supply information visibility. The researcher decided to extend the study sampling and interviewed 3 participants from the supply chain demand-side (customers) to get more insights from practitioners to correct or enrich the emerging category (round 2). As such, two interviews were conducted with three participants from a public hospital which is an actor (customer) in the pharmaceutical supply chain. The researcher analyzed the two interviews and compared with data collected in round 1. By comparing and aggregating data from the interviews, the researcher understood the big picture of the New Zealand pharmaceutical supply chain context and gained insights into the studied object.

Upon data analysis of the interviews in the second rounds, the researcher decided that no further information was needed to collect from the demand-side actors. Instead, the research sampling continued to focus on participants who are supply chain practitioners in New Zealand-based pharmaceutical firms. Data collection round 3 was conducted. At the beginning of round 3, the researcher recruited two participants who have more than 20 years of experience. Upon data

analysis of these interviews, the researcher identified that in round 1, participants were from either a large multinational corporation (MNC) affiliate or a local SME, and in round 3, the two participants were from an MNC affiliate SME. In New Zealand, SMEs are (small and medium enterprises) companies that have 0-49 employees (New Zealand Small Business Council, 2019). Although participants were from MNC affiliates, their perception of the studied phenomenon tended to be deviated to some extent due to their firm characteristics. For example, participant 11 who was an experienced practitioner in a MNC affiliate SME stated that information flowed smoothly within the firm because they have a flat organizational structure while participant 2, from a large MNC affiliate, asserted that they were having an organizational silo leading to some difficulties in acquiring information internally. In addition, in evaluating the role of IS in developing SCIV, participant 7 described that, as a local SME, they have had a simple information system which they found satisfactory, whilst participant 11 stated that they have a world-standard information system in place as their MNC headquarter information system which they found clunky and useless. Therefore, the researcher determined to diversify the sampling in trying to recruit participants from diverse pharmaceutical firm conditions.

As a result, in the data collection round 3, the interviewees represented four key types of pharmaceutical firms in New Zealand, including large MNC affiliates, small MNC affiliates, large local firms, and small local firms. These firms represent different types of firms in the pharmaceutical industry with different characteristics (see further description of firm types in chapter 4). The theoretical sampling was to include a diversified range of perspectives on SCIV and the decision-making process. The diversity of participants allowed the researcher to sample a multiplicity of experiences that are both significant and prototypical of their firms, as well as different among one another, to develop a multi-angle understanding of the researched object (Charmaz, 2006). The theoretical sampling enabled the researchers to collect rich data and have

had multiple comparison groups to increase the scope and generality of the developed model and to correct and adjust the emerging categories to diverse conditions (Glaser & Strauss, 1967). Overall, 21 participants were interviewed: six from large MNC affiliates, six from MNC affiliate SMEs, three from large local firms, three from local SMEs, and three from a public hospital. Table 3.1 provides a brief description of profiles of supply chain professionals and their organizations, respectively.

Table 3.1: Profile of Participants

Position	**Years of Experience**	**Firm Type**
Procurement Manager	20 years plus	Large MNC Affiliate
Head of Supply Chain	15 years plus	
Pipeline Manager	25 years	
Logistic Manager	16 years	
Export Manager	7 years plus	
Demand Planner	> 5 years	
Head of Supply Chain	30 years	Small MNC Affiliate
Country Manager	30 years plus	
Senior Inventory & Distribution Manager	28 years	
Market Planner	10 years plus	
Supply Chain Lead	n/a	
Quality Manager	12 years	
General Supply Chain Manager	20 years plus	Large Local Firm
Forecasting and Planning Coordinator	> 5 years	

Procurement and Contract Specialist	> 5 years	
Managing Director	30 years plus	Small Local Firm
Managing Director	20 years plus	
Inventory Manager	Less than 5 years	
Supply Chain Manager	20 years plus	Hospital
Pharmacy Lead - Contract Manager & Senior Technician	20 years plus	

3.3.2.2. Participant Recruitment

Participant recruitment refers to the process of identifying and approaching appropriate participants. This section details the processes used to gain access to the recruitment of supply chain professionals for interviews. Participants were initially identified through existing New Zealand business directories as well as the LinkedIn network. The researcher gathered relevant contact information and then contacted them via phone calls, emails, or sending messages on LinkedIn. However, the success rate was quite low. Only a few of the contacted professionals replied. Another approach to potential participants was through personal connections. Through personal relationships with two people who used to work in pharmaceutical firms, the researcher was introduced to potential participants and attained 100% acceptance. It is noticeable that personal connection is a much better approach to gain access to participants in New Zealand-based pharmaceutical firms. In addition, a snowballing technique (Miles & Huberman, 1994) was also used, where the researcher asked participants to introduce other participants they might recommend given the objectives and questions of this study.

Following the ethics procedures (as described in section 3.5), the researcher contacted by email to send an official invitation and information sheet to the selected participants. Communication

continued to check their availability to take part in the research until the supply chain professionals accepted the invitation.

3.3.2.3. Semi-structured Interviews

The constructivist grounded theory places a strong emphasis on in-depth, intensive interviewing to purposely yield an intimate exploration of the meanings that participants attribute to their experiences (Charmaz, 2006). The semi-structured interview which allowed for both standardization and flexibility in data collection was used in this study. The semi-structured interview is the most widely used format for qualitative research; facilitating insight into participants' viewpoint and eliciting rich data (Wilkinson, Joffe, & Yardley, 2004). A semi-structured interview consists of a set of questions referred to as an interview schema and varying additional questions emerging from the conversation between the interviewer and the interviewees (Charmaz, 2002; DiCicco-Bloom & Crabtree, 2006). Probes will be used to augment the questions when participants have difficulty in elaborating their viewpoints and to gain detailed information on the topic (Wilkinson et al., 2004).

To ensure the interview effectiveness, pilot interviews were conducted (Marshall & Rossman, 2014). The researcher conducted three pilot interviews with a PhD., student who has had senior-level experience in the corporate environment, and two Massey University supply chain officers with the objective to verify clarity, content and the flow of questions and the researcher's involvement. Constructive feedback was provided by these interviewees, which helped adjust the interview guide. In this process, several interview questions were reworded, modified, and regrouped to improve the clarity and flow of questions.

Face-to-face interviews were preferred because they allow the researcher to interact with interviewees and obtain non-verbal clues such as body language and facial expressions (Rubin & Rubin, 2011). Most of the interviews were conducted face-to-face at the participants' offices

in Auckland, New Zealand. However, when the three participants suggested, Skype or phone interviews were the choice.

The researcher provided an information sheet (Appendix 6) to each participant and explained the nature and objective of the research via emails and notified the participants, once again, at the beginning of each interview. The participants were advised that each interview would last approximately 60 minutes. The participant consent form (see Appendix 5) mentioning details of their rights as a participant was also provided to the participants and was returned with the signatures of the participants.

During the interviews, the researcher asked questions following the interview schema. Upon hearing the first responses from the interviewees, the researcher used probes to steer the conversation. During the conversation, the researcher asked how and why questions that lead to deeper conversations about underlying issues. In this way, the researcher tried to construct meaning from the conversation, as part of the construction process of social reality together with participants.

Each interview began with an introduction and some questions to ascertain demographic information (Appendix 2). This established a rapport between the interviewers and the participants and helped create an understanding of the purpose of the study (Strauss & Corbin, 1998). All respondents were assured of confidentiality. The researcher recorded field notes and memos to capture thoughts, feelings, observations, or insights following the interviews.

The researcher continued conducting interviews until theoretical sufficiency was reached; that is when the concepts were fully developed (Charmaz, 2006) (see section 3.3.3.3). During data collection, even though the aim is to get close to the situation being explored, the researcher must periodically step back to maintain skepticism so as not to introduce bias (Strauss & Corbin, 1998). Bringing knowledge and experience to the study is important to provide theoretical sensitivity (Strauss & Corbin, 1998).

The interviews went on for 60-120 minutes, with the median length around 78 minutes, which is then audio-recorded and transcribed verbatim for data analysis. The researcher transcribed eight interviews first-hand. Transcribing was found to be challenging and very time-consuming. After discussion with supervisors, the decision was made to utilize a professional transcription service (Myers, 2013). The professional transcribers signed a confidentiality agreement before audio files were sent to them. Once transcripts were received, the researcher checked all transcripts for accuracy along with the recording twice before using them for the analysis. The researcher then sent the transcripts to participants who requested for review, no participants made any changes.

3.3.3. Data Analytical Process

Data were analyzed following the constructivist grounded theory analysis method (Charmaz, 2008). Data analysis began immediately following the first interview and continued throughout the data collection process, allowing the development of a theoretical model. The method encapsulates a more impressionistic coding procedure which was fashioned to construct a conceptual interpretation (rather than exact apprehension) of the phenomena (Charmaz, 2006, 2008).

3.3.3.1.Unit of Analysis

The previous studies of the supply chain decision have typically assumed that the firm makes the decision using quantitative models to best serve the long-term goals of the company. However, typically it is not a firm that decides; rather, in most cases, it is a human being who makes the decision. The decision-makers that make the decisions (e.g., supply chain managers, procurement managers or logistic managers) are human (Mantel et al., 2006).

The research design of this study reflects its exploratory nature, as well as its holistic approach to delving into the supply chain decision-making process from an individual point of view. Thus, this research relied on the individual decision-maker (supply chain professionals) as the unit of analysis when qualitatively exploring perceptions of SCIV and how supply chain decisions are made with visible information.

3.3.3.2. Coding

Following each recorded initial sampling interview, data were analyzed parallel to data collection, managed by NVivo11™ qualitative analysis software. Coding, constant comparison, and memo-writing began early with the first few interviews. The comparison of data within transcripts and among transcripts enabled the researcher to identify new leads to be followed up in subsequent interviews (Charmaz, 2008).

Following the constructivist grounded theory (Charmaz, 2008), the coding process was conducted not in a linear but an iterative and constant comparative fashion. The interview transcripts were analyzed according to the procedure of constructivist grounded theory data analysis with three sequential phases of coding initial coding, focused coding, and theoretical coding. Initial coding was performed based on the guidelines of Charmaz (2006) and Charmaz (2008), meaning a preliminary identification of concepts that fit with the data. Initial coding involved studying fragments of data and systematically labelling them with codes to allocate units of meaning (Charmaz, 2008). The researcher used line-by-line analysis as the strategy to fragment narratives with labels and highlighting the underlying meaning as this is an appropriate heuristic device for coding initial intensive interviews (Charmaz, 2008). Gerunds, the noun forms of verbs, were used to assign labels to chunks of text. It enables the researcher to define what is happening in blocks of text or a description of incidents, to see implicit processes, and to keep the researcher analyses active and emergent (Charmaz, 2008; Strauss &

Corbin, 1990). In some cases, in vivo codes were identified which are the words or phrases derived directly from the language of the supply chain practitioners (Charmaz, 2006) such as "proactive communication", "buy-in", "engaging with stakeholders", "sign-off". In vivo codes help to discern participants' meanings and in explaining their emergent actions (Charmaz, 2008). The analytic level of grounded codes is mainly descriptive.

As the early patterns emerged, the transcripts were revisited and compared to make sure analysis was indicative of the data. This second layer of analysis ensured that the initial assumptions made in the first analysis process could be challenged and adjusted (Strauss & Corbin, 1990), and encouraged new interpretations of participants' narratives (Charmaz, 2006). Constant comparison of preliminary data sets contributed to the formation of tentative categories.

After the initial codes that are most frequent and significant have been identified, the researcher continued with focused coding that requires the researcher to sort and refine the analysis to synthesize and explain a large amount of data (Charmaz, 2006). The researcher scrutinized her focused codes to evaluate which ones best interpreted the empirical phenomenon, which then became tentative theoretical categories (Charmaz, 2006). Each transcript was reread and revisited carefully and then challenged against initial categories identified in the initial coding. Constant comparison of data against pre-identified categories, and categories against newly categories ensured the analytical worth of the categories. When considering which codes to raise to theoretical categories, the researcher looked for those codes that carry the weight of the analysis. The focused codes were then challenged against the data by using them to study large batches of data (Strauss & Corbin, 1990). This process became beneficial for conceptualizing multiple perspectives of supply chain practitioners whilst ensuring common meaning within the studied phenomena. Concurrent memo writing enabled the researcher to merge, synthesize categories, expound analyses and develop emerging insights. Focused coding continued until

all the theoretical categories were identified (Charmaz, 2006). These major focused codes were treated as tentative categories subject to further analytic treatment (Charmaz, 2008). For example, the codes 'reaching consensus on the decision', "signing off decision" and "escalating decision" were aggregated to create the focused code of "reaching agreement". Another example, "validating information with", "consulting with", "engaging with", and "involving people in" addressed the same notion of the importance of getting relevant stakeholders within their firms engaged in the supply chain decision-making process and were therefore categorized into a more focused code of "engaging with relevant stakeholders".

The final coding step is theoretical coding, which consists of the refinement and abstraction from data and interpretive detection of connections among categories that represented the social reality of the phenomenon (Charmaz, 2006). Theoretical coding provided an insight into the relationship between concepts to develop an integrated theory (Charmaz, 2006). The research conducted intensive comparative analysis, contrasted tentative categories with the codes, and came back to data to ensure an indicative representation of the participants. For example, "engaging with information systems", "engaging with relevant stakeholders" and "engaging with self" addressed the same concept which emphasized the importance of engaging different sources in acquiring and processing information for supply chain decision-making; therefore, the researcher categorized them under a more theoretical abstract code of "informative engaging".

Charmaz (2006) defines the constant comparative method as an iterative process to compare data with data, data with code, code with code, code with category, a category with category, and category with a concept. As the study aimed to understand supply chain professionals' perceptions of SCIV and experiences of how supply chain decisions are made, the constant comparison method was instrumental in developing an abstract rendering of social processes derived from participants' narratives. As previously stated, the guidance provided by Charmaz

(2006) was used within the study to compare data against data, contrast analysis across multiple cases, and develop abstract categories for organizing labels and classifying memos. The advocated methods were developed to enable in-depth exploration into supply chain professionals' perceptions of SCIV for decision-making support and generating insight into how they make supply chain decisions using the visible information.

Diagramming, a visual device that depicts the relationship between analytic concepts is also another tool to be utilized in this analysis process. Accordingly, the researcher drew diagrams extensively during the process of coding using the Xmind8 App. For instance, the researcher drew various diagrams to represent the relationships of categories and sub-themes concerning the research questions. These figures were reviewed, revised, and merged many times during the different steps of coding. In the writing phase, these diagrams were integrated into figures described in the findings and discussion chapters.

3.3.3.3. Theoretical Sufficiency

Theoretical sufficiency occurs when no new patterns emerge in the empirical data in combination with the researcher's theoretical sensitivity (Dey, 1999). Theoretical sufficiency was considered to have been reached when the existing categories coped adequately with new data in such a way that they no longer needed to be extended or modified (Dey, 1999). It does not necessarily mean exhaustion of data sources; it rather refers to the full development of a concept.

Theoretical saturation is traditionally assumed as a fundamental feature of grounded theory for discontinuing data collection and/or analysis and pointing to study completion (B. Saunders et al., 2018). Saturation means that no additional theoretical insights can be derived from analysis, and new data can no longer generate original codes (Glaser & Strauss, 1967). Urquhart (2013,

p. 194) defined saturation as: ‘the point in coding when you find that no new codes occur in the data.”

This study aimed to reach theoretical sufficiency instead of theoretical saturation (Glaser & Strauss, 1967). While both indicate that the data have been properly analyzed, the latter has been criticized because it “has connotations of completion [and] seems to imply that the process of generating categories (and their properties and relations) has been exhaustive” (Dey, 1999, pp. 116-117) which can be argued to resonate with the positivistic assumptions. This concern is mitigated by reframing the notion of saturation as being an analytical process, as opposed to the result of data generation (Dey, 2007).

In this study, in line with grounded theory, data collection and analysis were conducted simultaneously until theoretical sufficiency was judged to have been reached (Charmaz, 2006; Dey, 1999). Theoretical sufficiency was considered to have been reached when the data from these additional interviews did not add any more properties to the core category. Particularly, theoretical sufficiency does not indicate that further sampling might not have revealed new information, but rather that the researcher had sufficient data on which to build a conceptual understanding of how practitioners make supply chain information-based decisions with the available information, without ‘gaps or leaps of logic’ (Morse, 1995).

3.4. Scientific Rigor of the Research

Scientific rigor is of critical importance when determining the worth of empirical research (Manuj & Pohlen, 2012). The quality of grounded theory research may be evaluated using different sets of criteria (Charmaz & Thornberg, 2020). To address scientific rigor within this study, a set of four criteria consisting of credibility, originality, resonance, and usefulness as proposed by Charmaz (2006) was used to appraise quality. This section describes how the researcher addressed the study’s rigor.

Credibility refers to having sufficient relevant data for asking incisive questions about the data, making systematic comparisons throughout the research process, and developing a thorough analysis (Charmaz, 2006). According to Charmaz and Thornberg (2020), interviewing is not considered an effort to mirror reality but as emergent interactions through a mutual exploration of the interviewee's experiences and perspectives. This research adopted the qualitative interview which helped the researcher gather vivid and rich data through asking open-ended questions, listening closely, and following up on what the interviewee was expressing in the interview. The researcher also moved back and forth between collecting and analyzing data that prevented her from collecting data in a random way and feeling overwhelmed due to large amounts of data to work on. Credibility was maintained in this study by conducting systematic comparisons within data sets, across data sets, and ultimately developed into theoretical categories. Constant comparison was maintained throughout analysis leading to the building up of a theoretical model of Pharmaceutical Supply Chain Information-Based Decision-Making. In addition, the sample of 19 participants (except for the 3 participants from a hospital - the customer side) included 3-6 participants from each of the following pharmaceutical firm's types: six from large MNC subsidiaries, six from SME-sized MNC subsidiaries, three from large local firms, three from SME-sized local firms, as illustrated in Table 3.1. The range of specific firm contexts provided an opportunity for comparisons, and to adjust and confirm the emerging model to diverse conditions. It was designed also to augment the credibility of the research and the substantive model (Charmaz, 2014; Charmaz & Thornberg, 2020). Credibility was further enhanced as theoretical sufficiency of concepts was achieved upon theoretical and categories full development. The in-depth conducted interviews and the systematic use of grounded theory methods made sure that the final theoretical model demonstrated research credibility (Charmaz, 2006).

Originality can take varied forms such as offering new insights, providing a fresh conceptualization of a recognized problem, and establishing the significance of the analysis (Charmaz & Thornberg, 2020). Due to the open and exploratory approach, the developed model showed originality (Charmaz, 2006) as it contributes to the literature by offering new insights and providing a fresh conceptualization of information-based decision-making in the pharmaceutical supply chain context with three phases that are driven by the informative engaging mechanism. Particularly, supply chain decision-making literature traditionally assumed that managers are rational – they gather all relevant information and use all necessary time and computational resources to process this information. The model developed in this study showed that because decision-makers are bounded in their ability to acquire and process information, they need to engage with their knowledge and experience in determining information gathering and processing in making supply chain operational decisions. Moreover, the supply chain practitioners hardly decide by themselves, instead, they need to be able to identify and engage with relevant stakeholders to gather proprietary information and more importantly to align their interests and achieve a high level of agreement for the decision.

Resonance demonstrates that the researcher has constructed concepts that not only represent their research participants' experience but also provide insight to others (Charmaz, 2006; Charmaz & Thornberg, 2020). To gain resonance, researchers must fit their data-gathering strategies to illuminate their participants' experiences. The empirical grounding of the model led to resonance as participants in the study and other supply chain practitioners in the pharmaceutical supply chain could recognize most or all elements included in the theoretical model.

Usefulness includes clarifying research participants' understanding of their everyday lives, forming a foundation for policy and practice applications, contributing to creating new lines of research, as well as revealing pervasive processes and practices (Charmaz, 2006; Charmaz &

Thornberg, 2020). The theoretical model also demonstrated usefulness as it contributes to the development in theory-building research in SCM, clarifies the information-based decision-making process in the pharmaceutical supply chain, and reveals that active engagement with relevant stakeholders during the decision-making process seems to be vital to encourage constructive behaviour of internal parties who have different interests and to achieve decision buy-in. This has practical implications in pharmaceutical supply chain decision-making and execution.

3.5. Ethical Considerations

Ethical issues are critical for social research. Ethics must be considered before data collection, as required by the university. The ethical status of this research was discussed with supervisors to review risk factors based on the Code of Ethical Conduct for Research, Teaching, and Evaluation Involving Human Participants.

This study was evaluated by peer review as low risk. Ethical issues related to this study are discussed below. Regarding informed consent, participants were informed about the nature and aims of the research beforehand. Participants' rights were mentioned on the consent sheet, such as freedom to withdraw from the research, the right to ask questions or express doubts, the right to allow or disallow the use of a digital recorder, and the right to be informed about publication details. A detailed information sheet and consent sheet were provided to the participants if they expressed willingness at the time of the initial contact. They then had sufficient time to consider and ask questions before their interview.

As for the protection of confidentiality, the identity of participants and organizations sampled in the study were securely stored so that only the researcher had access to the relevant file. All transcripts, tapes, field notes, and analyzed data were stored under fictitious names to ensure

the confidentiality of participants and their organizations and will be destroyed five years after data collection.

3.6. Chapter Summary

In this chapter, the research philosophy, the research method, and rigor and credibility were discussed. It was discussed that the nature of this study is exploratory and qualitative. The constructivist grounded theory was introduced, and the process of data gathering was explained. The analytical process as well as the rigor of the study was discussed. The ethical considerations were mentioned at the end of the chapter.

Chapter 4: Findings (RQ1) – Supply Chain Information Visibility

4.1. Chapter Overview

This chapter presents the findings in answering the first research question: "How do supply chain professionals perceive supply chain information visibility in the pharmaceutical supply chain?" It is the first of the two chapters reporting the findings from this empirical study. The findings presented in this chapter address participants' perception of supply chain information visibility (SCIV) in the supply chain and its components in the New Zealand pharmaceutical industry. This chapter illustrates the categories and sub-core categories that emerged from the data analysis (Figure 4.1). For each category, examples of the participants' comments are provided, which are interpretively explained.

Prior literature has provided numerous definitions of SCIV; yet there is not any common understanding of SCIV in the pharmaceutical supply chain. In addition, despite the importance of SCIV in supply chain management (SCM), the literature does not offer a clear understanding and evidence about the barriers that might impede pharmaceutical companies from successfully develop SCIV in their supply chain. This chapter presents empirical findings that can address the above gaps. To this end, first, the findings from the supply chain practitioners' understanding of SCIV and its components in the context of the New Zealand pharmaceutical industry are presented. This is then followed by the findings that can help identify the factors that impact developing SCIV.

This chapter is organized as follows. Section 4.2 describes the research context – the New Zealand Pharmaceutical Industry. Section 4.3. shows the findings of participants' definitions of SCIV. Section 4.4 reports the components of SCIV on the internal and external level. Section 4.5 presents findings that are associated with how SCIV can be achieved in the pharmaceutical

supply chain. A summary of the chapter will be provided at the end of the chapter (Section 4.6).

4.2. The Research Context: The New Zealand Pharmaceutical Industry

New Zealand is a relatively small and geographically isolated country with a correspondingly small pharmaceutical market (around 0.1% of the global pharmaceutical market). The country has a small pharmaceutical manufacturing base, as it imports most pharmaceutical products. The headquarters of most of the New Zealand pharmaceutical suppliers are in the United States or Europe, and they supply pharmaceuticals to their affiliates to distribute in the New Zealand market. Most of these pharmaceutical manufacturers have a supply chain structure that uses distributors/wholesalers and a third-party logistics provider in New Zealand. A distributor works closely with a manufacturer to sell more goods and gain better visibility of these goods. Distributors find wholesalers who will re-sell their products. A wholesaler works more closely with retailers to match their needs by buying products in bulk at a discount. The role of the third-party logistics providers is to distribute the products from the manufacturers to the wholesalers/distributors or from the wholesalers/distributors to the hospital pharmacy, depending on the supply chain of the individual organization. In New Zealand, 80% of products in the industry go through Healthcare Logistics - the third-party logistics provider because the company can comply with the strict standards set by the New Zealand Medicines and Medical Devices Safety Authority (Medsafe) (Moore, Matosin, Rook, & Weber, 2015). On the demand side, Pharmaceutical Management Agency (Pharmac), a government agency, is responsible for price negotiations with the manufacturers. Pharmac commonly agrees with the manufacturers the prices that they will pay for drugs under given conditions. Wholesalers will negotiate this price with manufacturers/distributors and receive discounts based on agreed terms of sale. In

turn, community pharmacies will purchase from the wholesaler and receive discounts for agreed terms of sale (Moore et al., 2015).

4.2.1. Regulation in New Zealand Pharmaceutical Industry

Pharmaceuticals is one of the world's most regulated industries. In New Zealand, the Ministry of Health is responsible for the delivery and regulation of healthcare and therapeutic products. These regulatory functions are performed by the Ministry's business unit, Medsafe, which is responsible for regulating therapeutic products, and medicines control, and the distribution chain of medicines. Thus, Medsafe is responsible for quality governance that makes sure the medicines are safe and effective for New Zealanders to use and that they have undergone quality manufacturing and distribution processes. Pharmac is responsible for the government funding of therapeutic products with a priority on low pricing. Pharmac make decisions on which medicines and medical devices are funded to get the best health outcomes within the available funding (Pharmac, 2020).

The New Zealand pharmaceutical market is dominated by its public health system, and therefore Pharmac's monopsony on publicly funded pharmaceuticals and its statutory independence in decision-making give it a strong bargaining position (MacKay, 2005). Pharmac is allocated a fixed annual budget and uses a wide range of methods to generate price competition and to otherwise achieve favourable supply terms (Pharmac, 2020). Pharmac run annual tender processes to negotiate the price and terms of supply of medicines and medical devices that will be purchased for use in the public health system. The winning bidder gets to be the sole supplier of the medicine for a fixed term (usually three years) (MacKay, 2005). Pharmac uses its monopsonist power in negotiating price with suppliers, which can lead to significant price reductions (in some cases greater than 90 per cent) (Vogler, Kilpatrick, & Babar, 2015). This has allowed Pharmac to drastically restrain the growth of

New Zealand's pharmaceutical expenditure while expanding access to medicines (Ragupathy, Kilpatrick, & Babar, 2015). However, a common critique of tendering processes is that the sole supply of medicines may result in a supply shortage (Morgan & Boothe, 2010) Accordingly, Pharmac adopts several mechanisms to avoid supply shortage in New Zealand. According to Pharmac (2020), the main mechanism is a legally enforceable contract with sole pharmaceutical suppliers. The suppliers are required to sign a contract with Pharmac in which they accept responsibility to maintain ongoing supply. In addition to a supplier's general responsibility to maintain a stable supply, the contracts mean that if they become aware of a possible shortage, they are required to notify Pharmac so that action can be taken. Particularly, Pharmac (2020) require suppliers to let Pharmac know if stock levels fall below two months' supply or if they become aware that an out of stock is possible. With advance notice, they can act together to avoid threats to medicines availability. The company is also usually liable for any extra costs involved in sourcing suitable alternatives in case of a supply shortage. In addition, Pharmac take a company's supply track record into account when they are thinking about awarding a supply contract to reduce the risk of selecting unreliable suppliers.

4.2.2. Challenges in The Pharmaceutical Supply Chain in New Zealand

Because most production occurs overseas, New Zealand is also vulnerable to international changes in demand and supply of medicines. These changes can be difficult to predict and may arise because of things like manufacturing shortages, increases in demand because of an epidemic, natural disasters, or changes in regulatory rules in other countries. Because these changes are outside the suppliers' control, they are faced with high-level risks of out of stocks. In addition, New Zealand's geographic location raises lead times to obtain products to around 4–5 months, constraining companies' abilities to react to any shortages (MacKay, 2005; Tran, Childerhouse, & Deakins, 2016).

The tendering mechanism in New Zealand provides sole pharmaceutical suppliers with volume gains and reduction of marketing costs but also exposes them to the high level of risks in managing their supply chain (MacKay, 2005). First, they are contractually obliged to ensure the constant medicines availability for New Zealanders which means that they need to keep a high inventory level or else they are liable to pay all the extra costs for placement in case of supply shortage. Second, in competing for the supply contract, pharmaceutical suppliers have to offer the lowest price to Pharmac, which forces them to find ways to reduce costs and are unable to keep high inventory levels. This affects the whole supply chain including pharmaceutical companies, wholesalers, and pharmacies—thus making the 'pipeline' stocks much lower than they need to be (MacKay, 2005).

Third, pharmaceutical suppliers are also facing uncertainty due to Pharmac's constant switching of products. The sole-supply tenders are often for three years, so products' supply can become tenuous toward the end of the contract period (as uncertainty mounts as to whether the contract will be re-awarded or go to an even cheaper supplier), thus cutting margins and possibly quality and reliability even more. Suppliers that fail to win a tender might have to withdraw their products from New Zealand as there is no longer any market for them. In some cases, entire companies have had to withdraw because their continued presence has become no longer viable in New Zealand (MacKay, 2005). Thus, it is challenging for pharmaceutical firms in making inventory planning.

Operating in the New Zealand market and regulation, pharmaceutical firms must face the dilemma of inventory management. On the one hand, they need to keep high levels of inventory to comply with Pharmac's contract terms and to deal with long lead-time due to the country's geographic isolation. On the other hand, their low margins have made keeping high-level stock uneconomical. Therefore, inventory management is one of the most important areas in managing the supply chain for pharmaceutical firms in New Zealand.

The following figure 4.1 illustrates the findings that will be presented in this chapter. Detailed descriptions are provided in the following sections.

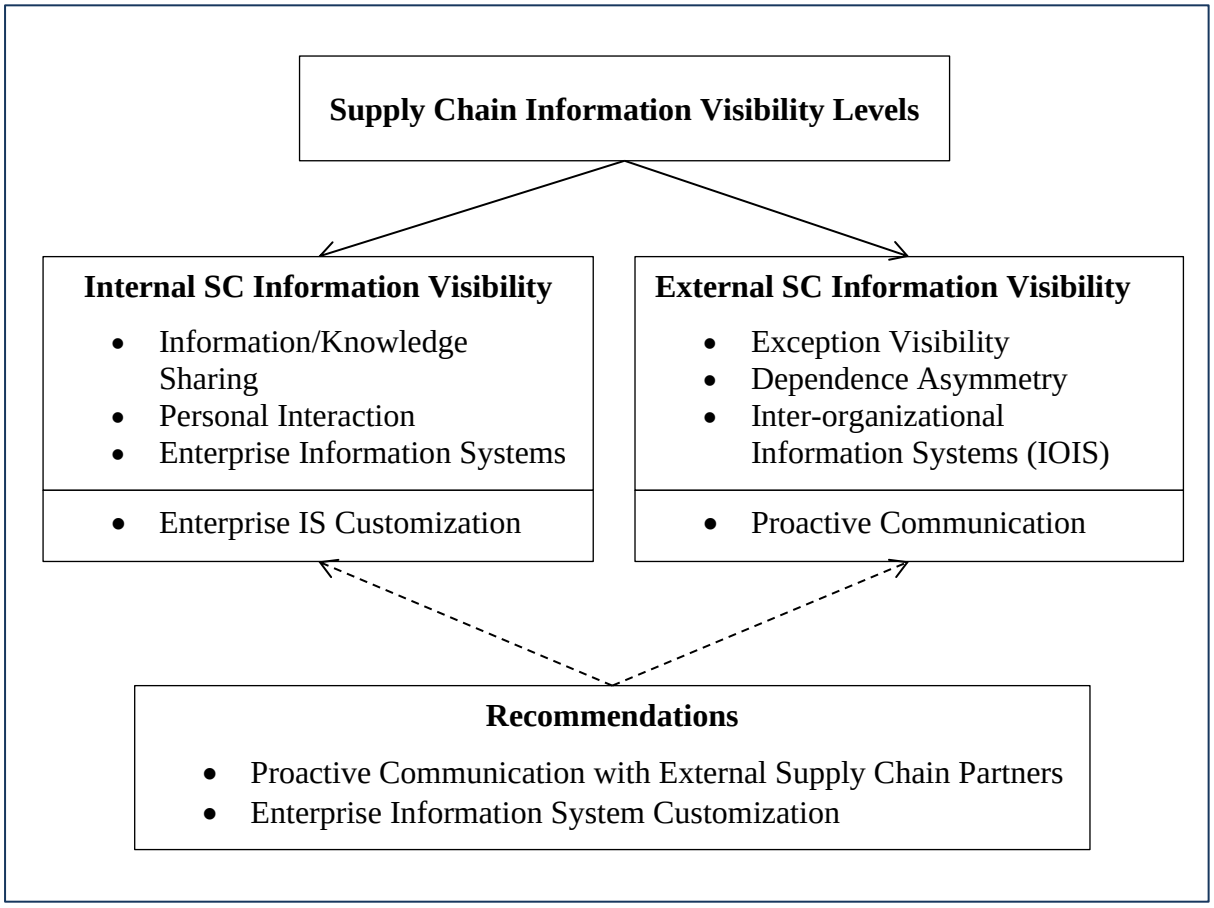

Figure 4.1: The Perception of Supply Chain Information Visibility in The New Zealand Pharmaceutical Supply Chain Context.

4.3. What is Supply Chain Information Visibility?

While SCIV has been a "buzzword" in both academia and industry, most of the participants in this study explained that they did not come across this exact term in their organizations. They, however, could relate it to other existing terms or describe what the term means.

A participant explained that their company did not use the term SCIV, but she considered it as relevant to "transparency".

> *I think we have in place something like visibility, although we do not use the same word. It is transparency rather than visibility but the same thing (Participant 5).*

Another participant stated that:

> *I am sure I know what it means right but I guess I have not come across it in the technical term (Participant 15).*

Participants' perception of SCIV shows that SCIV is an end-to-end transparent view of what is happening across the supply chain. For example, participant 10 defined SCIV as having end-to-end visibility for supply chain coordination:

> *The goal of the supply chain is to have that end-to-end visibility; so, you can effectively and efficiently coordinate all the operations and activities. To ensure that you know you have the supply for a product, you are not holding inventories, you can see where this is, and you can move the resources or support to various areas. To me, that's what it is, it's having visibility of, the sales data, the inventory data, the production data, and transportation data (Participant 10).*

The same understanding was common among most participants. For example, participants 21 and 5 defined SCIV as having end-to-end visibility:

> *Visibility to me means, being able to see all the information from the time that a customer places an order to the delivery of that product and the seamless flow of that communication from start to finish (Participant 21).*
>
> *The supply chain is sort of the end-to-end process. [Visibility is about] at each step, we are sharing information within the system, with colleagues, with customers, with suppliers, with each department (Participant 5).*

In the same vein, participant 16 described SCIV by highlighting the purpose and the advantage of it:

> *[SC Information visibility] helps us build a picture of what is happening within a supply chain. It is a kind of situation awareness (Participant 16).*

As seen in the representative quotes, SCIV is a multi-level phenomenon. That is there are two levels of SCIV. Findings of these two levels are presented in the following section.

4.4. The Supply Chain Information Visibility Levels

According to the participants, SCIV has two levels: internal and external SCIV. *Internal SCIV refers to having a transparent view of what is happening across functional departments within a firm. External SCIV, on the other hand, refers to having a transparent view of what is happening in a firm's external supply chain partners.* Generally, the participants asserted that they have sufficient internal SCIV because of the high level of inter-departmental communication and collaboration within their firms. On the contrary, the level of external SCIV remains limited. The following sentiment by Participant 5 illustrates the different levels of internal and external SCIV:

> *[Supply chain Information visibility] is at different levels. All information is open within the company… We all, anytime, have visibility of each other, of what we are doing, or of the [end-to-end] process. But, on the external level, it is limited. It is only what we need to know, and that is always not everything (Participant 5).*

4.4.1. Internal Supply Chain Information Visibility

Participants believed that internal visibility is when information and knowledge are seamlessly shared across internal departments and functions (i.e., purchasing, manufacturing, distributing, sales, marketing) within a firm. They indicated that because they could build an open communication environment between individuals within their firms that their firms were having a relatively sufficient level of SCIV across their internal business functions. For the participants from pharmaceutical firms that had small and flat structures, the level of internal SCIV is satisfactory. In small and flat-structure organizations, people rely more on

interpersonal communication to share information, and the organization benefits from a more open communication culture. A supply chain manager clearly explained that the organizational structure enabled an informal and open communication environment for information and knowledge sharing within its boundary.

> *It [communication within our company] is very informal because we are a small team. We are very much a team, as a family. It is how I describe it. In New Zealand, we are quite different. You know this is our culture as well. We are a small team. We do not have a lot of hierarchy. Our General Manager sits in an open plan office with everybody else… We have open-plan offices with our different break-out rooms, so it is very informal, and I do not have to book a meeting to talk about a product with the product manager. If I need to talk with supply chain people, I can pick up the phone, flick them a message, call by their desk when I am in the office (Participant 12).*

The findings showed that participants did not find it difficult to share information and knowledge when they were working in small companies in New Zealand. The following participant identified proximity as the facilitating factor for information and knowledge sharing among colleagues in a pharmaceutical firm.

> *We [supply chain and brand managers] generally have monthly communication. But if at a specific time the brand manager needs the assessment immediately, I will let them know immediately. We are lucky here because we are in the same building (Participant 4).*

On the contrary, for the participants from larger companies, it was harder for them to get information/knowledge shared from other members within their firm. For example, one participant described that the larger the size of the company, the more difficult it is to know who has the information/knowledge and to know how and where to find and reach them.

> *We would not have information with everyone in [company] because there are just too many people to know everyone. But you would ask … you'd always try and figure out who the role people are to make sure that you're getting that information correctly (Participant 13).*

A few participants stated that the availability of organizational silo within a large-sized company inhibited a seamless flow of information. Organizational silo refers to a lack of communication among employees within the company where different teams or departments are going towards different goals instead of working together (Abedalla, 2014). When an organizational silo exists, there might be gatekeepers in the companies that inhibit SCIV. For internal information flows, gatekeepers may hold back information that should be disseminated to colleagues in other departments. For example,

> *If we need guidance or help, there is the overarching Product and Supply team, but it is separate from the Sales and Marketing team. So, in that sense, there are times where it is us and them aspect… Our Sales team are the only people who have personal communication with those people [in the market]. And if they have heard that they are fully stocked and going to stop to buy this year, it never flows back. It is a waste because that is exactly the information, we need… Do not wait for it to happen, if you know anything, feed it on (Participant 1).*

The organizational silo structure is considered as a barrier so that information could not flow openly and seamlessly across a company. Thus, even if a person of a department knows exactly where to get the information, they might face structural walls and cannot access needed information.

> *In [our company], it is very much silo sort of departments. We have Procurement, Supply chain, Technical, Quality,…so all the different areas of business… sometimes it is difficult to get everything and in procurement, we want to see everything. We*

like to see everything; we like to be able to look at the big picture. But the lower level you go down, down to operational level, it is kind of silo… They do silo, it is easy to do silos internally (Participant 2).

The findings show that there are three main components of an internal SCIV within a pharmaceutical supply chain: (1) Information/Knowledge Sharing (2) Personal Relationship, (3) Enterprise Information System.

4.4.1.1. Information/Knowledge Sharing

According to participants, and as mentioned above, internal visibility is achieved through seamlessly sharing information/ knowledge between different parties within a focal company. Before the findings of *information/knowledge sharing*, it is necessary to make a clear distinction between information and knowledge.

Information is defined as structured and understandable data, organized to be a useful input to creating knowledge whilst knowledge is derived from the information when people reason or work with information (Bakker, 2006). Knowledge is about beliefs and commitment, validated in a person's perception or expectation for taking actions (Costa, Soares, & De Sousa, 2016). As such, knowledge can be understood as the interpretation of information based on the knowledge and experiences the individual already possesses (Bakker, 2006). According to Polanyi (2009), there are two types of knowledge, explicit and tacit. Explicit knowledge can be in the form of manuals, blueprints, procedures, policies, forecasts, inventory levels, production schedules, market intelligence data... In contrast, tacit knowledge is implicit, hard-to-conceptualized and subjective, and is part of an individual's experiences; it is evidenced in behavior or actions and is often highly ambiguous (Venkitachalam & Busch, 2012).

The participants pointed out that interpersonal communication with internal colleagues such as marketing and sales managers can earn them access to explicit knowledge in the form of market

intelligence. Market knowledge might include objective or explicit information such as market size, demand changes, competitors, regulations, and norms (Costa et al., 2016). Market knowledge requires activities on the market, thus only marketing and sales managers can capture that knowledge and share it with supply chain practitioners through personal interactions. One participant illustrated that talking directly with brand managers can reveal a lot of useful market knowledge:

> *The brand manager has a wealth of information of what is going on in the marketplace, their information is not always be captured in the forecast …The forecast has information of what is going to sell, but when things happen in the marketplace quickly; you often cannot wait for the forecast to be adjusted (Participant 4).*

The statement of participant 2 indicated that important market knowledge can be shared through having face-to-face meetings with marketing colleagues:

> *When you talk to marketers, they know sometimes from hearing out in the business, what is going to happen, what the patterns are. It is good to sit around the table and say, ok this is what we are looking at, any issue? Because they [marketing people] have got such kind of experience. The system is great, you could do sort of predictive analysis and statistical forecasting, but I think some of the guys here are very informative and additive-meaning? as well (Participant 2).*

In addition, participants stated that they can learn proprietary information and knowledge through collaboration with knowledgeable people. One participant described an example of asking the internal expert's advice to verify the information on hand.

> *[If] I would have to check to clarify the information I do have. So, if I am unsure of the reaction of producing something; I will go to the supply manager or directly to salespeople to seek advice (Participant 4).*

Likewise, another participant liked to talk directly with experts to help interpret information correctly:

> *I would say you would always need to talk to people because they're the experts in the areas. And they can explain it to you quite nicely. Rather than looking up in information system and then coming up with your assumptions on what has been said (Participant 13).*

In the same vein, another participant emphasized that collaboration with a knowledgeable person is needed to interpret the information extracted from the information system.

> *At the end of the day, the best system in the world still requires someone with market intelligence to look at it in my view. If you rely just on a software package to pop out the number, you will end up in trouble (Participant 7).*

The second component of internal SCIV is *personal interaction,* which is presented below.

4.4.1.2. Personal Interaction

Related to the previous component of internal SCIV (i.e., information/knowledge sharing), there appeared to be another component that participants referred to as a factor that facilitates internal SCIV within pharmaceutical firms, *personal interaction.* Personal interaction relates to personal regular communication based on close and long-term relationships that foster mutual trust to enhance SCIV. This understanding is reflected by the following sentiment:

> *I interact with marketing because they provide me with a budget. I must work with the Regulatory (department) because they are working with Medsafe and I need to know the status and upcoming regulatory issues or status, quality, and market access… I work with the most, say the whole company (Participant 12).*

Participants preferred direct and interpersonal communication with colleagues of different departments within their firms to acquire and/or share useful information and knowledge. A

manager indicated that (s)he prefers to proactively talk with colleagues in other departments to get updated information.

> *I deal a lot with Quality [colleagues]. Just before we are getting ready to dispatch the product, we have to make sure they pass the testing, so I talk with them a lot. And rather than waiting for them … I just go up to them and say, "I am waiting for something, or have it got through or do you have something on your desk". It is open and I prefer to go to them beforehand. There is a nice lady, and we keep our collaboration closer (Participant 5).*

Particularly, interpersonal interaction is a quicker and more convenient way to provide and/or share information and knowledge across a company's functions.

> *I need them [sales colleagues] to provide me with what is happening out on the market. It is a lot quicker than waiting for each budget review. Like if we do a budget review every quarter and I am needing that every month from them. I cannot wait. I will be chasing them and say what is happening you know so we are in quite close contact (Participant 12).*

In addition, for companies who are part of a multinational corporation, interpersonal communication with global supply chain colleagues is also useful means to get proprietary information and knowledge.

> *We obtain different information [regarding supplier selection] in different ways. For example, with internal [local] colleagues I will ask them to tell me who [suppliers] they currently use, who are our suppliers' competitors in the marketplace, I will go off and I talk to other people outside; if I have a network of people, I will ask who else are around… We have networks like raw materials networks. We have global colleagues... they can help us. We have monthly meetings with our [global] colleagues, and we share information. We share with them what our sourcing*

projects are, then they tell us information about key suppliers, what is happening in advance as they have already dealt with them for a long time. We need to know as much as possible (Participant 2).

Another participant also emphasized the important role of interpersonal relationships in developing internal visibility.

I always had chocolate in my drawer for when Marketing people came along. You made them excited, happy, good to see you – so then they will give you information and now enjoy the relationship with you. Then you can get the information you need to be able to do your job. So again, it is not just doing your job, it is how do you create the relationship to allow you to execute stuff there (Participant 20).

Participant 3 added that building a close relationship was key to enhance open and clear interpersonal communication, which in turn, facilitated information and knowledge sharing.

It depends on the relationship that you have. I think personal communication is essential and you have to have that [to acquire the information you need], and you have to build the relationship (Participant 3).

Unlike the first two components of internal SCIV (i.e., information/knowledge visibility, and personal interaction), there is a third component, *enterprise information system*, which seems to have less impact on SCIV. The findings of this component are presented in the following section.

4.4.1.3. Enterprise Information Systems

Most of the participants mentioned that their firms have adopted ERP systems for capturing, storing, and sharing information. The participants described that they have access to the ERP systems at any time and can collect a large amount of data from there. ERP systems are employed to integrate business processes, by organizing, codifying, and standardizing business

processes and data (Jeyaraj & Sethi, 2012). ERP systems allow generating timely and accurate information within firms and collaboratively sharing this information between firms through an integrated database to have better communication with other firms (Loh & Koh, 2004). Thus, the systems enable employees to access the common database and uniformly manage data, preventing the expense on transportation of data from one department to another, the redundancy, and repetitions of data (Jeyaraj & Sethi, 2012).

Participants stated that they would go to the ERP systems to seek out the needed data in the first place because they can have automatic access to this data at any time.

> *We have SAP [ERP system] to share the information; everything is put in there from production planning to procurement, order, customer service, dispatch of products. All of that we have access to. We can instantly get the information (Participant 5).*
>
> *It is the same [ERP] system […]. The flow is if the marketing department uploaded the forecast, that went automatically to production, and then it is Production can see what the impact of the changes is, and the other way round is also true if Production updated any dates, any quantities… (Participant 3).*

However, they did not perceive ERP systems as an effective element to facilitate internal information visibility. Firstly, participants generally described the available ERP systems as "clunky" and "complex" and thus are difficult to use for serving their information needs.

> *In the future, it [enterprise system] could be good, but right now, in my experience, it is quite clunky (Participant 12).*
>
> *I would happily get rid of SAP [ERP system]. It is clunky and it is not intuitive (Participant 11).*
>
> *There is SAP… It is often an awful system to use in the sense that it is quite complex, (Participant 16).*

Participant 1 stated that it is time-consuming and inconvenient to use ERP systems to collect and/or share data due to its complexity. Specifically, it was challenging in acquiring needed information using the ERP systems.

> *We have the systems which are set up for us to be able to easily change or see any aspect of the supply chain... But it is like every time you bring in the systems, you also bring barriers... There is a lot of wasted time when people trying to find the right information... And it just needs to be given in the way to ensure people are comfortable with (Participant 1).*

In addition, because of the adoption of inappropriate ERP systems, one participant pointed out the failure to adopt the technology for capturing and sharing information automatically.

> *I think that there is a lot of work that we do to try and make the system easier to work with or easier for other partners and other people that are involved in it to be able to submit their information and their data… How do you make that a simple process rather than something that takes half a day? How do you provide with a technology to be able to walk and then just scan up rather than counting it on a piece of paper and then send it back to people and they have to type it to the system? What we are looking at is how do we make it easier (Participant 20).*

In addition, according to the findings, although the internal ERP systems provide supply chain practitioners' access, the data and information stored in the ERP systems are perceived to be of low quality in terms of accuracy and interpretability.

Participants concerned about data inaccuracy because people manually input data in the ERP systems instead of having data sharing and capturing automatedly. Thus, the accuracy of information is dependent on the people who put the data into the systems.

> *We have a reliable system, but it also depends on – how good the people are doing their job because we involve in a lot of inputting [data into the IS] (Participant 19).*

Another participant also pointed out that information in the information systems is perceived as not reliable because the process of capturing information into ERP systems is not automated.

> *The information system is only as good as the good information you put into it... We have a reliable system... But it also depends on how good people are doing their job because [people] involve a lot of input... We cannot just seek and guest the system, that is why we come to ask people (Participant 2).*

Participants 1 and 4 gave examples of how ERP systems might store outdated data because people delay putting data into the systems.

> *For instance, if a supplier sent us something that we purchased, I can track against that supplier as soon as it is in the system... if I expect to see the product in our system and it is late… I would call our warehouse team because there is a chance that it [product] is already sitting at the warehouse but not yet in the system (Participant 1).*
>
> *[My concern] is not the quality of the system itself but the quality of the information that goes into the system (Participant 4).*

In this study, while internal supply chain information visibility refers to having a transparent view of what is happening across functional departments within a firm. External supply chain information visibility refers to having a transparent view of what is happening in a firm's external supply chain partners and is discussed in the next sections.

4.4.2. External Supply Chain Information Visibility

According to the findings, participants agreed that their firms were having limited visibility of their external supply chain partners in terms of both information quantity and quality.

On the supply side, except for the participants from small multinational-corporation affiliates, the participants described a limited level of understanding of what is happening with their

external suppliers (i.e., visibility of material and finished product suppliers). For example, a manager emphasized the lack of supplier visibility due to unwillingness to share information.

> *We lack information from suppliers and from us to suppliers too. Both ways (Participant 2).*

Participant 7 referred to the limited visibility of external suppliers and explains that they were reluctant to share information due to concerns of misusing shared proprietary information.

> *We do not have visibility into our suppliers. They see that [inventory level information] as confidential… because it will provide insights into their whole business. I would consider [the same] if I were them because it is sensitive information. If I had to know, for example, that they have a big stock shortage coming up, then that would be sensitive information. If I were to tell the stock market that this company is going out of stock [then] what would happen to share price. They are not going to share that with me (Participant 7).*

Additionally, another participant gave an example of a supplier's sharing low-quality information even though they were willing to communicate the information.

> *Some suppliers can share how many batches they manufacture a year or how many times a year they manufacture a specific product. Some companies will not be able to give detail at all and make it difficult for us to plan when to place the orders… Like one supplier, I have been emailing for the last week and I said, "I am struggling right now to make a decision whether to increase our current order with you or to wait. What is your lead time?" And they are just being very vague (Participant 21).*

Similarly, some participants remarked that they consider supplier visibility as challenging because they are unable to receive information in time. A manager described an example of the consequence if the company was unable to have information shared on time.

[In case of a supply plant in China is going to close], we might get the notice [from the supplier] 6 months in advance, but it is not enough… We realize that we are stuck because we do not have enough time [to find a replacement] … But if we know in advance [sooner]… it allows us time to qualify the new source (Participant 2).

For the participants from small multinational-corporation affiliates, their firms have had sufficient and reliable levels of supplier SCIV. The reason lies in the close relationship between them and their suppliers who are their headquarters. As these firms are their headquarters' distributors in New Zealand, their suppliers are more willing to share information with them. For example, a manager informed that all their products are supplied by internal suppliers who are their MNC headquarters, and they have established regular interaction with the regional and global point of contact regarding supply issues.

We [New Zealand-based company] are their customer. They are servicing their affiliates, even though we all work for the same company… I have a regional and a global point of contact … If you think of [company] globally, there are many countries, so we have to have someone that takes responsibility for New Zealand and that is my single point of contact… [We can] build up a very good relationship with that single person and they understand the New Zealand business (Participant 12).

On the demand side, participants asserted that they had a limited understanding of what was going on. Particularly, New Zealand pharmaceutical companies have difficulties in getting information shared from customers. Even if they were able to access customer's information, the shared information was not of high quality. As a result, they perceived customer visibility as challenging. One participant described the lack of demand visibility and used "hurt" to symbolize its challenge.

Quite a lot of our customers are reluctant to update [demand forecast]. [Customer] information flow really hurts us. We spend time on the phone and emails trying to

chase updated forecasts all the time… As you know, it is crucial for us to have a bit of [demand] visibility of what is going on (Participant 16).

Participant 2 further explained the reason that inhibiting the information sharing between supply chain partners. Concerns about the probability of leaking sensitive information to unintended recipients and causing negative consequences to have made supply chain partners hesitant to exchange proprietary information.

You have to be very careful because even if you need [external information], your discussion might become an issue and it might go public, they might think you have a problem with your stock or something like that. You have to be careful, do not discuss too early, they can panic… We have to be very careful in this business, especially in this health business (Participant 2).

In addition, participants stated that it is challenging to get accurate information from their customers. One participant described the concern of information inaccuracy:

About our customers, we have got clear forecasts from them. What we generally find is that the customers tend to over forecast. And when you have a huge number of customers who are over forecast then you have got problems. it would be great that the customer forecast was accurate on arrival so then you can try to move towards that (Participant 4).

Similarly, participant 13 claimed the concern of inaccuracy forecast information from customers due to customers' poor competence in creating forecasts.

Some [customers] may not have the best demand planning team which means that their forecast can be fluctuating quite a lot. It is quite difficult for us to plan (Participant 13).

Another participant further explained the reason for limited customer visibility is the nature of the pharmaceutical industry. Notably, that customers of pharmaceutical companies are

generally retail and hospital pharmacies whose primary role is patient service rather than supply chain service. Their information capturing and sharing is not specifically designed for supply chain management purposes. Consequently, customers might be unwilling to share information with pharmaceutical companies or might provide low-quality information.

> *The issue of most pharmaceutical [companies] is the dispensing of products through a retail or hospital pharmacy. And we have no real visibility on the stock level of retail or hospital pharmacies (Participant 7).*

In the same vein, participant 20 claimed that the limited level of customer visibility was common in the pharmaceutical industry due to the nature of their customers' business.

> *Not all of our customers care as much about say, data flow and information… There are some challenges around everybody's accuracy of their data… A lot of the people that place purchase orders on us, their primary role is something else. If they are pharmacies, they are trying to run their business, [and] their business is providing the prescription to a patient... Likewise, for hospitals, their focus is really patients (Participant 20).*

Participant 6 confirmed the reason for the limited level of customer visibility of all the pharmaceutical companies is the customer's information systems are not SCM oriented. As a result, the information sharing with pharmaceuticals firms remained limited.

> *Now, the systems are a little bit dis-oriented; again, most of our focus has been on managing patient's information rather than managing the stocks that have been used for the patients. The problems we have versus other corporates are the corporate probably may have a more mature system to deal with distribution and warehousing and tremendous products. Whereas [our systems] tend to be not poor systems but people probably have not understood logistics because the core competency here is clinical, taking care of patients (Participant 6).*

Generally, external supply chain information visibility is limited and challenging on both supply and demand side due to the unwillingness to share information between supply chain members in the pharmaceutical supply chains. Participants identified three main components of external SCIV: (1) Exception Visibility, (2) Dependency Asymmetry, (3) Inter-organizational information system (IOIS). These components are discussed in the following sections.

4.4.2.1. Exception Visibility

The participants referred to *exception visibility* as one important aspect of external SCIV. Exception visibility refers to having access to information regarding disruption events within a supply chain from relevant supply chain members to manage the supply chain risks. Disruption events are "incidents such as an unanticipated event within a supply chain with the associated negative outcomes of that event on the supply chain" (Nooraie & Mellat Parast, 2015, p. 193). Particularly, the participants described external information visibility as having visibility into the supply chain disruption events that occur or are about to occur as products and materials move along their supply chains.

One participant highlighted how important it is to have visibility of exception events so that they could better manage their pharmaceutical supply chain.

> *We get a monthly report which gives a whole load of other information that I have a quick glance at. It is nice to have but it is not necessary. It would be important to have if we had problems… The information we get on the reports, if there were problems, it is good information… It is important to identify where there are problems (Participant 11).*

Other participants stated that they only have information of exception events and changes shared from external partners.

We manage by exception. We do not have any visibility [on the customer side], apart from, if there is an issue. So, if there has been an issue and they need to let me know (Participant 17).

Likewise, participant 16 described that pharmaceutical supply chain management needs to have real-time alerts and warnings of temperature expiry to avoid the cost of writing off damaged products.

The thing that we currently need is those alerts and warnings, particularly, if there is a temperature expiry. We have unfortunately had to write off a lot of materials over the years particularly in air freight where products can be offloaded at various hubs. The warmer temperature at these places would melt capsules and other things and we went ahead to write a lot of stuff off (Participant 16).

Similarly, other participants stated the necessity of sharing information on supply issues as early as possible so that the company has time to respond to the changes effectively.

We have life-saving medicines, and we cannot run out of stock. If we do, it is just a major, major issue. If there are any issues in the supply of those critical medicines, then we must know about them, and we need to be able to manage them collectively…. So, if there is one thing in the whole supply chain that we need to improve or where we need more information or we could somehow get better is the upstream supply and that's more around earlier notification of supply issues (Participant 18).

All the time and we know the lead times and we know how soon they can send the stock. So normally, if everything goes smoothly, there is no chance to run out of stock except if there are any unexpected manufacturing issue. So, if there is an issue, we will get information beforehand. They know that we keep ordering something on a regular basis. So, when we placed an order and they knew that, oh, there were some

manufacturing issues, not now but maybe a month or even two months later, they let us know. So yeah, we will try to manage to get this filled (Participant 19).

Another participant gave an example of a supplier closure in which situation the company needed to know of the change months in advance to be able to qualify a new supplier because there were only a few available options, and the supplier selection procedure is time-consuming and complicated in the pharmaceutical industry.

[If a manufacturing plant is closing], we would like to know when they will stop the manufacturing… If we know in December that they are closing, we do not have enough time for a [supplier] replacement. But if we know in advance what we can do like - before you close, could you please make x amount for us - that will make sure that beyond December, we have stock in our plant, and it allows us time like six months to qualify the new [supplier]… We need to keep good communication [to be informed] of any change months in advance or even years in advance (Participant 2).

In addition, according to the findings, they require to have item-level information of in-stock and in-transit inventory to track exception events. The adoption of Auto-ID technologies (see 4.4.2.3) for tracking product and materials as it moves along the supply chain enables firms to discover alerts of exception events and ensure compliance with regulatory requirements. As participant 7 stated that the company can have information visibility of in-transit inventory flow as it progresses through the supply chain:

We can track that they [inventory] are on the ship, where the ship is… And we send all our stock out and again we can track where it is, where it has gone, whether it has been received (Participant 7).

Likewise, another participant mentioned the use of data loggers that allow monitoring pharmaceutical products' physical state (i.e., temperature) along with their movement within

the supply chain. The objective of capturing this information is to detect issues that create threats to product quality to comply with the requirements in the New Zealand Code of Good Manufacturing Practice for Manufacture and Distribution of Therapeutic Goods (Medsafe).

> *When our product comes in, they must meet the New Zealand Registered Standards – Medsafe…I check the temperatures when the stock is coming in. Many of our products have biologics, so they must be temperature monitored…[We use] simple data loggers that we have to connect to a USB port and do not require special software. It works but it is not the most efficient (Participant 17).*

In addition to exception visibility, the second aspect of external SCIV that participants referred to was dependence asymmetry.

4.4.2.2. Dependence Asymmetry

According to the findings, the linkage between pharmaceutical firms and their external supply chain partners is based on arms-length relationships. There is a high level of dependence asymmetry between New Zealand pharmaceutical companies and their external suppliers that has led to their transactional linkage. Transactional linkage refers to a weak relationship between supply chain actors that is the opposite of partnership in which supply chain actors collaborate and coordinate closely to achieve shared goals. Dependence in SCM is understood as "a firm's need to maintain its business relationships with supply chain partners to achieve its goals" (Zhang & Huo, 2013, p. 546). In this study, dependence asymmetry is understood as the absolute difference between a focal firm's dependence on a partner and that partner's dependence on the focal firm (Lee et al., 2014; Vijayasarathy, 2010). Particularly, the external partners are not necessarily dependent on New Zealand companies while New Zealand companies are more dependent on external partners. One participant clearly explained that New Zealand businesses are typically too small in value to their partners, thus, external partners are

not dependent on doing business with New Zealand companies to be successful. Thus, there exists transactional linkage between supply chain partners where information sharing only happens on an ad-hoc basis.

> *The challenge when you are in New Zealand is that you are not a major market. You know that we are less than 1% of the global market, so if [external supplier partners] lost 10% of your customers in New Zealand, globally it might be 0.1%. What does that matter? If it was China, then they will do anything they possibly can because it is a major market, and it is growing. Not only because New Zealand is small, but of course the growth is small also… They do not care, I think, is the answer whether you lose 10% customer in New Zealand. It just the risk they would take (Participant 7).*

Similarly, another participant indicated the same reason that external partners are not dependent on New Zealand businesses. Consequently, New Zealand companies are always the least prioritized partners to them.

> *We have life-saving medicines, and we cannot run out of stock... The suppliers usually understand that. But still, we are in New Zealand. We are at the bottom end of the world, and we are usually the last priority (Participant 18).*

Participant 7 further explained the situation where their firm's suppliers were unwilling to provide them access to their information system.

> *[Sharing information through IS] requires that different partners in that chain are willing to give you that connectivity. And as I said, we are significantly disincentive for them to give us that access… [While] we need to have an integrated information systems that talk to each other if we want to have true visibility (Participant 7).*

Meanwhile, New Zealand companies are more dependent on external suppliers because it is very costly and time-consuming to change to a new supplier in the pharmaceutical industry. It

is difficult to find a supplier replacement because there are a limited number of qualified suppliers, and the replacement procedure is highly regulated and time-consuming.

> *The pharmaceutical industry is a regulated industry… And the [limited number of] suppliers that you can source [materials] from can be over the time reduced. Because in pharmaceutical [industry] we have got certain good manufacturing practices (GMP), and we have to buy from reputable companies. And sometimes, a company is going to close due to different regulations in China. It is not easy to work in a regulated industry, while in other industries you can buy from anyone you want. Unfortunately, we cannot do that (Participant 2).*

According to the findings, in the presence of asymmetric dependence, the possibility of opportunistic behaviour by external partners might increase, leading to withholding important information or unwillingness to share proprietary information on time. For example, one participant reflected that the external partners hesitated to share useful information with the focal company although the company has actively shared their information.

> *We provide an update on the forecast every month and on the flip side, we are also looking for the same from our customers. But quite a lot of our customers are reluctant to update. We are often a quite small niche, so a lot of our products are small [in volume]. We are probably of the low value. The products are high value, but low value in spend for a lot of our customers. And then information flow really hurts us (Participant 16).*

Another aspect of external SCIV that participants identified was *inter-organizational information systems.*

4.4.2.3. Inter-organizational Information Systems (IOIS)

For participants, inter-organizational information systems (IOIS) play a critical role in external SCIV. Participants believed that there is a lack of IOIS visibility in the New Zealand pharmaceutical industry due to the unavailability of IOIS through which supply chain members can use to collect, analyze and disseminate information with each other. An IOIS is understood as a network-based information system that extends beyond traditional company boundaries (Hong, 2002). The participants stated that information of external partners was not automatically shared and captured through IOIS. As one participant stated:

> *We do not have the integrated (information systems) with the partners. If anything goes wrong; and we need to receive information from partners, it is just by phone or by email. If something is happening there, then they just call and say, "the delivery date cannot be matched, we need to adjust and so on" (Participant 3).*

Other participants further explained that because of the unavailability of IOIS, a focal company, once receiving information from supply chain partners, had to manually enter that information into the Enterprise Resource Planning (ERP) systems for storing and dissemination across the company. As such, the quality of shared information in terms of timeliness and accuracy is threatened; and thus, there exists a limited level of external visibility. One participant compared information sharing with IOIS (in Australia) and without IOIS (in New Zealand) to illustrate how information is manually put into the company information systems in a delayed manner.

> *We get the data daily [from external partners] but do not enter it in [ERP system]; we enter it into [ERP system]at the end of the month. Whereas in Australia, they will have an electronic link with their distributor and so it is entered daily. So, where they have a daily sales report in Australia, it is generated straight out of [ERP system]. Whereas we do our manually, in an excel spreadsheet… (Participant 11).*

One participant further explained that the New Zealand businesses were required to adopt additional technology to enable direct data transfer. However, they were not able to justify this investment due to New Zealand's small-value business.

> *At the moment, information [from external partners] comes in a file and we transfer it manually into our systems. It would be nice to have direct data transfer, but the cost of doing that is not cost-effective relative to the size of profitability of doing business in New Zealand… We have been talking for a long time about having direct data transfer. But unfortunately, the New Zealand market is small and not very profitable, so it is hard to get the justification to commit the resource to do it (Participant 11).*

Similarly, another participant stated that due to the lack of electronic links, the suppliers also had to manually load the shared information into their internal system:

> *We place an order to our [external supplier] and it is just an Excel spreadsheet [through email] … and they manually load [the order] into their system (Participant 18).*

Especially, despite the absence of IOIS, a few participants described the use of Auto-ID technologies for tracking granular information of products across organizational boundaries, including data loggers and barcodes. Barcodes refer to the placement of computer-readable codes on items to enable efficient track and storage of information about the items moving across the supply chain such as product numbers, serial numbers, and batch numbers (Tatoglu et al., 2016). Barcodes play a key role in the pharmaceutical supply chains, enabling parties like retailers, manufacturers, transport providers, and hospitals to automatically identify and track products as they move through the supply chain and therefore provides greater information visibility. For example, one participant stated:

> *We use a GS1 barcode, we have agreed with GS1 direct global partner that every single product that we do has that information in it. We work with [partners' names] to provide all this information (Participant 20).*

Likewise, another participant described the use of smart data loggers to track a product's temperature condition. The use of a smart data logger provides temperature warning, thus enables companies to identify and proactively respond to disruptive events and avoid damage to product quality.

> *Data loggers are used for temperature warning and providing visibility of [the] freight as it moves… Because a lot of pharmaceutical ingredients are sensitive to temperature… We can put smart data loggers on those, and they would be able to track the goods. That is becoming critical for us, particularly as we get more complex with the number of products that we are working with, and the timeline that we are working with (Participant 16).*

In addition to the two levels of information visibility, the findings showed that there are three specific mechanisms that participants believed could improve SCIV in the pharmaceutical supply chain. These findings are presented in the following section.

4.5. Factors That Can Improve Supply Chain Information Visibility

The participants believed that SCIV in the pharmaceutical supply chain could be improved by (a) proactive communication with external supply chain partners, and (b) Enterprise Information System Customization.

4.5.1. Proactive Communication with external supply chain Partners

According to the findings, the barriers to external SCIV are concerns with the risk of opportunistic behaviour and dependence asymmetry. Thus, participants recommended that their organization could achieve a higher level of SCIV by proactively communicating with their external partners. Proactive communication with external partners means regularly sharing high-quality information with partners and constantly asking for information from them. Participants emphasized that being small players in the supply chain, they need to proactively open and express their commitment with their external partners rather than stay isolated and waiting. Proactive communication might contribute to reducing the risk of opportunistic behaviour and at the same time building mutual trust as the critical condition for information/knowledge sharing. Proactive communication can earn a firm accurate information shared promptly from their external partners.

> *… I think you need communication that either starts from one person and makes it work and it can be a collaborative thing from start… And I think it starts where one side needs to step up and show trust and collaboration first and then the other will respond (Participant 1).*

Further, Participant 2 insists that a company should keep regular communication with their partners even if they have nothing new to share to express their effort and commitment to building a long-term relationship with the partners. Participant 2 illustrated an example.

> *If that is a supplier you only buy from every two years, you [should] contact that supplier twice a year. You keep in contact with them just "how are you doing", "we forecast 24kg in the next year", and then we update for the next six months even though it is a long track to next year. [You ask your suppliers] If you have any change, please let us know as soon as possible... They know that we need to know*

[about changes] as soon as possible so they know how important their business to us … Keep good communication" (Participant 2).

Participant 2 could not emphasize enough the importance of proactive communication to improve relationships with external partners.

We need to keep close relationships with people. Even if we do not have anything to discuss, we remain to contact. Because, when people stop meeting because we do not have anything to discuss then it would become a month and another two months. You have to be always in front of your suppliers to say we are here; we are here so that let them know how important they are (Participant 2).

Similarly, participant 13 emphasized the importance of proactive communication between the company and its external suppliers and customers whenever changes might occur for mutual benefit:

With our top customers, we'll be trying to have calls weekly with them, send emails regularly to make sure that they're fully up to date with what we can do with their products. Um, generally that our kind of lower value customers there is not much information spread because they may only order from us once per year. In that time, there is no need to be in communication with them (Participant 13)

One thing for us is that if we cannot manufacture, we like to let our customers know straight away so that they can start planning for them to distribute. Saying that we are not going to supply in time… and here are the reasons why we cannot supply at this point. They know the actual realistic date that they are going to get it so that they can plan and be able to plan accordingly. And be able to distribute from there. And from them to send us a forecast so that we can know what they want in the future. They can let us know what demand that they need and the points of are they

getting more business? Are they decreasing business? What is going on? That we can be able to supply what their demand is (Participant 13).

4.5.2. Enterprise Information System Customization

Participants claimed that the current ERP systems are too complex to use. One possible reason that can explain this claim is the adoption of an inappropriate ERP system. According to the participants, their companies are using ERP systems that are not specifically developed for SMEs like them.

According to the findings, eighty per cent of New Zealand organizations in this study are using the SAP or Oracle - ERP systems though these ERP systems are generally designed for large enterprises with complex business processes. In addition, one interesting finding is that most of the firms that are using complex ERP systems are subsidiaries of multinational corporations (MNCs). These SMEs are adopting the same ERP systems as their headquarters for information systems standardization on a global scale. They were unable to independently select the most appropriate ERP system for their business needs. The participants complained that the SAP - ERP system is too complex to use while SMEs' business processes do not require such a complex system. For example, according to one participant, while New Zealand-based firms need customized ISs aligning with their specific business operation, the MNC's information systems strategy ignoring their requirements and continues to improve the ERP system towards global standardization.

I have been through probably six ERP changes in my career. The drive seems to be more around standardization rather than customization. So, [standardization means] China does the same as Japan, Japan does the same as New Zealand, New Zealand does the same as Australia type of things. They are trying to make sure that all members work similarly rather than how do we make it [the information system]

perfect for Australia and New Zealand? How do we make it perfect for China?... The drive is always about how to make vanilla ice cream, not about making other flavors (Participant 20).

As a result, the participant recommended that it is necessary to customize ERP systems for their specific business needs; however, simultaneously, they made it clear that they did not have sufficient financial resources to invest in ERP customization.

I think that the information system can be of strategic benefit if it is used right and used with thought around our case, so we got to invest in this. And this is going to allow all this process to work better. Like I said before that we are asking the same pot of money to maybe research something or build a facility... But that money then cannot go into the [information] system to make it better (Participant 20).

This recommendation is in line with small local firms in this research who had success with customized information systems as explained by their managers. These participants of two small local New Zealand companies remarked that their business has adopted appropriate IT applications and has gained good results for their investment. The adopted applications particularly cater to SMEs' needs. One participant described the benefits in terms of inventory cost reduction.

It is an ERP system. It is kind of basic but – and it just copes with what we do. Basically, the order comes in [ERP system] through our website… It has been an amazing system... We have got great visibility on our stockholding, whether we are overstocked or understocked, what the key issues are amongst all that… We used to hold $5 million with the stock inventory. Now we hold between $3 and $3.5 million. So that system enabled us to reduce our inventory down significantly and because we have less inventory, we have less inventory holding cost and we do not write off as much stock (Participant 18).

Another participant also emphasized the importance of having appropriate systems for the specific requirements of the business.

> *Because for a small company, it is quite expensive to have lots and lots of software packages. We only use [application name] and it has quite a good ability to do forecasting or anything like that for us… Being a small company, we obtain information simply from our software which manages our inventory (Participant 7).*

Participants from the New Zealand firms find and adopt appropriate ERP systems which are specifically designed for SME processes and at a reasonable price.

4.6. Chapter Summary

This chapter presented the findings that addressed the first research question: "how do supply chain professionals perceive the SCIV state in the pharmaceutical supply chain?". The findings reported the supply chain professionals' perception of SCIV in the pharmaceutical supply chain. The conceptual categories and the sub-core categories were identified and interpretively elaborated on by providing representative quotes from participants. It was reported that supply chain professionals understand SCIV to be, having a transparent view of what is happening across the end-to-end pharmaceutical supply chain. The findings showed that SCIV has two levels in the pharmaceutical supply chain, internal and external. Internal SCIV refers to having SCIV across different business functions within a firm while external SCIV refers to having SCIV of a firm's external supply chain partners.

Second, this chapter has examined the characters of SCIV at both levels. It reported that the internal SCIV is operationalized with three main components: information/knowledge visibility, personal interaction, and enterprise information system. The external SCIV has three aspects: exception visibility that ensures the sharing of exception events happening in the

supply chain promptly. The other aspects of external SCIV are dependence asymmetry and inter-organizational information system.

This chapter also presented the findings that offered recommendations for SCIV development. The recommendations focus on solving the existing issues that inhibit the development of SCIV at both internal and external levels. The recommendations include proactive communication with external supply chain partners, enterprise information system customization.

While this chapter presented the findings of research question one, the next chapter presents the findings of research question two: How do supply chain professionals make informed supply chain decisions?

Chapter 5: Findings (RQ2) – Information-based Decision-making

5.1. Chapter Overview

This chapter presents the findings that address research question two: How do supply chain professionals make informed supply chain decisions? The findings are based on participants' experience in making decisions in the pharmaceutical supply chain. The findings provide an important understanding of the information-based decision-making process in the New Zealand pharmaceutical supply chain context. The decisions described in this study focus on the operational decisions. While strategic supply chain decision-making includes sourcing, production, facility location and distribution and logistics decisions, operational decision-making includes inventory management, demand forecasting, procurement, scheduling and routing decisions (Gunessee & Subramanian, 2020).

This chapter addresses operational decisions and is divided into four sections, beginning with an overview of the chapter. A description of key findings accompanied by some examples of the participants' quotations of the research question 2 in section 5.2 and section 5.3. The chapter ends with a summary.

5.2. The Information-based Decision-Making Process: "Informative Engaging"

Participants believed that an information-based decision-making process in the pharmaceutical supply chain refers to the open and transparent process where supply chain decisions are made based on high-quality information through an informative engaging mechanism:

> *The decision-making process has to be based on facts and figures… There should be the reasoning for your decision. You present it with certain facts and give your*

reasoning, and then relevant stakeholders need to be agreeable to that (Participant 14).

It is always best to make decisions on a team. So that you can hear information from everyone else to make sure that you are not ignoring, or you have not missed or ignored one thing that can be crucial in your decision-making. For me per se, I need to be working as a team with Sales and Marketing. I try and get information from everyone. And then there will be a small group that will make the final decision (Participant 13).

The findings reported that supply chain decisions must be made based on facts and figures for decision justification and transparency. Particularly, one participant explained that the pharmaceutical industry was ethical and had a high level of accountability. Thus, supply chain decision must be made based on a comprehensive analysis of quality information to ensure the decision-making process is transparent and justifiable.

It is an ethical pharmaceutical industry where you have to base decisions on facts… You just make decisions based on the facts and understanding of the market and what is happening (Participant 11).

Another participant described supply chain decision-making as a data-driven process, and stresses that data-driven decision-making is preferable:

In a supply chain space, it [decision-making] is data-driven... And in my area [supply chain], we prefer data-driven (Participant 15).

Data from another interview explains why data-driven decision-making is important in the pharmaceutical supply chain process. The participant asserts that supply chain decisions in the pharmaceutical industry were regularly audited. As such, decisions must be based on collected evidence to ensure the ability to justify to auditors.

There is usually more comfort if you use evidence than gut feelings, because when the auditors came if they called you into an interview and they wanted to ask, "how did you make the decision from picking this supplier instead of this supplier?" What if something goes wrong? It does not stand a chance if you say I used my gut feeling. So, it is better when you say here is what was provided (Participant 17).

The data analysis showed that the information-based decision-making process in the pharmaceutical supply chain is characterized as an 'informative engaging' process (Figure 5.1). Informative engaging emerged as the core category in the data and appeared to be a pivotal mechanism for the implementation of the information-based decision-making process in the pharmaceutical supply chain. The process is a three-phase process (i.e., informing, option generating, and aligning) through which three engagements take place: engaging with technological tools, engaging with relevant stakeholders, and engaging with self.

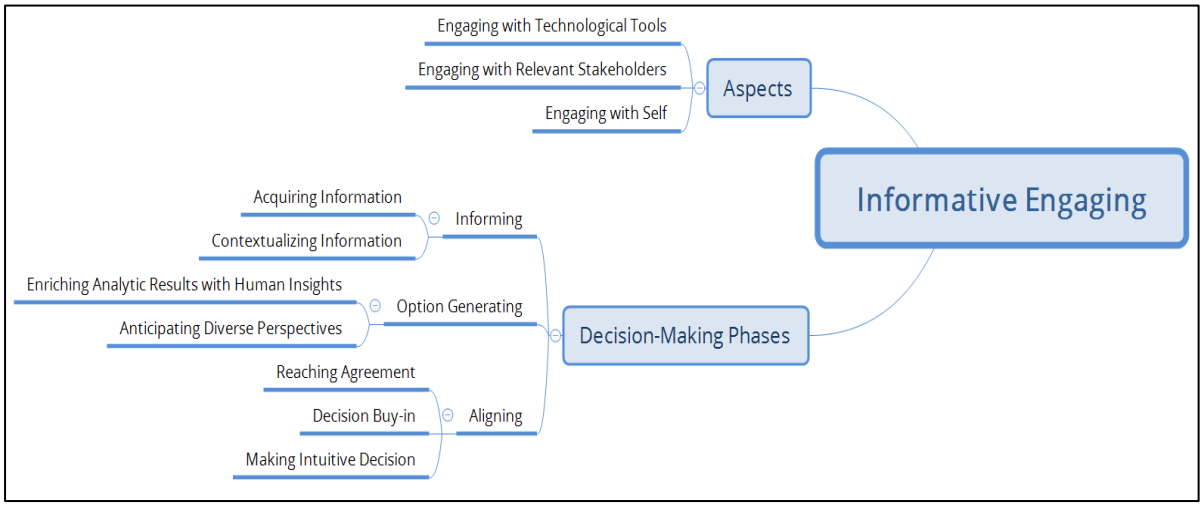

Figure 5.1: Research Question 2 - Core Category and Sub-Categories

Informative Engaging refers to the proactive process where decision-makers deliberately and actively engage with technological tools, relevant stakeholders, and themselves in gathering and transforming quality information and knowledge into an actionable and agreeable decision. The following representative statements from participants explain the informative engaging process:

In our business where the supply chain is pretty much an integrator of all other departments, we work very closely with other departments… Typically, the other areas of the business will be looking to provide recommendations on what we are planning to do. And then those recommendations would then be reviewed by senior management to sign off (Participant 10).

When you have got to decide, you need to understand the stakeholders... You need to get information from different stakeholders and interpret it. It is critical that you engage with stakeholders around the decision you want to make. It is dependent on the seriousness of the decision to determine who to consult, when to consult, when you can go ahead. (Participant 4).

Engaging with technological tools including information systems and analytic tools and relevant stakeholders in the decision-making process enables the decision-makers to collect quality information and anticipate diverse perspectives about the decision situation. This leads to decision-makers being able to make information-based decisions based on non-biased and multi-dimensional points of view.

Our system will apply the algorithm to the historical demand and generate a forecast going forward. It automates that whole process for us, and it has been an amazing system. We have a dashboard, and I can see on that dashboard whether we hold excess stock or whether we have stock that is about to run out. There is a lot of information in there… But on a month-by-month basis, the last part of the month, we read forecasts together - the sales and marketing team and inventory manager, and me. We sit down and we review, go through the forecast the next stock; go through the specific skews if we know that there is an issue, either overstock or understock. Or because of a marketing issue or something is hitting the market, then we need to adjust the forecast manually (Participant18).

We generally make decisions as a team… The information system is great, we could do sort of predictive analysis and statistical forecasting, but I think some of the guys here are very informative and additive as well. We put it [collected information] all together. [Then] we have a meeting, one says, and then other people add something, and we have a good informative decision around the table from what we know… Everyone has its input… You have got everyone is buy-in, everyone agreed on the decision. There is no surprise, no one is left out, and everyone owns it (Participant 2).

The three aspects of the informative engaging process including engaging with technological tools engaging with relevant stakeholders and engaging with self are depicted in Figure 5.2. The following sections will present more interview data about the three aspects of the informative engaging process.

Figure 5.2: The Informative Engaging Aspects

5.2.1. Engaging with The Supply Chain Information Systems

According to the findings, *engaging with technological tools* refers to the process of utilizing information systems and analytical tools to acquire, analyze quality information, and maybe generate options during the supply chain decision-making process. The process of engaging with technological tools enables decision-makers to gather and put information into action to make informed decisions. However, the effectiveness of utilizing technological tools is

dependent on the decision-makers' ability to use the tools and the quality of the information generated from these tools.

The supply chain management information systems are designed to provide information and information processing capability to support the strategy, operations, management analysis, and decision-making functions in the supply chain (Tarokh and Soroor, 2006) (see 2.4.4.1). According to the findings, decision-makers engage with SCM information systems to acquire and/or to share information with relevant stakeholders. Supply chain professionals can have access to the SCM information systems at any time and collect and share a large amount of data.

Supply chain data and information from different functional divisions are captured and managed in the ERP systems that create a common database. Decision-makers engage with ERP systems to gather historical and predictive data, i.e., what happened or what is happening across the supply chain for the decision-making process. Participants stated that information systems are the main data sources for supply chain decision-making.

> *We have SAP [ERP system] to share the information; everything is put in there from production planning to procurement, order, customer service, dispatch of products. All of that, we have access to. So, we can instantly get the information (Participant 5).*
>
> *It is the same integrated [ERP] system […]. The information flow is if the Marketing [department] uploaded the forecast, that went automatically to Production, and then it is Production can see what the impact of the changes is, and the other way round is also true (Participant 3).*

However, the availability of ERP systems does not guarantee that decision-makers can get access to the right data. As pointed out in chapter 4, there are many issues with the existing ERP systems. The ERP systems are considered to store a large data set from a variety of sources

within a company. Unfortunately, participants reported that they sometimes have difficulty in gathering useful data. Due to the complication of the systems, it took a lot of time and was difficult for decision-makers to locate and retrieve the right data in the IS even though they knew the data was available.

> *We have the systems which are set up for us to be able to easily change or see any aspect of the supply chain... But it's like every time you bring in the systems, you also bring barriers... There is a lot of wasted time when people trying to find the right information... And, it just needs to be given in the way to ensure people are comfortable with (Participant 1).*

Other participants added that the firm needed a common database to avoid storing data in dispersed systems. The reason is despite the availability of data in the systems, it is challenging for the participants to locate and access the data they needed.

> *I need a [common] database where I can grasp all the data at once. Because sometimes, people need to make a decision, but it is delayed because they have to keep looking for information in different places (Participant 3).*

Participants were concerned about data inaccuracy because people manually input data in the ERP systems instead of having data sharing and capturing automatedly. Thus, the accuracy of information is dependent on the people who put the data into the systems.

> *We have a reliable system, but it also depends on – how good the people are doing their job because we involve in a lot of inputting [data into the IS] (Participant 19).*

In addition, some participants mentioned that engaging with ERP systems enables them not only to access a common set of data but also generates insights from data using existing analytic tools. Participant 10 engaged with the enterprise system to acquire a historical view of supply chain activities and generate forecasts based on historical data using analytic tools embedded in the system.

I suppose SAP [ERP system] and other tools can help with historical perspective and getting you a historical view, which may help you in making decisions going forward. We do have good analytic tools for our forecasting. Most things in the supply chain are available or calculable so typically most of the information is accessible so you can tend to get access to it (Participant 10).

Most of the participants stated their preference for using Excel spreadsheets as the tool for data management and data analytics. According to them, Excel spreadsheets are flexible and easy to use.

We manage quality information by Excel. I am not the only one because most of the people and even the marketing people like to do their spreadsheets (Participant 19). Excel is still the way we really manage a lot of our information. Obviously, we stick it in SAP [ERP system] and SAP becomes the master data holder. But a lot of the analysis and a lot of our reports and stuff are excel-based (Participant 15).

Participant 15 continued to explain the benefits of using Excel for data analysis.

Excel is especially important, as it is so flexible. You have got a million reasons why you might want to manipulate data or look at something in a certain way on Excel. It is just so flexible… To my experience with that flexibility of Excel, it is just so powerful that it ends up being used regardless (Participant 15).

Furthermore, another participant asserted that Excel is the preferable analytic tool rather than information system-based tools.

SAP [analytic tools] is clunky. It is clunky and it is not intuitive. If we were to do any analysis or anything we download the numbers from SAP [ERP system] and we do it in Excel. Excel is far better and simpler (Participant 11).

Besides using Excel as the dominant analytical tool, participants from firms that have appropriate and efficient information systems asserted the usefulness of engaging with information system-based analytical tools in generating historical patterns and forecasts.

> *The information system can basically provide shaped history and tell you what the next few months to be the trend (Participant 7).*

In addition, another participant reported that engaging with analytic tools facilitates decision-makers to aggregate, manipulate, and analyze historical data to create valuable insights.

> *It is a standalone demand management system... Basically, all the sales go into it. We have historical sales for every stock-keeping unit (SKU), or pretty much every stock-keeping unit... Our system will apply the algorithm to the historical demand and generate a forecast going forward. It automates that whole process for us, and it has been an amazing system. We also have a dashboard, and we can see on that dashboard whether we hold excess stock or whether we have stock that is about to run out (Participant 18).*

Similarly, another participant mentioned the importance of using data visualization tools to present data results in a digestible format. It helps to develop a common understanding and put everyone on the same page.

> *It is like a simple graph. When we are doing our forecasting, we can just visualize it on a page. So, we can see a tidy graph that is showing us the historical data, expected data, and showing clear trend… Because if you are just looking at numbers, it would be way less intuitive about what the data is doing (Participant 15).*

5.2.2. Engaging with Relevant Stakeholders

Engaging with relevant stakeholders refers to the process of proactively involving relevant stakeholders in different phases of the supply chain decision-making process. This is the

proactive and transparent mechanism that facilitates the exchanging of proprietary information/knowledge and gaining alignment between different stakeholders in the decision-making process. The objective of engaging with relevant stakeholders is to facilitate a transparent and open decision-making process for decision commitment and coordinated execution. Participants reported that engaging with stakeholders involves identifying the relevant stakeholders in a specific decision-making process and engaging with relevant stakeholders in different stages in the decision-making process.

According to the findings, the relevant stakeholders can provide valuable information/knowledge and/or have an interest related to the decision. Stakeholders who have the impact or interest related to the decision should be engaged in the decision-making process. For example, Participant 3 engaged with the subordinates in the decision-making process for their commitment to the decision execution.

> *If it is something that could impact the team, I try to involve everybody that needs to be involved in making the decision together. Because what I see at the end, if the decision is taken that involved you but you were not involved, it could be that you are not so engaged to that as if you would be if you were involved. Every time if I see the benefit if I involve the group, I will try to do that because I think it's more successful for the implementation and success (Participant 3).*

In addition, according to the findings, decision-makers need to engage with people who have relevant expertise or proprietary information in the decision-making process to collect high-quality input for better decision support. It leads to expanding the decision-makers' knowingness and understanding of the decision situation.

> *When you need to make a decision, you need to get information from different stakeholders and interpret it. Supply planning is all about numbers, so you must try*

to command the stakeholders down to give you numbers, but you need to understand what is behind the numbers (Participant 4).

Participants further stated that engaging with relevant stakeholders can help in interpreting information.

I would always need to talk to actual people because they are the experts in those areas. And they can explain it to you quite nicely. Rather than looking it up on information systems and then coming up with their assumptions on what has been said… I think that talking to people is much better and way more relevant (Participant 13).

Another participant asserted that engaging relevant stakeholders in an open discussion during the decision-making process facilitates stakeholders to raise their interests and concerns, leading to mutual understanding and reaching consensus.

I would always involve the Chief Operating Officer and the person looking after our finance, so it will be at least three of us will look at the inventory that we have on hand, what we have been sold, and what our forecasts are… [When] the Chief Operating Officer put forwards our forecast, if we are comfortable with that then we will sign on that, and if we are not comfortable with that we will discuss and reach consensus where we are comfortable with and sign it off (Participant 7).

The third component of 'informative engaging' that participants identified is *engaging with self*.

5.2.3. Engaging with Self

Engaging with self refers to a mindful process through which the decision-maker relies on their intuition (see 2.5.2.2) in the decision-making process. According to the findings, decision-

maker's intuition refers to their experience and business understanding that enable decision-makers to determine the information sources and the extent of the data collection and analysis.

> *I don't necessarily need to know everything in detail, but I need to know at the back of my head the overall big picture of what's trying to be achieved and if it [the information] is relevant then yes, I'll know the full detail of it (Participant 12).*

In addition, another participant asserted that the decision-makers need to use their intuition in determining the extent of data collection and analysis to avoid information overload in the decision-making process. Information overload refers to the excess amount of information available that potentially result in confusion and uncertainty.

> *I think, there's so much information. [Decision-maker] needs to be able to sort through what is critical and analyse it (Participant 16).*

To gather the most relevant information and avoid information overload, one participant suggested that when considering a piece of information, the decision-maker uses intuition to determine the most useful information for decision support:

> *"... ask yourself "what would I do differently as a result of this information? If the answer is "yes", I will still top-down graph and order my stock, if it is "no" then I would say do not get the information. Because it will add nothing, and it only distracts you (Participant 7)."*

In addition, some experienced participants stated that decision-makers should incorporate their own experience and business understanding in interpreting information. One participant mentioned that it is necessary to use prior experiences to support information interpretation.

> *You have to use experience and knowledge to actually interpret the facts [...]. So, you can understand what is causing the numbers, you can understand that you had high sales in the first half of the year more than normal because a competitor was out of stock (Participant 11).*

Similarly, another participant described the incorporation of their experience in dealing with relevant stakeholders in the decision-making process to achieve decision approval.

> *What I might do now, after almost 20 years into a career, is different from what I might have done 15 years ago. Because I have got better at doing different things and that my experience has led me to head towards [persuading stakeholders with] more of that soft side [telling a story] and other pieces than just only ever focusing on the data (Participant 20).*

Especially, one experienced participant asserted that they heavily rely on their own experience in combination with acquired data in making supply chain decisions.

> *I am autonomous in making decisions. I do not need endorsements from management. The key success of my role is experience because I have been there so long. So, the major factor in my daily decision-making is experience not necessarily information. I mean obviously, I rely on information from sales: what were our sales, what is our stock on hand, so that sort of information I need (Participant 12).*

According to the findings, the three aspects of informative engaging (i.e., engaging with technological tools, engaging with relevant stakeholders, and engaging with self) drive the whole process of the information-based decision-making in the pharmaceutical supply chain process. The findings of the three-phase process are presented in the following section.

5.3. The Phases of the Information-based Decision-Making Process

The information-based decision-making process involves three main phases driven by the process of informative engaging: informing, option generating and option validating. The 'informing' phase consists of *information acquiring* and *contextualizing information.* The phase 'option generating' includes *enriching analytics results with human insight* and

anticipating diverse perspectives. The third phase, 'aligning', consists of three sub-sets: *reaching agreement, decision buy-in,* and *making an intuitive decision* (Figure 5.3).

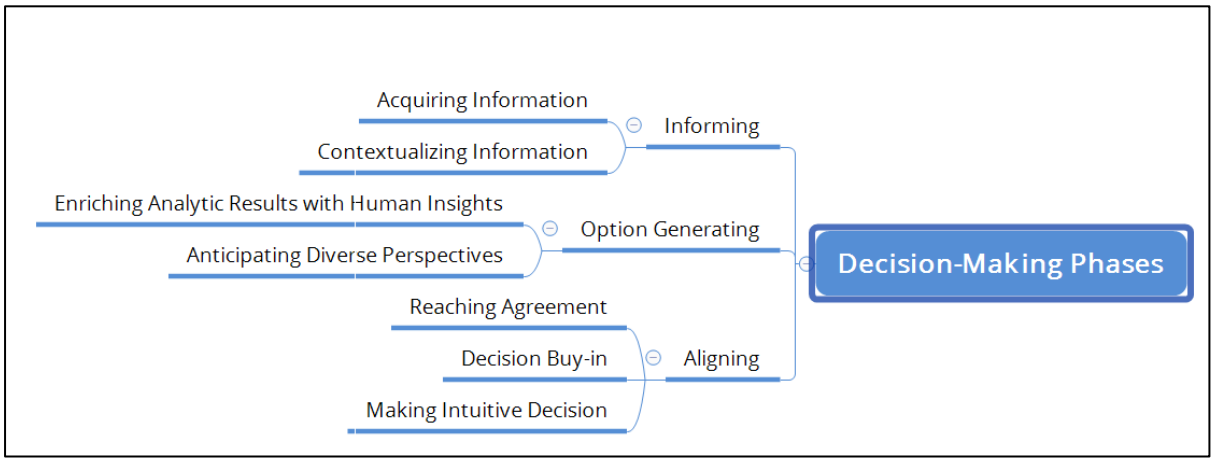

Figure 5.3: The Information-based Decision-making Phases

These phases are implemented to ensure the decision-making process is transparent and based on quality information to achieve high levels of agreement amongst relevant stakeholders.

5.3.1. Informing

Informing phase refers to the process of acquiring and interpreting quality information from multiple sources (including both technology-based and human sources). This phase involves the decision-makers proactively engaging with their selves in determining relevant and useful information sources and interpreting the collected information. It also involves the process of engaging with both information systems and stakeholders to collect a quality information base for decision support.

5.3.1.1. Acquiring Information

The participants consistently reported that information from external partners is important for them in making decisions; however, it is challenging for them to gather information from their suppliers and customers (see Section 4.4.2). Participants stated that they heavily rely on internal information sources to gather information for their supply chain decision-making. First, the

decision-makers engage with themselves in determining the information sources they will go to and the information they need to acquire for decision support; and then engage with various sources to acquire the needed information.

According to the findings, making supply chain decisions "require information from different areas", which requires the decision-maker to engage with multiple sources including both information systems and human sources for information gathering.

> *I obtain different information in different ways. For example, with internal colleagues, I will ask them to tell me who [suppliers] they currently use, who are our suppliers' competitors in the marketplace. I will go off and I talk to other people outside; if I have a network of people, I will ask who else is around. Then I will talk with the business [function] what are the important requirements for them about suppliers? I will look into the [ERP] system, if I look for financial information, I'll look at how much they spent over the past X amount of time. When I go out to market, I can then get all the quotations and come back, then I can start analyzing and I can benchmark (Participant 2).*

Similarly, another participant added that collecting information from different sources will provide decision-makers with a holistic view of the decision situation.

> *If we have got a problem, we need information and we will get all sorts of information from different places. We have some data we just had and clear… We look through our systems. It is not too hard. You have got stock and you have got demand. You got the price. You got those factors… Another team will have something subjective. It would be the reports from other representatives in the field or by the managers saying this is a situation. They believe that this is the right thing to do, whatever. We need to take all information and that's part of the decision-making process (Participant 18).*

Participants generally reported that they can gather historical data from the enterprise information systems. However, they preferred to engage with human sources to get updated information and relevant knowledge.

> *I would say you would need to talk to people because the information in SAP [ERP system] is just raw data, so you would always need to talk to people because they're the experts in those areas. And they can explain it to you quite nicely. Rather than looking upon information systems and then coming up with their assumptions on what has been said. I think that talking to people is much better and way more relevant because then you get the information behind why it is happening rather than come off with your own assumptions (Participant 13).*

Some participants asserted that they prefer to gather information from human sources because they believe that knowledgeable people are more resourceful, and thus the knowledge acquired from them are more useful than from the information systems.

> *I think I would place greater value on personal communication. I think it is much more valuable than the raw data [in the ESs…Brand manager has a wealth of information of what is going on in the marketplace, their information is not always be captured in the forecast… The forecast has information of what is going to sell but when things happen in the marketplace quickly, and you often cannot wait for the forecast to be adjusted (Participant 4).*

Another participant added that market knowledge gathered from relevant stakeholders complements information collected from other sources.

> *When you talk to marketers, they know sometimes from hearing out in the business, what is going to happen, what the patterns are. It is good to sit around the table and say, ok this is what we are looking at, any issue? Because they [marketing people] have got such kind of experience. The system is great, you could do sort of predictive*

analysis and statistical forecasting, but I think some of the guys here are informative and additive as well (Participant 2).

In addition to engaging with knowledgeable people to interpret information from a holistic view, participants also noted the possibility of engaging with the decision-maker's knowledge himself in interpreting information implication. For example, participant 4 asserted that using his (her) knowledge make changes to the information in the information systems.

They update forecast [in the information systems] monthly but they do not process the change… I will rely on my knowingness to overwrite the system basically or else we are not responsive [to changes] (Participant 4).

With the overwhelming amount of data available to decision-makers, participants need to engage with themselves to decide the extent of information collection to avoid information overload that might lead to "analysis paralysis". That means, although the decision-maker can access a variety of information sources, they need to be selective to avoid being distracted and confused. The right information is the most relevant to their decision-making requirements.

I always consider what really impacts the business? What [information] is relevant? Because sometimes we have lots of information that is not relevant, or it would not make a difference… And it can be different from time-to-time, from problem-to-problem (Participant 3).

One participant reported that instead of gathering as much information as possible, the decision-makers look for information that is relevant to mindfully solving the given problem.

I do not necessarily know everything in detail, but I need to know at the back of my head that the overall big picture of what is trying to be achieved. And if it [the information] is relating to me then yes, I will know the full detail of it (Participant 12).

Other participant asserted that decision-makers engage with their intuition to validate the information's accuracy. Participants generally agreed that the right information for the decision-making process is the one they can trust for its accuracy.

> *Everybody needs to give me the correct information. Whether it is the partner, if it is the managers or the subordinates, the information must be accurate. I need to trust the information is right. If I do not trust the information is right, then that will be the last one to consider (Participant 3).*

Similarly, participant 13 emphasized that the decision-makers must trust the information is accurate to use it in the decision-making process. When they can trust the information, it becomes fit for use.

> *How would I describe good information? It is the reliability of it… The way the supply chain would work is that we get relevant information, and we just have to trust in others that actually know the specific details of the information (Participant 13).*

5.3.1.2. Contextualizing Information

Contextualizing refers to information interpretation in its relevant context. Without understanding the contextual factors, the decision-makers might falsely interpret the information. For example, one participant described the importance of interpreting the collected data through embedding the data into its real context to accurately define the decision problems. For example, in the case of "having too much stock", there is a problem, but being overstocked is just a symptom indicating the existence of an underlying problem. It is vital to understand all the contextual factors to define the real problem.

> *If you have got a problem, the first thing is – what is the problem? We have got too much stock. But then you need to spend some time on that situation… most people*

> *do not spend enough time on that: you have too much stock. OK. "What do we need to do? What's the solution?" But no, we have got too much stock, "why is it?" and get a good understanding. So "did we just make a mistake and order too much?" or "is it because a competitor has done something?" or "has something else happened in the marketplace" (Participant 18).*

Similarly, another participant stated the importance of information contextualizing to correctly understand the issue.

> *If your [business] growth in the first half of the year is way bigger than the second half of the year; you should understand what was causing the numbers. You should understand that you had some export orders in the first half of the years, so that's [contextual] understanding (Participant 11).*

Other participants explained that the decision-makers cannot merely rely on the statistical forecast generated in the information systems to determine the existence of a real problem. The key issue is figuring out whether the system is reporting a problem or only the symptoms of a problem. Thus, the participant needed to consider the related contextual factors in addition to the information systems-generated forecast. When making a purchasing decision, the participant had to understand the contextual factors that impact the demand forecast, thereby identify a real problem.

> *Historical information is good when I am looking into what is the demand for the next two or three years. But [when I need to make a sourcing decision] I need to be careful because in some areas of our business if a product has been out of stock, I need to understand whether there is a seasonal product or a competitor [prior to making a decision].*

Furthermore, participant 3 discussed the need to understand the context of the decision to determine the relevance of the information to support decision-making. By using a reverse

engineering technique, the decision-maker could figure out what information is relevant based on a clear understanding of the decision objective.

> *I try to concentrate to put more value on where the big business impact is…I have to look into the future. If I do not lose the margin now, I will lose the customer, I will lose them forever. It is better to lose the margin now and keep the customer because next year I can recover that…If I just get the information regarding we are losing our customer, I don't care about cost. Because it does not make a difference because we are focusing on keeping the customers, then I just make the decision (Participant 3).*

The second phase of information-based decision-making is *option-generating.*

5.3.2. Option Generating

The option-generating phase refers to the comprehensive process of discovering and generating options based on the information collected in the informing phase. In this phase, alternative options are generated out of an open and active engagement process with the decision-makers' business knowledge and experience, with relevant stakeholders, and with the analytic tools.

5.3.2.1. Enriching Analytic Results with Human Insights

According to the findings, for the forecasting decisions, the decision-makers engage with analytic tools (see section 5.2.1.1) in assessing the measurable aspects of the decision situation and suggesting forecasts based on historical data. However good the quality of the analytic-tool-generated suggestions, participants consistently recommended engaging with themselves and/or with relevant stakeholders to enrich the analytical results and generate the ultimate options. Thus, the decision-makers engaged with the analytic tools, with themselves, and in

further open discussion with stakeholders to ensure a holistic understanding of the problem and support the decision-makers in generating better options.

One participant discussed the importance of utilizing analytic tools to create initial forecasts and incorporate their market understanding to supplement and generate revised options.

> *[The information system] has a quite good ability to do forecasting or anything like that for us. However, at the end of the day, the best system in the world still requires someone with market intelligence to look at it in my view. If you rely just on a software package to pop out the numbers, you will end up in trouble (Participant 7).*

Similarly, participant 12 provided an example of the necessity to incorporate their experience and business knowledge to adjust the forecasts made in the supply chain information systems. The participant explained that there may be proprietary information that was not captured in the system. Thus, the decision-makers had to add more insights to the analytical results to generate better-informed forecasts.

> *I do not [100%] agree with [forecasts] in the Advanced Planner and Optimizer system because the system is only a computer system, it is not a human. I have never not reviewed it, every month. The Advanced Planner and Optimizer does not know if we have got a contract that we have been awarded in the future. This is the manual adjustment that I have to put in there… Because it is system generated forecast, so I am just validating it… [While] the forecast considers only historical data, I am also looking mainly for the future as the stock I am ordering in is for the future not the past… so I will tweak it and make the changes needed (Participant 12).*

In addition, the findings reported that decision-makers engaged with multiple stakeholders with relevant expertise to enrich the insights generated in the analytic tools. The analytic insights might provide decision-makers with a limited or incorrect understanding of the decision situation because they are created from historical data. Thus, the combination of analytic results

and additional knowledge elicited from experts will provide a holistic view of the problem and support the decisionmakers in generating better options.

Participant 18 described the process of engaging with stakeholders of different internal functional areas in reviewing and improving forecasts generated automatically in the information systems and eventually create options collaboratively. Specifically, relevant stakeholders were invited to a consensus forecast meeting in which they were proactively engaged in reviewing and contributing richer knowledge to the analytic forecasts. This open and transparent discussion encouraged stakeholders to surface private and proprietary information to improve the analytic forecasts.

> *Our system will apply the algorithm to the historical demand and generate a forecast going forward. It automates that whole process for us, and it has been an amazing system. We have a dashboard, and I can see on that dashboard whether we hold excess stock or whether we have stock that is about to run out. There is a lot of information in there… But on a month-by-month basis, the last part of the month, we read forecasts together - the sales and marketing team and inventory manager, and me. We sit down and we review, go through the forecast of the next stock; go through the specific skews if we know that there is an issue, either overstock or understock. Or because of a marketing issue or something is hitting the market, then we need to adjust the forecast manually (Participant18).*

In addition, according to the findings, the participants mentioned that they actively consult with relevant stakeholders to discover and develop alternative options. This engagement with stakeholders helped participants identify and anticipate diverse perspectives.

5.3.2.2. Anticipating Diverse Perspectives

Participants asserted that supply chain decisions generally relate to different internal divisions' activities. Therefore, the decision-maker must engage with relevant stakeholders via open discussion to surface various concerns and perspectives to be incorporated in generating options.

> *In our business where the supply chain is pretty much an integrator of all other departments, we work very closely with other departments… Typically, the other areas of the business will be looking to provide recommendations on what we are planning to do. And then those recommendations would then be reviewed by senior management to sign off (Participant 10).*

Participants also explained that engaging relevant stakeholders in an open discussion facilitate the emergence of diverse options.

> *We need to come up with a variety of different options in a team. We need to brainstorm and come up with multiple options. No idea is a silly idea. What about this and this and this? And as a team, we get more options (Participant 18).*

Similarly, another participant described the process of discussing with multiple stakeholders for suggestions around different aspects of the decision situation. The decision-maker was open to multiple perspectives in finding and generating alternatives.

> *[I need to make] the production planning that determining, in the next four weeks, what we are going to make. So that requires an assessment of what we need to make, and what we can make. I will consult with supply planners about what we should make, I will consult with the production manager about what we can make. I will consult with the quality team to make sure that we are able to make so that all materials are released in time. I will talk with those three parties and raise any issue*

particularly with supply planners on whether we can make what they want (Participant 4).

I never tend to make the decision myself; I would either ask my colleagues, our team. I will go and see them and ask them: "what do you think?" or "do you have anything to add?". Sometimes, people from quality department have information that will change our whole angle (Participant 5).

In addition, Participant 21 clearly stated the need to engage with relevant stakeholders to make sure that the decision-makers have anticipated the needs and perspectives of all the relevant stakeholders in the discovery and generation of options.

*We have individual forecasts. We have two planners that do all the forecasting. But we have a weekly meeting after they have submitted the updates for the week to verify and make sure that there is nothing there, we have missed with stakeholders from every business area… We've got all the representatives from different areas [*i.e.*, procurement, planning, manufacturing, packaging, and quality] coming together and we go through forecasts and say: "This is the plan? Is this going to be achievable? What are all the considerations?... I think the disadvantage is, sometimes, we compare too many opinions, but the advantage is at least you are considering all the possible options. I guess some potential risk areas might have been missed previously (Participant 21).*

In the same vein, other participants described a deliberate phase in the decision-making process where decision-makers engaged with relevant stakeholders in numerous meetings to inform their options and consult stakeholders with any concern relating to the initial options. The decision-makers then incorporated all the recommendations in making the final decision. The decision-making process became transparent to all the stakeholders.

> *We would put all the data together, measure it, and see where the costs fall out. [Then] we will generally go through numerous meetings with regional people as well as with the local people to just say, "This is what we're looking at. This is what we think we need to do. This is what the next step is." And then we might go through a couple of rounds with the parties to see where they think we need to be. And after that, we might make a decision (Participant 20).*

Participants stated that the options that are generated during the option generating phase need to reflect relevant stakeholders' concerns. Options that are not aligned with stakeholders' concerns are less likely to acquire stakeholders' support. This finding represents the third phase of information-based decision-making in the pharmaceutical supply chain process, the aligning phase.

5.3.3. Aligning

The aligning phase is the third phase in the information-based decision-making process. This phase refers to a process to ensure that the whole of the relevant stakeholders' concerns is identified and considered. The aligning process is important as it would result in decisions being supported by relevant stakeholders. Achieving the support for the decision ensures a higher possibility of commitment to decision execution. Participants reported that they consulted and engaged relevant stakeholders in evaluating alternatives and reconciling differences to reach an agreement on the final option. However, in case of limited availability of information and expertise, the decision-makers used their own experience and business understanding in making decisions if they could be justified.

The aligning phase consists of three aspects: reaching an agreement, decision buy-in, and making intuitive decisions.

5.3.3.1. Reaching Agreement

Reaching agreement refers to a process that ensures that all the relevant stakeholders' concerns are incorporated and served to reach a consensus on the final decision. Participant 21 reported a group decision-making process in which multiple stakeholders from relevant functional divisions were invited to surface all the concerns to be addressed to reach an agreement on the final decision.

> *I am engaging with a lot of key stakeholders […]. I am a firm believer in a group thing as opposed to individual because then, that means we are not missing stuff because we have got so many different perspectives coming in from different areas, so we are making sure that we are catering for the whole stakeholders (Participant 21.)*

In addition, another participant described that the decision was made through an open discussion among relevant stakeholders. The decision-making process encouraged all the stakeholders to surface their concerns and reconcile their different perspectives to reach a consensus on the final solution.

> *I would always involve the Chief Operating Officer and the person looking after our finance, so it will be at least three of us, will look at the inventory that we have on hand, what we have been sold, and what our forecasts are… [When] the Chief Operating Officer put forwards our forecast, if we are comfortable with that then we will sign on that, and if we are not comfortable with that we will discuss and reach consensus where we are comfortable with and sign it off (Participant 7).*

Another participant described the decision-making process where different stakeholders participate in the discussion and reach a consensus on the decision together.

We try and get information from everyone. And then there will be a small group that will make the final decision. It is never based on just one person alone. It has to be agreed by those people or the group that it will impact (Participant 14).

Furthermore, other participants asserted the importance of engaging with senior stakeholders to validate the decision to ensure the alignment with the organizational goals. A participant stated that the senior manager signed off the decision to ensure that the decision was of high quality and aligned with the organizational goals.

I am not so much making the decisions. The [planning] teams are empowered to make decisions… My role is literally to sign off… so just to make sure it [decision] fits in with the big picture and the business strategy and strategic direction (Participant 16).

Another participant described stakeholders who participated in signing-off the decision for validation. By signing-off, the stakeholders at different levels ensured that the decision aligned with local/global objectives and showed their approval to the decision.

Normally, it has to be in a wider meeting where we are discussing [the options]. Even if I did make the decision, it is supposed to get signed off by the other people… Different tiers of people are signing off. If it is quite cheap and it is not going to be much money then-than? just local people sign it off, [if it is] getting more money than people further up the chain need to sign it off (Participant 15).

Other participant asserted that escalating supply chain decisions for validation is necessary to ensure its quality and agreement.

It is always good that you get the reassurance of what you have decided because in the supply chain most of our decisions affect the business… We have to make sure or validated or escalated before we say: "yes, we should do something" ... If someone will go to me and say, "why did you make that decision?", then at least I

have evidence to say I have validated it with this supporting evidence, so I know that it is correct (Participant 5).

The second aspect of the aligning phase that participants identified was *decision buy-in.*

5.3.3.2. Decision Buy-in

Decision Buy-in refers to the level of agreement to support a decision. Because all the relevant stakeholders have engaged in and understood every aspect of the decision-making process, they hold a higher level of support and commitment to the resulting decision. Participants referred to this aspect of the aligning phase, *decision buy-in.* Participant 10 explained the rationale for engaging with relevant stakeholders for their recommendations in the decision-making process.

It would be the stakeholders demanding the people who are going make the decision to understand what perspectives they have. So that hopefully, you can take that on-board and be upfront. Maybe do some pre-work with those people separately so that when it does come to sending the final piece of paperwork out for approval or having a meeting then pretty much you know whether everyone is on your side so that the success is quite high (Participant 10).

When relevant stakeholders participated in the decision development, they are likely to buy into the decision. It is because they have actively engaged in the decision-making process.

Once we have gathered and analyzed all the data, we call a panel that has representatives from different key areas of the company [to make the decision together]. It is not me making the decision solely. And so, we have got group buy-in from different key stakeholders (Participant 21).

Some participants stated that they asked different stakeholders to participate in the decision-making process. The relevant stakeholders participated in discussing differences in functional-specific interests and concerns. As a result, there was a high-level of agreement and the

possibility of stakeholders' "buy-in" of the decision because they had their input and they owned it.

> *We generally make decisions as a team… The information system is great, we could do sort of predictive analysis and statistical forecasting, but I think some of the guys here are highly informative and additive as well. We put it [collected information] all together. [Then] we have a meeting, one says, and then other people add something, and we have a good informative decision around the table from what we know… Everyone has its input… You have got everyone's buy-in, everyone agreed on the decision. There is no surprise, no one is left out, and everyone owns it (Participant 2).*

Additionally, participant 3 asserted that if the decision implementation required coordinating actions of different stakeholders, then it was better to engage these stakeholders in the decision-making process. It is because when relevant stakeholders are involved, they feel respected and become more committed to decision implementation.

> *I try to involve everybody that needs to involve taking the decision together. Because what I see at the end, if the decision is taken that involved you but you did not involve, it could be that you are not so engaged to that as if you would be if you were involved. Every time if I see the benefit, I will try to do that because I think it is more successful on the [decision] implementation and success (Participant 3).*

The data showed that the information-based decision-making in the pharmaceutical supply chain sometimes requires the decision-makers to heavily rely on their previous experiences, especially when dealing with uncertain situations. This aspect of decision-making in the pharmaceutical supply chain process was identified based on the data as *making decisions based on intuition.*

5.3.3.3. Making Intuitive Decisions

Intuitive decision-making refers to the decision-makers who engage with their intuition in decision-making when experiencing uncertainty and ambiguity in the absence of information availability. According to participants, they should try hard to get sufficient information for decision-making support. However, there are always unknowns to deal with. Therefore, in making supply chain decisions, they should try to collect as much relevant information as possible, and simultaneously, should be confident to make decisions relying on their intuition.

> *I will try and gather the information I need, and I will be proactive in trying to gather that information. But you have got to make a decision. I mean in the supply chain I think you cannot be scared to make a decision and own it (Participant 12).*

Another participant also emphasized that a decision-maker needed to make the decision regardless of the insufficient information in hand. If decision-makers kept seeking complete information, they became paralyzed and indecisive. Being carefully prepared and decisively acting on available information would be elements to make decisions in the absence of supporting information.

> *It is important for everyone to have in mind that we can make the decision with the unknowns. The fun part is if you make the decision you have to make a call now, if you do not make a call you are going to be stagnant, so decide and learn. So let the action happens, control as best as you can but learn from it the next time. And that is the key (Participant 1).*

Participant 7 added an example of applying the intuition in making decisions in the absence of much information.

> *It is based on how much information you get… If it is a new product in a new market with not many competitors then that is going to require a lot of intuition to run*

different scenarios and choose the one that you feel comfortable with, in the absence of much data (Participant 7).

Similarly, participant 3 emphasized that the more informative of the decision-making process, the better the decisions that will be made. However, in urgent cases, without much data collected, the decision-makers should be confident in decision-making.

The more information I have, and the more time I have to make the decision, it is better decisions; because I have time to grasp the data, analyze the data, and make the decision... [However] if I do not [have enough information and time], I have to work with what I have. I think the timing is the most crucial… This is the decision; this is the timing, and we need to make it, then I will make it (Participant 3).

Overall, the data showed that SCIV in the pharmaceutical supply chain decision-making process is achieved through a multi-phased process that supports the informative engaging process.

5.4. Chapter Summary

In this chapter, detailed explanations with specific quotations from participants were presented to illustrate the information-based decision-making process that can lead to SCIV in the pharmaceutical supply chain. This chapter illustrated the core category of Informative Engaging which is the ruling mechanism for the decision-making process. The informative engaging process was defined as *the proactive process where decision-makers deliberately and actively engage with technological tools, relevant stakeholders, and themselves in gathering and transforming quality information and knowledge into an actionable and agreeable decision*. More findings were reported as to the three phases of an information-based decision-making process in the pharmaceutical supply chain. The three relational phases are driven by the informative engaging mechanism: informing, option-generating, and aligning. In the next

chapter, the findings presented in Chapter 4 (research question 1: perception of supply chain information visibility) and Chapter 5 (research question 2: the supply chain information-based decision-making) are combined to develop the Pharmaceutical Supply Chain Information-based Decision-Making Model.

Chapter 6: Discussion – The Pharmaceutical Supply Chain Information-based Decision-Making Model

6.1. Chapter Overview

This chapter discusses the findings from Chapter 4 and Chapter 5. The purpose of this chapter is to position the findings within the extant literature and introduce a theoretical model of information-based decision-making in the pharmaceutical supply chain: *The Pharmaceutical Supply Chain Information-based Decision-Making Model*.

The chapter is structured as follows. The first part provides a brief introduction. The second part of the chapter (Section 6.2) discusses the findings of research question 1, which addresses the concept of SCIV, the two levels of SCIV, and discusses the characteristics of SCIV in comparison with existing literature in SCIV. Based on the findings, a conceptual framework of supply chain information visibility (SCIV) is introduced. Section 6.3 presents the Pharmaceutical Supply Chain Information-Based Decision-Making model which is developed from the combination of findings presented in chapter 4 (research question 1) and chapter 5 (research question 2). The last section (Section 6.4) summarizes the chapter.

6.2. Supply Chain Information Visibility

The findings present a holistic view of the SCIV concept that SCIV comprises both internal information visibility and external information visibility. The findings of this study complement prior research on exploring the SCIV concept (Barratt & Oke, 2007; Brandon-Jones et al., 2014; Kim et al., 2011) by elaborating upon the concept at both internal and external level. Prior studies have been largely describing SCIV on the external level where a firm has the limited information visibility of what is going on in the supplier and customer parts.

Since the various internal functions comprising a firm are as much a part of the supply chain as are the firm's external suppliers and customers (Vickery, Jayaram, Droge, & Calantone, 2003), having information visibility of both internal and external supply chain's operations are both critical. Internal SCIV refers to having a transparent view of what is happening across functional departments within a firm. Internal SCIV involves frequent personal interaction amongst people in internal functional divisions and information sharing via enterprise information systems. According to the participants, the internal functional divisions are viewed as functional silos based on traditional departmentalization and specification, thus inhibiting smooth information flow within their firms. Frequent and open personal interaction amongst internal stakeholders helps to break down the functional barriers and enhances the sharing of proprietary information and knowledge. Internal visibility allows information shared from external supply chain actors to flow smoothly and act upon within the firm, while internal visibility enables a firm to integrate and share their accurate and complete internal information to its partners.

6.2.1. Exception Visibility

The findings of this study show that to develop end-to-end (from first-tier suppliers to end customers) visibility across a pharmaceutical supply chain, SCIV needs to be achieved on both internal and external levels. The internal level emphasizes cross-functional information sharing within a firm, while the external level stresses the sharing of information between a firm and its external supply chain partners.

External SCIV refers to having a transparent view of what is happening in a firm's external environment including customers and suppliers. The findings reported that the external SCIV characterizes with exception visibility across the entire supply chain to manage the supply chain risks.

Exception visibility refers to having access to information regarding disruption events within a supply chain from relevant supply chain members. Disruption events are "incidents such as an unanticipated event within a supply chain with the associated negative outcomes of that event on the supply chain" (Nooraie & Mellat Parast, 2015, p. 193). This finding is in line with previous SCIV studies that emphasize the criticality of having information visibility of changes and especially disruption events across the supply chain in managing the pharmaceutical supply chain. Rai et al. (2012) describe SCIV as a unified detailed view of inventory positions and in-transit shipments in the inter-firm logistics process and of cascade alerts on critical events. Similarly, Nooraie and Parast (2015) highlight SCIV as the capability of sharing on-time and accurate data on the amount and location of inventory to detect and respond to supply chain risks. Vitasek (2006) define SCIV as inventory management software applications that track and trace inventory globally at a line-item level, notifying the user of significant deviations from the plan.

Despite suppliers' unwillingness to share information to New Zealand-based pharmaceutical firms, the findings describe the obligation to share information regarding disruption events across the entire chain. In pharmaceutical supply chains, all actors are forced to comply with product manufacturing and handling requirements to ensure sustainability of medication supply (Papert et al., 2016; Shah, 2004). Pharmaceutical firms are dependent on external sources and supply chain relationships to some extent and consequently exposed to any disruption happening at any actor within the chain (Bode & Macdonald, 2017; Xu et al., 2020). As a supply chain disruption has a ripple effect, supply chain actors must share information about disruption events across the chain for early discovery of possible disruptions and timely activation of mitigation measures (Xu et al., 2020). The unavailability or inaccessibility to the key information such as disruption events can lead to a reactive, unorganized, and subtle response to the disruptions, thus compromising the supply chain efficiency to a greater extent

(Esper, 2021). As such, exception visibility for managing disruptions is crucial in the pharmaceutical supply chain.

The finding of exception visibility also adds empirical evidence to body of SCIV research emphasizing on the need of SCIV to build supply chain resilience to cope with disruptions. Relevant evidence can be found in the literature (Brandon-Jones et al., 2014; Mubarik et al., 2021; Williams et al., 2013; Yang et al., 2021). Brandon-Jones et al. (2014) find that SCIV is the specific capability that enhances supply chain resilience. Wang and Wei (2007) also assert that SCIV has a direct impact on achieving greater supply chain flexibility (i.e., the adaptability of firms in the supply chain to respond to an unexpected change in the transaction processes). In addition, having visibility of the upstream (supply-side) and downstream (demand-side) supply chain operations can support the firm to quickly discover and minimizes the impact of risks (Barratt & Barratt, 2011; Grötsch et al., 2013; Messina et al., 2020; Mubarik et al., 2021). Other current studies have highlighted that enhancing supply chain visibility in the supply chain through gathering, processing, and sharing information among the partners is one of the strategies to build supply chain resilience for managing the unpredictable disruptions caused by the Covid-19 pandemic (Gunessee & Subramanian, 2020; Ivanov & Dolgui, 2020; Xu et al., 2020).

6.2.2. The Role of Information Systems in Supply Chain Information Visibility

The extant literature suggests that information systems play a critical role in enhancing information sharing amongst the internal departments within a firm (Arshinder et al., 2008; Rai, Patnayakuni, & Seth, 2006; Rosenzweig, Roth, & Dean Jr, 2003). Previous studies show that enterprise information systems facilitate information sharing between actors across a supply chain if the information systems are selected and employed appropriately (Barratt & Barratt, 2011; Brandon-Jones et al., 2014; Goswami et al., 2013; Kim et al., 2011). On the other

hand, other studies discuss that the investment in enterprise information systems per se does not necessarily guarantee information sharing success. Instead, it is the compatible, user-friendly information systems that can contribute to information sharing and information processing in organizations (Yang & Maxwell, 2011). Thus, within an organization, if the available information systems are not easy and efficient to use, the decision-makers might not trust the shared information (Yang & Maxwell, 2011).

The findings in this study indicate that there is no significant impact of the enterprise resource planning (ERP) systems on enhancing SCIV. In addition, the findings also point out that application of automatic identification technologies such as RFID or barcodes within the pharmaceutical supply chains is scarce. These findings are consistent with existing studies exploring the role of information systems in the New Zealand context. Basnet and Wisner (2012) examine factors that affect internal information integration in the New Zealand manufacturing industry context. They find that the adoption of ERP systems is not related to achieving internal integrated information flow in New Zealand companies. In addition, in their study of factors for achieving supply chain excellence, they point out that New Zealand companies do not rely on information systems to support information communication for supply chain integration Luo et al. (2018).

The two reasons that can explain their findings relate to typical characteristics of New Zealand companies. First, firms in New Zealand are typically SMEs who have flat structures and rely more on personal communication styles. Second, SMEs are generally small businesses and have limited resources for advanced information systems investment (Luo et al., 2018). In addition, the findings report the third reason that relates to the adoption of an inappropriate ERP system. Researched firms are using ERP systems that are not specifically developed for SMEs' processes. It is suggested in the extant literature that ERP investment can only bring about competitive advantages if ERP systems align with the objectives of the company (Koh

& Maguire, 2004). Most of the firms in this study are using the SAP or Oracle ERP systems that are generally designed for large enterprises with complex business processes. The participants perceive their firms' ERP systems as "clunky", and their business processes do not require such a complex system. The standard ERP system would be helpful for a large business in managing information. However, such a complex system may hinder the fast response and decrease the efficiency in small firms' simple processes (Loh & Koh, 2004). Meanwhile, there exists other midrange and less complex ERP systems developed to cater to the needs of small and medium-sized firms (Loh & Koh, 2004). Some participants recommended that firms select the appropriate information systems that align with their specific business requirements to fully realize the benefits of the information systems in enhancing SCIV.

6.2.2.1. The Role of Information Systems in Developing Supply Chain Information Visibility

Recent technological advancements have significantly increased supply chain partners' ability to seamlessly connect with one another (Fawcett et al., 2007). However, New Zealand pharmaceutical companies are generally unable to have external partners invest in IOIS development.

Prior SCIV studies have reported the importance of IOIS in enhancing access and sharing of accurate and timely information, and thus increasing SCIV levels. Existing SCIV literature discusses the benefits of using advanced technologies (e.g. RFID) to capture the granular details of information related to the flow of products along the supply chain (Francis, 2008; Musa et al., 2014; Papert et al., 2016; Rai et al., 2012) and to coordinate the flow of information between partners in the supply chain (Barratt & Barratt, 2011; Barratt & Oke, 2007). The IOIS means that the infrastructure of the information systems between the supply chain members is compatible, and that information flows automatically between enterprise information systems.

When organizations are connected through IOIS, the linked system becomes an important environment for sharing high quality information between supply chain partners (Kim et al., 2011; Lee et al., 2014). Accordingly, inter-organizational information system (IOIS) visibility has proved to be an integral part of SCIV to improve the visibility across organizational boundaries. Supply chain partners with highly integrated infrastructure can easily have access to information of various supply chain partners such as inventory backorder status, production capacity constraints, and demand forecast information (Barua, Konana, Whinston, & Yin, 2004).) argued that integrated information systems is a key element for having a successful SCIV.

On the other hand, a fragmented information systems infrastructure can negatively affect the coordination of information flows between firms (Rai et al., 2006). Furthermore, Dong, Xu, and Zhu (2009) asserted that fragmented information systems along the supply chain inhibited supply chain partners from sharing real-time information. In the New Zealand pharmaceutical industry, companies are unable to develop IOIS with external suppliers and customers, thus IOIS for SCIV is missing. As discussed in the previous section, external suppliers do not have an interest in developing a partnership with New Zealand firms due to the low volume of their business. The external companies, thus, are not willing to share information as well as to invest in integrating their information systems with New Zealand partners.

In addition to the adoption of IOIS, prior studies reported the necessity to instantaneously capture the granularity of information by using the automatic identification technologies (i.e. barcode, two-dimensional multi-row barcodes, matrix codes, contact memory, and radio frequency identification system or RFIDs (Bartlett et al., 2007; Papert et al., 2016) to achieve the visibility of the object (e.g. an item, a package, a pallet, or a container). These advanced technologies are useful for tracking products during shipment and determining the status of inventory in the pipelines. Automated information capturing provides the unified view of

products from production planning and shipment at manufacturers, to storage and movement by freight forwarders and ocean carriers, to inspection and clearance by customs authorities, and inland transport to the final destination (Somapa et al., 2018). Rai et al. (2012) identify information systems' functionality in SCIV as the means for capturing granular information on the flows of shipments and the status of stocks across multiple locations as well as the alerts on critical events during the in-transit journey. Musa et al. (2014) discussed the automatic identification technologies to be enablers of supply chain product visibility.

The barcode, RFID and sensor technologies for location, temperature, pressure, humidity, and vibration have been used for developing and keeping a record of the product's materials and components, its physical state throughout the supply chain, the product's forward movement to the user-customer, customer's experience of the product, and the reverse logistics and reuse or termination of the product. The aim of visibility is to foster planning, control, and agility of operations associated with the product and to improve customer experience of the product. Recent SCIV studies in regulated industries also identified the necessity to adopt advanced technologies for tracking and tracing products and materials along the supply chain for regulation compliance (Klueber & O'Keefe, 2013; Musa et al., 2014). Klueber and O'Keefe (2013) described the detailed requirements of the SCIV systems that allow for tracking and tracing of objects' serial numbers to avoid counterfeits, increase the flexibility to react to disruptions in transport through in-time information about delays and automated alerts, increased consolidation of shipments through better data quality and early information of shipments and meet documentation regulations while simultaneously increasing the efficiency of documentation of physical movements.

In line with previous research, the findings reported that firms in New Zealand have adopted tracking technologies such as data loggers and bar codes for capturing and keeping a record of the product's details: monitoring its physical state (i.e., temperature) in the distribution of

temperature-sensitive drugs and identifying products. The adoption of these technologies has provided greater product SCIV in the pharmaceutical supply chain. The objective of using these technologies is to monitor and develop records of products to comply with the New Zealand medicines regulations that require actors to ensure and prove correct medicines manufacturing and handling throughout the entire pharmaceutical supply chain. However, the existing technologies adopted in New Zealand pharmaceutical firms remain simple and are not sufficient to realize all dimensions of requirements for product visibility. For example, data loggers are small objects that measure temperature and store temperature profiles. An integrated sensor captures temperature data at predefined intervals and saves this data in the data logger's memory. The data loggers are then put into the transportation accessories of the pharmaceutical products to monitor temperature profiles. A data logger records a temperature profile but does not protect the drugs against excessively high or low temperatures. In other words, a logic or regulating function for temperature control is missing (Papert et al., 2016). Therefore, participant 17 explained the need to have advanced technologies in place that enables automated capturing more details of the products in the distribution journey (i.e. temperature, location) and transferring information from the devices into enterprise system: *"we are hoping in two years, we will use real-time temperature monitors that also have got a GPS location so they can tell us if they move and send alerts of any temperature breaches. [We need] the data loggers that have GPS location and tracking to upload the data via Wi-fi. So, we do not need to take the logger and connect it to a computer and then download data from it* (Participant 17).

In the same vein, Papert et al. (2016) has analyzed the deficiencies of existing automatic identification technologies adopted in the pharmaceutical supply chain and proposed three advanced solutions to enhance information visibility in pharmaceutical supply chain including

passive radio frequency identification tags, transport containers with sensor nodes, and a SCIV dashboard to enhance SCIV for regulation compliance.

In addition, the findings reported the ability to track in-stock and in-transit inventory across the supply chain and have item-level information using tracking technologies such as barcodes and data loggers. In pharmaceutical products, many ingredients are sensitive to temperature, thus practitioners should be able to track products and materials as they move in the supply chain at any point of time to make sure that these products are kept in suitable condition to remain standard quality. Participant 16 describes that their company has applied smart data logger technology to track the real-time data of the position of freight for temperature governance *"the data loggers are used for temperature warning, and they again can give you visibility of your freight as it moves".* This technology enables supply chain practitioners to be aware of any possible warnings and alerts if there is temperature issue and comply with regulations in the protection of product quality from manufacturers to the patients.

Findings from the extant literature have revealed the automation characteristic of SCIV encompassing the levels of automated information capture and automated information transfer among participants in a supply chain (Somapa et al., 2018). According to Somapa et al. (2018), the metric used for automated information capture is the extent to which automatic identification technologies are employed to capture the status and the flow of products and/or materials that are transiting along the supply chain. Findings from the extant literature reveal different levels of information systems use ranging from manual records to fully automated systems (Balasubramanian et al., 2002; Griffiths et al., 2007). While automated information transfer/integration is the extent to which information sharing across organizations is conducted via IOIS systems (Somapa et al., 2018), practical transferring methods in the extant SCIV literature range from the manual transfer (e.g. fax and mails) to fully connected IOIS systems (Kim et al., 2011).

According to the findings, the adoption of tracking technologies enables pharmaceutical firms to automate the capture of the status and the flow of products and/or materials that are transiting along the supply chain. However, the findings also reported the missing part of automated information transfer due to the unavailability of IOIS between New Zealand pharmaceutical firms and the external partners in the supply chain. Thus, the external visibility in the New Zealand context is only partially automated and needs more investment in the development of IOIS. The companies in New Zealand are slow in the adoption of technologies for information sharing purposes. Lacking automated sharing information of inventory level in the supply chain is one of the barriers to developing inventory visibility. Papert et al. (2016) assert that the functional capabilities of current technologies for practical monitoring solutions, such as barcodes, data matrix codes, and data loggers, are insufficient to enhance the pharmaceutical SCIV and to ensure and prove that drug handling satisfies the good distribution practice guideline.

6.2.2.2. The Role of Personal Interaction in Supply Chain Information Visibility Development

According to the research findings, personal relationship is critical for enhancing SCIV on both internal and external levels.

The findings of this study indicated that external SCIV is challenging to achieve because there is a lack of interest and appreciation by external supply chain actors in sharing resources of proprietary information. Most of the participants in this study are embedded in SMEs in New Zealand where there exists asymmetry dependence in their supply chain. In this context, the firms are heavily reliant on their external partners in their supply chain and therefore have little influence over their partners, while the external actors have little interest in them. According to Zhang and Huo (2013), if a firm is dependent on its suppliers/customers, it will contribute a

high level of resources and work more closely with its partners to ensure the stability of resource acquisition. On the contrary, if a firm is less dependent on its suppliers/customers, it might be less likely to develop a strategic tie to external partners. Thus, in the presence of dependence asymmetry in the relationships with external partners, the partners are disincentivized in terms of information sharing, dedicated investments and joint relationship efforts (Nyaga, Whipple, & Lynch, 2010).

External partners were not interested in building IOIS for automated information-sharing. Moreover, the pharmaceutical industry is more risk-averse than other industries; consequently, members of a pharmaceutical supply chain are more cautious and reluctant in sharing resources, especially, in the context of the arms-length relationship. Accordingly, the information sharing between pharmaceutical firms in New Zealand and supply chain external actors is limited to manual sharing on an ad-hoc basis in case of disruptions or exception events. This finding is consistent with the finding of Vijayasarathy (2010) that mutual dependence can have a positive influence on the willingness and commitment to share information, whereas high dependency asymmetry can have a negative impact on exchange relationships and information sharing. Also, high levels of dependence might lead to uncertainties and opportunistic behaviours (Ireland & Webb, 2007), resulting in SC members who are reluctant to share information. In addition, the findings confirm Lee et al. (2014) and Kim et al. (2011) suggestion that mutual dependence does impact SCIV; and the higher level of dependence asymmetry between supply chain partners, the fewer incentives to exchange or share their important information resources.

To improve the level of SCIV on the external level of the pharmaceutical supply chain, participants recommended proactive communication between supply chain professionals in the New Zealand firms and their external partners to improve relationships with external actors. Proactive communication includes actively sharing their high-quality information to the

partners' requirements and constantly asking for information from external partners. Regular personal communication can foster trust by assisting in resolving disputes and aligning perceptions and expectations (Moorman, Deshpande, & Zaltman, 1993). Trust is developed in the early stage of a relationship and, in general, great levels of trust increase a firm's willingness towards information sharing (Handfield & Bechtel, 2002) to enhance external SCIV. Similarly, the participants emphasized that proactive and regular communication with external partners will increase the willingness to share information. In addition, open and honest communication can lead partners to a better understanding of their obligations, facilitate quicker adaptation when circumstances change (Schreiner, Kale, & Corsten, 2009). Proactive personal interaction, thus, can enhance quality information shared in a timely manner from the external supply chain actors.

In addition, the findings reported that personal relationships across internal functional divisions play an important role in the elimination of organizational silos and thus facilitate information sharing within a firm. First of all, most New Zealand companies are SMEs, they can build a conducive environment to establish mutual trust with personal relationships with each other (Luo et al., 2018). In this situation, they rely more on personal communication (via face-to-face, cell phone, or email communication) to organize cooperative schedules and information sharing. Second, personal interaction based on mutual trust encourages people to commit to sharing the proprietary information they normally would not share (Zhang & Huo, 2013). Third, personal communication facilities the sharing of proprietary knowledge within a firm while the enterprise systems cannot. People within a firm shared knowledge in the form of operation insights, procedures, policies, forecasts, inventory levels, production schedules, market intelligence data that are of great value for decision support.

6.2.3. The Conceptual Framework of Supply Chain Information Visibility

Based on the findings in the New Zealand pharmaceutical firms and after reviewing the extant literature, this study develops a conceptual framework to understand the SCIV construct in the context that asymmetrical power is available leading to inferior actors' challenges to develop information visibility of external part in the supply chain.

The construct of SCIV encompasses internal SCIV and external SCIV. Both internal and external visibility to are important in SCIV development across the pharmaceutical supply chain (Somapa et al., 2018).

SCIV is characterized by three main characteristics: automated, relational, and informational characteristic. Figure 6-1 illustrates the characteristics of SCIV and their relationships with the internal and external SCIV.

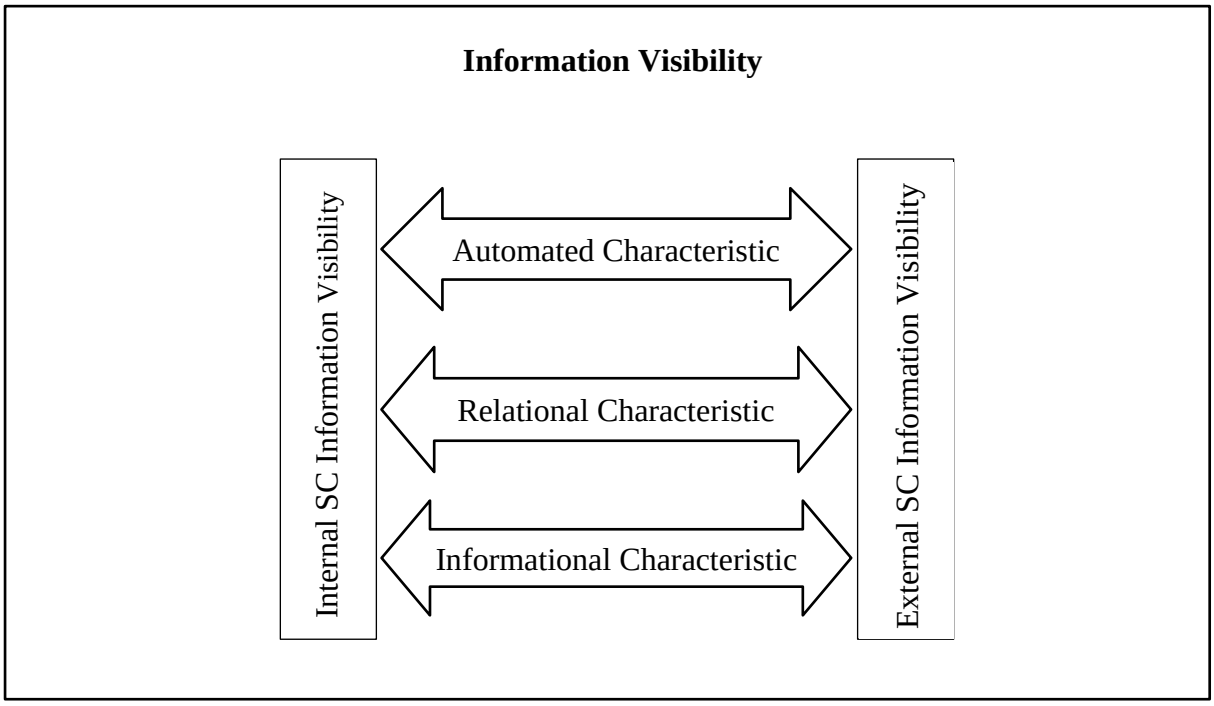

Figure 6.1: The Conceptual Framework of SCIV in Pharmaceutical Supply Chain

Automated characteristic is related to information technology as an enabler to acquire and distribute information within a firm as well as amongst supply chain actors. Automated

characteristic refers to the ability to capture and transfer the necessary information in a timely manner by using information systems in diverse forms and methods.

Relational characteristic is related to internal linkages within a firm, and external linkages between a firm with external supply chain actors as an enabler to sharing information across the supply chain. Relational characteristics refer to the ability to acquire and distribute the necessary information in a timely manner through personal communication.

Informational Characteristic refers to numerous characteristics including information accuracy, timeliness. and completeness.

So far, the findings regarding SCIV have been discussed. The findings were positioned within the extant literature and a conceptual framework of SCIV in the pharmaceutical supply chain was introduced. The model can help better to understand the construct of SCIV in the pharmaceutical industry construct and how to facilitate its development for better performance. The findings will be used in the following section to develop a theoretical model of information-based decision-making in the pharmaceutical supply chain.

6.3. The Theoretical Model of Information-based Decision-Making

In this section, the Pharmaceutical Supply Chain Information-based Decision-making is introduced. This model is both descriptive and prescriptive. It is descriptive in that it describes how SCIV is perceived by pharmaceutical supply chain practitioners (research question 1) in New Zealand. The model is prescriptive in that it explains how the practitioners can use SCIV to make the information-based decisions in the pharmaceutical supply chain process (research question 2). The model and its components, including the relationship between SCIV and the information-based decision-making process are discussed in the following sections.

The model (Figure 6.2) offers a comprehensive overview of the process through which supply chain decision-makers can make information-based decisions of the pharmaceutical supply

chain. The model also explains the role of SCIV in the information-based decision-making process.

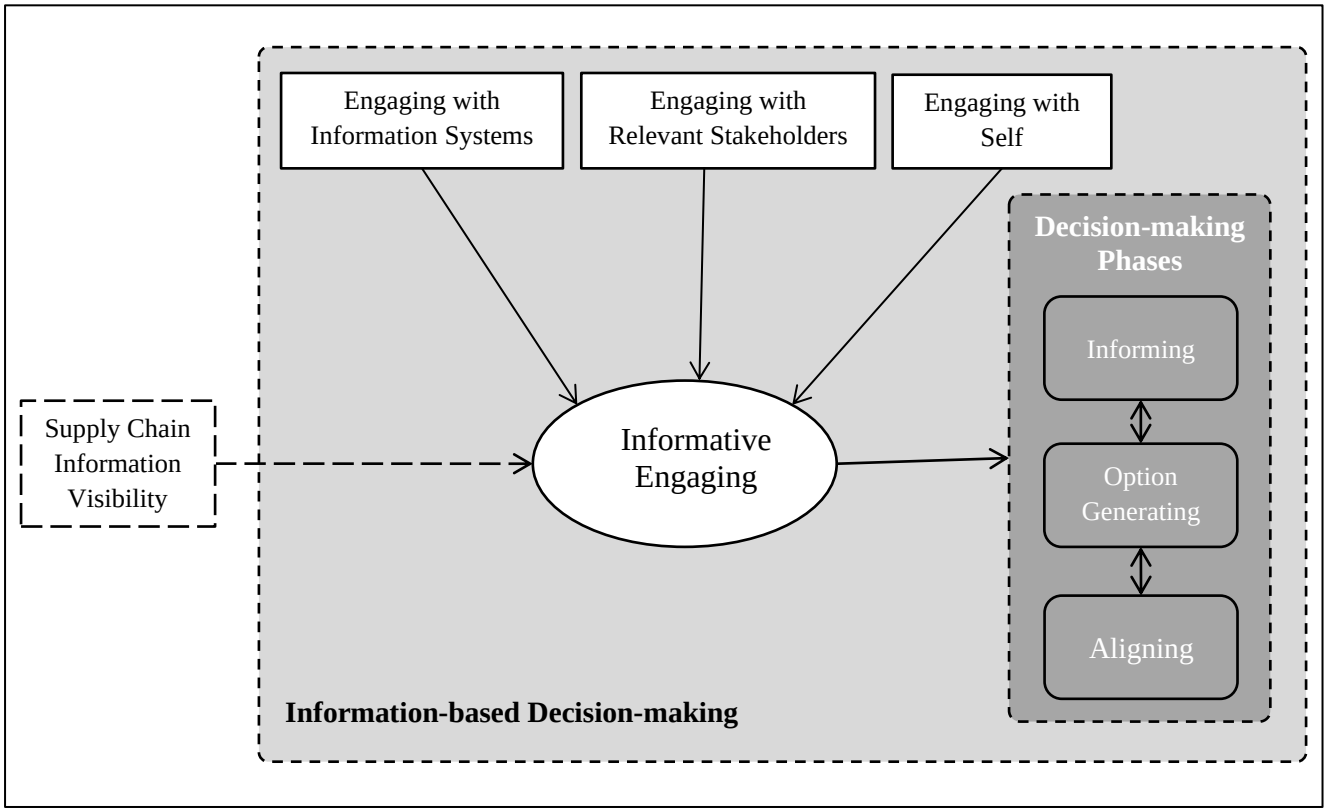

Figure 6.2: The Theoretical Model of Information-based Decision-making

In the data analysis, informative engaging emerged as the core category in the process of information-based decision-making. The findings showed that information-based decision-making in the pharmaceutical supply chain is a multi-phase process that is driven by an informative engaging process.

6.3.1. Informative Engaging

Informative engaging refers to the extent to which the decision-maker engages with technological tools, with relevant stakeholders, and with self (findings of these three aspects of the informative engaging process were presented in section 5.2. in Chapter 5.

Informative Engaging refers to the proactive process where decision makers deliberately and actively engage with information systems, relevant stakeholders, and themselves in gathering,

interpreting, and transforming quality information and knowledge into an actionable and agreeable decision. Through informative engaging, decision makers acquire, interpret, and transform quality information into decisions that ensure high levels of agreement amongst relevant stakeholders. The findings pointed out that through the informative engaging process, the decision makers guide the supply chain information-based decision-making by determining (1) what, how, and from whom information is acquired and shared, (2) how the information is processed to generate options, and (3) how the information is used to get agreement on the final decision.

The three embedded aspects of informative engaging are discussed below, including engaging with information systems, engaging with relevant stakeholders, and engaging with self.

6.3.1.1. Engaging with Supply Chain Information Systems

The supply chain information systems are designed to "provide information and information processing capability to support the strategy, operations, management analysis, and decision-making functions in the supply chain" (Tarokh & Soroor, 2006, p. 426). The findings of this study show that the decision makers in the pharmaceutical supply chain engaged with the information systems to collect and analyse data within their firms for the decision-making process, to make information-based decisions.

Generally, information systems in the pharmaceutical supply chain are used to provide automated information capturing ability that enables supply chains practitioners to trace all events that occur during the movement of products in real-time and, by analysing the recorded information, to trace unusual events or inefficiencies in the process ERP and SCM systems facilitate generating and sharing timely and accurate information within firms and collaboratively sharing this information between firms through an integrated database to have better communication with other firms (Loh & Koh, 2004; Somapa et al., 2018). The

participants in this study mentioned that due to the lack of IOIS and interest in information sharing, they were unable to access the information from their supply chain external parts.

Since information systems-enabled decision-making enhances the managerial abilities and reduces the difficulty of SCM (Sambamurthy, Bharadwaj, & Grover, 2003), the exponentially increasing available data coupled with new data analytics tools enable supply chain managers to deal with the complexity and to enhance the performance of these supply chains (Somapa et al., 2018). Therefore, international firms are heavily investing in their capabilities for data analysis by incorporating decision support tools, executive systems, and business intelligence and analytics technologies (Brusset, 2016). On the contrary, in New Zealand, the supply chain decision makers reported that they collected a common set of raw data from the SCM information systems and preferably aggregate them on Excel spread sheets for data interpretation.

The supply chain decision makers asserted that they prefer using Excel spreadsheets for data analysis rather than using analytic function in the existing SCM information systems because the systems were perceived as clunky and unreliable. They believed that Excel spreadsheets were flexible and efficient in analyzing data, so that they could easily identify exception events or any supply-demand failures to act on.

The participants also mentioned that due to the simplicity in using and disseminating Excel files, the participants could easily share the results of their data analysis with other stakeholders. The participants emphasized that sharing the results of the data analysis with stakeholders was important as it could help generate alternative options or justify decisions when presenting decisions to stakeholders or higher authorities for approval. The findings further showed how important it is to engage with stakeholders when making supply chain decisions in the pharmaceutical industry.

6.3.1.2. Engaging with Stakeholders

Engaging with stakeholders is another component of the supply chain decision-making process in the pharmaceutical supply chain process. Engaging with stakeholders refers to the degree to which relevant stakeholders are involved in collecting, processing information; and discussing perspective differences during the decision-making process.

According to the findings, the supply chain functions as the enabler for the whole of organization activities, thus supply chain decisions have a significant impact on different internal stakeholders (e.g., business areas such as marketing, sales, finance) as well as on external stakeholders (e.g., suppliers, distributors, third-party businesses). Thus, participants assert that decision makers need to involve relevant stakeholders in their decision-making process. As such, the supply chain decision-making process is fundamentally social: multiple stakeholders involved, multiple stakeholders are affected, and one stakeholder's thinking is influenced by the thinking of others (Larrick, 2016). Regarding decision-making as a social process, Vroom and Jago (1974) further describe that when a decision situation emerges within an organization, there are typically several alternative social mechanisms that vary in the person or persons participating in the decision-making process, and in the relative amounts of influence that each has on the final solution or decision reached.

According to the findings, although supply chain decisions can be made either by an individual or a group, a decision can also be made by an individual in combination with other individuals. That is one decision maker might be responsible for making a decision, but the decision can be made with the extensive involvement of and input from relevant stakeholders during the decision-making process. Therefore, for this study, the supply chain decision-making process is understood as a continuum construct with individual decision-making process and group decision-making process as two ends of the continuum (see figure 6-3).

As such, the pharmaceutical supply chain information-based decision-making model is conceptualized as a continuum with individual and group decision-making at both ends. It implies that supply chain decisions can be made individually or in groups or in combination; however, relevant stakeholders to some extent must be involved in the decision-making process to ensure quality decisions in the pharmaceutical supply chain context. Accordingly, decision makers are flexible in determining the extent to which they need to engage stakeholders in their decisions. The roles could be the decision makers, the observers, or the advisors. The engagement process entails a certain level of consultation and dissemination of diverse information and knowledge between relevant stakeholders, and different stakeholders' involvement in discussing, validating, and integrating divergent perspectives during the decision-making process. The level of stakeholder engagement increases on the continuum from individual decision-making process towards group decision-making process. Thus, as the level of engagement increases, the pharmaceutical supply chain decision-making moves from individual towards group decision-making.

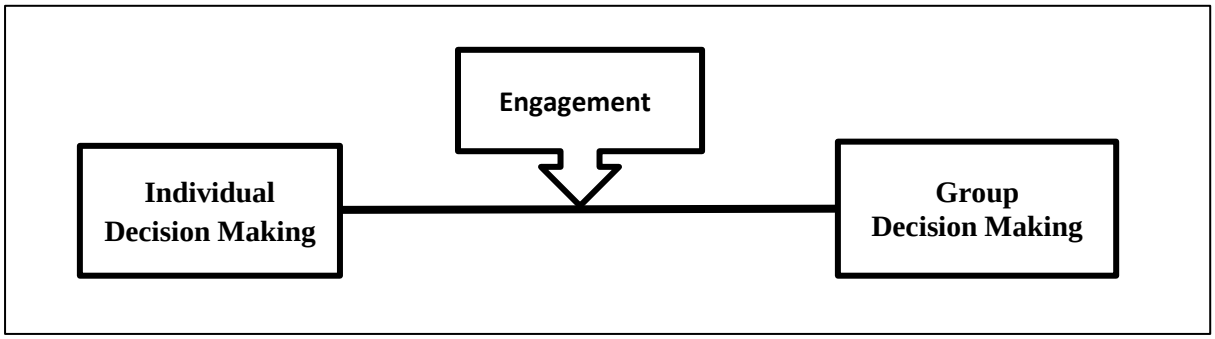

Figure 6.3: The Information-based Decision-making Continuum

According to the findings, stakeholder engagement is a distinct element of the supply chain decision-making process. Participants asserted that the higher level of engaging relevant stakeholders facilitates greater procedural rationality. Procedural rationality reflects an extensive collection and comprehensive analysis of a wider range of information and perspectives. Supply chain decision makers collect diverse information and perspectives and

further process the visible information to exhaust all the relevant information and develop creative alternatives through active engagement.

Procedural rationality in the presence of perceived SCIV level is an important aspect of individual differences in decision-making. As discussed in Chapter 2, procedural rationality refers to the "extent to which the decision process involves the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice" (Dean & Sharfman, 1993, p. 1071). As such, procedural rationality is characterized by "an attempt to collect the information necessary to form expectations about various alternatives, and the use of this information in the final decision" (Dean & Sharfman, 1993, p. 1071). Rationality is variable rather than absolute in the decision-making process, ranging from rationality-as-maximum at one end and by non-rationality (intuition) at the other, with bounded rationality in the middle. Decision makers engaging in less rational decision processes are more likely to make decisions based on experience, hunches, or simple rules of thumb (Tversky & Kahneman, 1981).

The findings contribute to behavioral supply chain management literature by empirically showing the role of stakeholder's constructive engagement as a driven force of a supply chain decision-making process. Behavioral SCM examines how one or more people influence the thoughts, feelings, and behaviors of individuals in making decisions (Gino & Pisano, 2008). In particular, the stakeholders' engagement indicates the positive influence of human social behaviour on the supply chain decision-making process where multiple stakeholders are involved, and the need to appreciate and consider each other's viewpoints and concerns to reach a meaningful and consensus decision.

In addition, the study asserts that stakeholder engagement ensures a broad range of decision-relevant perspectives are taken into consideration, openly shares and discusses divergent viewpoints, which result in a holistic and in-depth understanding of the decision situation and

a higher possibility to come up with new and creative solutions. Thus, stakeholder engagement reflects the constructive aspect of political behaviour in the decision-making process (Elbanna, 2018). Evidence related to the constructive political behavior can be found in the literature. When people from different departments, composing diverse functional areas, participated in the discussion in the decision-making process, the results could decrease uncertainty and enhance acceptance among involved parties (Elbanna, 2006). Moreover, political behaviour could ensure that all necessary aspects of the decision are evaluated (Elbanna, 2006). Stanczyk et al. (2015) find evidence that provide political is not harmful in even in the presence of goal misalignment between stakeholders with different interests as long as there is no powerful player dominating the decision-making. If firms could control the power balance between functions, they could create beneficial results even when goals among the participating functions are misaligned (Stanczyk et al., 2015).

While there have been extensive investigations on political behavior, most previous empirical studies have focused on political behavior as a negative force (Elbanna, 2018). Decision makers as political actors are thought to be enacting for self-serving and self-aggrandizement purposes in an unethical manner (Dean & Sharfman, 1993). However, there are decision-making studies that prove the constructive aspect of political behaviour (Elbanna, 2018).

Although supply chain decisions are usually made with the engagement of people with multi-functional and diverse professional background knowledge and competencies, the diversity of function and competency contributes to constructive political behaviour in the pharmaceutical context (De Dreu & West, 2001; Schwarber, 2005). Stanczyk et al. (2015) add that misaligned goals appear to be a necessary condition for behavioural politics to occur and affect procedural rationality. This study's findings show that while confronting misaligned incentives in the decision-making process might create disagreement, stakeholders will likely appreciate the increased comprehension of each other viewpoints and shared understanding of the decision

situation, and eventually come up with more creative alternatives to make high quality decisions.

The findings suggest that stakeholders who have relevant information and who are impacted by the decision should engage in the decision-making process. In particular, participants agree that functional diversity (Van Knippenberg, De Dreu, & Homan, 2004) is the important aspect of engagement, as different stakeholders with diverse functional backgrounds (e.g. quality, marketing, sales, finance function) are believed to bring a greater pool of decision-relevant information, knowledge and skills; and to have different perspectives on the decision situation. According to the findings, stakeholder engagement supports decision makers in validating information quality for decision-making use as well as validating individual information interpretation. As such, engagement serves to filter out irrelevant information and errors in intuition of the decision situation. Even more, engagement enables decision maker(s) to be exposed to divergent perspectives and a variety of alternative courses of action, thus a greater quantity of divergent viewpoints is explicitly taken into consideration to develop a holistic understanding of the decision situation.

Additionally, the need to reconcile divergent viewpoints of stakeholders may lead to more creative and innovative ideas and solutions (De Dreu & West, 2001; Schwarber, 2005). Prior literature on group decision-making also suggests that groups with functional and educational diversity are likely to encourage group members to analyze information to a greater extent and extensively discuss and integrate divergent perspectives to reconcile conflicts for optimal decisions (Oliva & Watson, 2011; Slotegraaf & Atuahene-Gima, 2011; Van Knippenberg et al., 2004). Similarly, prior studies on supply chain decision-making have suggested the usefulness of cross-functional decision-making (Kaufmann et al., 2014; Stanczyk et al., 2015). However, they have not explicitly explained the social mechanism underlying the positive impact of cross-functional decision-making on decision outcomes.

While engaging with technological tools could help the pharmaceutical supply chain decision-makers to collect data and information to gain an objective understanding of a situation, the findings show that the decision-makers in the pharmaceutical supply chain, rely on their intuition too, which according to the participants enable them to make a more holistic assessment of the decision-situation.

6.3.1.3. Engaging with Self

The findings reported that supply chain decision makers actively engaged with themselves in making supply chain decisions. Engaging with self refers to the decision makers use of their intuition in determining information acquisition and use in the decision-making process. *In this study, intuition refers to experience-based intuition that is defined as intuition based on prior experience and domain-specific knowledge stored in long-term memory (Kaufmann et al., 2014; Salas et al., 2010).* It is noticeable that, in the pharmaceutical supply chain context, the grounding of decision reasoning must be justified to all relevant stakeholders. Thus, the decision makers needed to use prior experiences and knowledge in making decisions because experiences and knowledge can be coded and presented (Stanczyk et al., 2015); while gut feelings are more intrapersonal and difficult to explicitly communicate and explain (Carter et al., 2017). This finding is consistent with Intezari and Pauleen (2019); Intezari and Pauleen (2018) who argue that managers rely on both data and intuition to deal with an uncertain situation.

As the studied supply chain decisions involve operational planning and control decisions, they are repeatable and require a high level of analysis and expertise to determine the best solution among a large number of possibilities (Snowden & Boone, 2007). Prior experience and supply chain management knowledge are of great use in acquiring and processing information in the supply chain decision-making process.

The supply chain decision makers in this study engage with their intuition in determining what is the relevant information to acquire, the extent of information collection, how and from whom information is acquired and processed. They rely on their experience-based intuition in evaluating the relevancy and accuracy of information to be acquired and used in the decision-making process.

The findings also show that acquiring information from personal sources other than information systems-based sources is a preferred method for pharmaceutical supply chain decision-makers to acquire their required information. As they perceived the existing information systems as complex and not useful, they were reluctant to engage with them while they were more comfortable interacting with people, especially with internal staff in functional departments. The supply chain decision makers stated that the data were not automatedly captured into the information systems and thus perceived the data accuracy was questionable. In addition, from their experience, they perceived that it was more convenient and effective in acquiring information from knowledgeable people within their firms because of higher information accuracy and interpretability. The more experienced decision makers are in their specific domain and a certain task, the more they rely on their experience in making decision. Novice decision makers, in contrast, heavily rely on information acquisition and comprehensive analysis of decision problems since they are not able to reflect on any similar past events. As a result, novice decision makers in this study relied on experienced colleagues' validation for information accuracy and interpretation. Smith, Larkin, and Flowers (2009) stated that experienced decision-makers are able to evaluate and interpret decision-related information better by relating it to previous experience that will increase their confidence in the decision-making process. Prior experience of a decision maker is useful in processing information and interpreting the decision situation since decision-makers have dealt with similar situations or contexts previously (Jansen, Curşeu, Vermeulen, Geurts, & Gibcus, 2013).

Thus, prior experience of decision makers can be used as the input and the guidance for them in acquiring and interpreting information during the decision-making process (Carter et al., 2017).

In addition, the findings pointed that the decision makers used their experience and knowledge to adjust the recommendations of the information systems. Particularly, they used their business understanding and experience to supplement those insights generated by the information systems. Information generated in the information systems might have limitations which might not be able to represent all relevant aspects of a decision, and can be mitigated by human intuition (Pauleen & Wang, 2017). Lycett (2013) argued that even though information systems make it easy to spot statistical patterns, trends and relationships, the critical next step of understanding the causes behind those patterns is still important to undertake actions that generate value. Human engagement is still involved in "accepting" the insights generated by information systems as being valid as useful, in deciding to deploy them to run operations in an unguided manner (Sharma, Mithas, & Kankanhalli, 2014).

6.3.2. The Process of Pharmaceutical Information-Based Decision-Making

The pharmaceutical information-based decision-making is a multi-phase process including informing, option generating, and aligning. Once the decision situation is identified, the informing phase initiates in which the decision makers acquire information from various sources and interpret the collected information to get an understanding of the situation and assist in generating relevant options. From this informing phase, decision makers discover and generate options alone or in discussion with relevant stakeholders. A decision is selected in the aligning phase when there is a high level of agreement amongst relevant stakeholders to ensure commitment to decision execution.

The pharmaceutical information-based decision-making process is characterized as a social and transparent process that combines a high level of rational decision-making and stakeholder engagement. In the process, decision makers conduct extensive gathering and analysis of information to develop greater insights into the reasoning to achieve justifiable and traceable decisions for stakeholders/authorities' approval. In addition, during the decision-making process, decision makers engage with various stakeholders. It is a two-way communication mechanism that provides a mechanism for exchanging information and promoting stakeholder interaction with decision-makers. Decisions are generated by evaluating numerous options until an option that satisfies decision makers and as many relevant stakeholders as possible is reached. The goal of this informative engagement mechanism is to achieve a transparent decision-making process with greater input from stakeholders and their support for the decisions that are taken (Cascetta et al., 2015). The extensive dissemination and consideration of a wider pool of information and discussion with divergent stakeholders in the decision-making process enable stakeholders to become knowledgeable of the decision situation in terms of importance, complexity, and immediacy. Although open discussion of divergent perspectives often generates disagreements, stakeholders will likely appreciate the increased knowledge they gained from expressing and listening to these different opinions (Olson, Parayitam, & Bao, 2007). This increased understanding should provide a common grounding for making decisions, which increases the possibility of stakeholders' comprehension and buy-in of the final solution.

Additionally, the level of the successful decision depends on the extent to which relevant stakeholders are committed to its success (Vroom, 2000). According to the participants, engaging stakeholders during the decision-making process through consultation for knowledge, open discussion of divergent viewpoints, validation of possible alternatives is a useful strategy to get stakeholders' commitment to decision implementation. Stakeholders'

constructive engagement in the decision-making process provides a setting for them to influence outcomes, makes them feel satisfaction because their concerns are respected and addressed, and increases their ownership of the decision as they have contributed to its creation and development. Amason (1996) found that team members became more committed to the final decision when they could discuss and share their views. Thus, decision commitment benefits the decision implementation process. Commitment decreases the likelihood of major resistance to the implementation of the decision from those whose ideas have been ignored, who do not agree with the proposed course of action, or who do not understand the reasoning that went into it (Olson et al., 2007; Schwarber, 2005). In addition, extensive discussion and integration of divergent perspectives result in greater comprehension of each party's concern, a shared understanding of decision constraints thus, will facilitate each stakeholder to better understand how to execute and coordinate with others for successful implementation of decisions (Oliva & Watson, 2011).

Such a high level of engaging multiple stakeholders represents the existence of constructive political behavior in the pharmaceutical information-based decision-making process in which the decision maker and relevant stakeholders constructively engage in the acquisition and use of information in making supply chain decisions. As a result, the decision-making process, which is transparent and participatory, enables all the relevant stakeholders to influence outcomes while facilitating the explicit accommodation of conflicting goals. These findings relate to the benefits of functional and competency diversity (Elbanna, 2018). Functional diversity is related to the number of functional backgrounds of decision-makers (S. Brown & Eisenhardt, 1998); and competency diversity is related to the diversity of decision-makers in terms of knowledge, skills, and abilities (Dayan & Elbanna, 2011). Supply chain decisions are usually made by people with multi-functional backgrounds, with dissimilarity in their knowledge and experience base, thus that diversity stimulates the practice of constructive

politics. Similarly, decision-makers who have been differently trained or educated may objectively disagree with each other in interpreting data because of their diverse professional backgrounds (Bell, Villado, Lukasik, Belau, & Briggs, 2011). In such situations, diversity can be beneficial for supplying a wider base of ideas during the decision-making process and hence may enhance the practice of constructive politics (Elbanna, 2018; Stanczyk et al., 2015).

Furthermore, based on empirical data, this study asserts that the operational supply chain decision-making is remarkably rationally bounded, suggesting the holistic approach in which decision makers consciously and extensively gather and use a substantial amount of quality information in combination with experience-based intuition as complementary inputs and guidance for decisions. The pharmaceutical information-based decision-making model is in contrast with most supply chain decision-making research that assumes managers choose to or can be induced to make exclusively rational decisions (Knemeyer & Naylor, 2011). According to the model, the supply chain practitioners are not rational to the extent that supply chain researchers normally assume. Supply chain decision makers are human, and human decision-making is bounded in its ability to acquire and process information (Simon, 1997). Decision makers are likely to augment any rules-based decision analysis approach with other information, sensitivities, and biases. The study thus contributes to the behavioral decision-making literature which has been largely overlooked in the supply chain management discipline (Tokar, 2010). Behavioral issues in terms of human behaviour and decision-making have significant relevance and importance for logistic research because people often fail to make choices consistent with normative or optimal policy and do so in specific and systematic ways (Stanovich & West, 2000).

6.3.3. Supply Chain Information Visibility and the Pharmaceutical Supply Chain Information-based Decision-making

This section explains the relationship between supply chain information visibility (SCIV) and information-based decision-making. The relationship is concerned with how SCIV supports the practitioners in making the pharmaceutical supply chain operational decisions.

The findings in this study show that operational decision-making in the pharmaceutical supply chain is information-based to ensure that the process is transparent and justifiable to different internal stakeholders. Therefore, the practitioners need information visibility, on both internal and external level to support their decision-making although they have different influence on the decision-making.

The integration of internal and external information visibility enables the practitioners to identify that an exceptional event is occurring in the supply chain. For example, both notification of an exception event from the external supplier or the communication of a feeling of demand change in the market from an internal colleague (e.g. the sales representative) are important for supply chain people to become aware of an emerging problem that require to act upon. Evidence related to the need for visibility to improve disruption discovery can be found in the literature (Barratt & Barratt, 2011; Bode & Macdonald, 2017; Messina et al., 2020; Williams et al., 2013). Barratt and Barratt (2011) and Messina et al. (2020) assert that SCIV should lead to faster disruption discovery, and that it allows supply chain practitioners to be aware of the context in which they operate and so easily discover future occurrences. Bode and Macdonald (2017) find that the internal and external information positively impacts the speed and ability of decision makers to process information to quickly discover the disruptive events. In addition, from this research findings reveal the behavioral factors that impact the practitioners in gathering and using visible information in making operational decisions. Accordingly, the supply chain practitioners crucially depend on the perceived accessibility

level of the information source in gathering information for decision-making support. The source accessibility refers to "the perceived amount of time and effort needed to locate a source and then to get the needed information from that source" (Auster & Choo, 1994, p. 211). Thus, the decision makers mainly obtain information to make informed decisions from the internal sources (i.e from internal information systems and internal stakeholders) that are readily accessible, rather than from the external sources that are hardly accessible. In addition, the second behavioral factor that determines the practitioner's selection of information sources relates to the source perceived credibility. Particularly, the decision makers depend on whether the information source is trustworthy and the degree to which they trust that source. The decision makers' trust is their willingness to rely on the visible information while the trustworthiness of an information source indicates its ability and willingness to act in the decision makers' best interests (Özer, Subramanian, & Wang, 2018). As such, the findings show that the supply chain practitioners rely heavily on the internal information visibility to support their decision-making. Supply chain practitioners generally turn to internal information sources to collect needed information because they are perceived more accessible and trustworthy. The practitioners perceive those external suppliers are hardly accessible and not trustworthy because suppliers are not willing to share information with them. However, in cases of small MNC affiliates, the decision makers perceive that information for their supplier sources is highly accessible and trustworthy because these suppliers are their MNC headquarters. Evidence related to the impact of behavioral factors on information gathering and using to support decision-making have widely presented in the information management (Auster & Choo, 1994; Lin, Cole, & Dalkir, 2014; O'Reilly, 1983; Zimmer, Henry, & Butler, 2007) and the behavioral operation management literature (Donohue et al., 2020; Özer et al., 2018).

Similarly, supply chain decision makers prefer personal sources of information-to-information systems sources. Because the information provided from personal sources is easier and faster to acquire and absorb. As participant 13 explained “I would say you’d always need to talk to people because they’re the experts in the areas. And they can explain it to you quite nicely. Rather than looking up information systems and then coming up with your own assumptions on what has been said… I think that talking to people is much better and way more relevant”. Sanbonmatsu, Kardes, and Herr (1992) suggested that how information is presented may cause the decision maker to notice or ignore that piece of information. For example, a decision maker may focus on information that is easier to retrieve, more familiar, or easier to imagine (Mantel et al., 2006). Moreover, personal sources are viewed as more credible and useful than information systems sources. Qualitative research suggests that personal sources of information are viewed as more credible than formal sources (Daft & Weick, 1984). The behavioral decision-making literature also suggests that personal information sources are more vivid (ability to recall information from memory), and thus may be more likely to suggest a positive future outcome (Mantel et al., 2006). On the contrary, participants did not prefer to acquire information from the existing information systems because the information is perceived to be difficult to retrieve due to the systems’ complexity and decision makers’ poor ability to use these systems. Thus, the personal information source is believed to be more useful in providing high-quality input for decision-making process.

6.4. Chapter Summary

This chapter introduces the model of pharmaceutical supply chain information-based decision-making based on the key findings. This chapter developed and discussed a theoretical model of the pharmaceutical supply chain information-based decision-making for pharmaceutical supply chains to understand the individual decision maker’s approach to making supply chain

decisions with a certain perceived level of SCIV. Then different aspects of the theoretical model are presented and discussed in relation to the existing literature in decision-making theory and supply chain management research areas. This theoretical model was discussed in its specific context this study focused on, the New Zealand-based pharmaceutical firms. The next chapter summarises the discussion and concludes the thesis.

Chapter 7: Conclusion

7.1. Chapter Overview

This study examines Supply Chain Information Visibility (SCIV) in the pharmaceutical industry and how practitioners in the pharmaceutical industry make supply chain decisions using visible information. The researcher interviewed practitioners who were involved in the decision-making in the pharmaceutical supply chain in New Zealand-based pharmaceutical firms. The findings of the interviews were presented in Chapter 4 (which addressed research question 1) and Chapter 5 (which addressed research question 2). Following a discussion of the findings and positioning the findings in the extant literature in the previous chapter (Chapter 6), this chapter draws together the key findings of the study and explains the contribution of the findings to theory and practice. The chapter is organized as follows. It begins with a brief overview of the study which is followed by a summary of the key findings. Then the theoretical contributions of the study and its practical implications are presented. The next section describes the limitations of this study. Directions for future research are also offered. Then, a reflection of the PhD journey is presented. The chapter concludes with a summary.

7.2. A Review of the Research

This study endeavors to contribute to and extend the field of SCIV and behavioral operations management. Both SCIV and behavioral supply chain decision-making have been widely researched. In the extant SCM literature, it is clear that SCIV is a desired capability in managing supply chains (Brandon-Jones et al., 2014; Goh et al., 2009; Goswami et al., 2013; Mubarik et al., 2021; Swift et al., 2019), however, SCIV do not guarantee positive effect on business performance in practice (Holcomb et al., 2011; Kim et al., 2011; Williams et al., 2013). In addition, while SCIV is assumed to play a critical role in managing pharmaceutical supply

chain that is a highly regulated and vulnerable field (Goh et al., 2009; Papert et al., 2016; Xu et al., 2020), there is a paucity in empirical evidence of specific characteristics of SCIV and its implications in the pharmaceutical supply chain. This is a significant research gap because a clear understanding of what constitutes pharmaceutical supply chain information visibility and how SCIV influences the ability of decision makers to process information to make better informed operational decisions can provide significant insight for practitioners in the pharmaceutical industry to develop and leverage SCIV to improve operational efficiency and better control the supply chain risks. To fill this knowledge gap, this exploratory study explored how supply chain professionals perceive SCIV of the pharmaceutical supply chain and how they make the informed decisions using the visible information. Accordingly, the following research questions were examined:

1. How do supply chain professionals perceive the SCIV state in the pharmaceutical supply chain?
2. How do supply chain professionals make informed supply chain decisions?

The data was mainly drawn from semi-structured interviews with supply chain professionals in the New Zealand-based pharmaceutical companies. Given the paucity of empirical studies about SCIV implications (Mubarik et al., 2021; Swift et al., 2019) and the application of behavioral decision-making theory in SCM research in the pharmaceutical supply chains (Donohue et al., 2020; Schorsch, Wallenburg, & Wieland, 2017), an exploratory qualitative approach using the constructivist grounded theory approach (Charmaz, 2006) was adopted to address the research questions. The data was collected from interviews with 21 supply chain decision-makers from 10 New Zealand-based companies' pharmaceutical supply chains. The participants were selected purposefully according to the selection criteria (as described in detail in Section 3.3). The key findings of this study have been presented in Chapters 4 and 5. The findings were then integrated to develop a theoretical model (Chapter 6) which explains the

step-by-step process of operational supply chain decision-making process at a given level of SCIV in the context of the pharmaceutical industry.

These findings and the model are briefly reviewed in the following section (Section 7.3) before the theoretical contribution and practical implications of the findings are discussed in Section 7.4 and Section 7.5, respectively.

7.3. Research Findings

The findings showed that the decision-makers in the pharmaceutical supply chains perceive information visibility as an end-to-end transparent view of what is happening across the supply chain. The findings also showed that the supply chain decision-makers in New Zealand-based pharmaceutical firms follow a multi-phased process which is driven by an informative engaging process. The informative engaging process consists of three aspects: engaging with self, engaging with relevant stakeholders, and engaging with technological tools. Through this informative engaging process, decision-makers acquire, interpret, and transform quality information into decisions through three main phases of informing, option generating, and aligning to achieve a high-level of agreement on the decision.

7.3.1. Perception of Supply Chain Information Visibility in the New Zealand Pharmaceutical Supply Chain from Practitioners' View

Chapter 4 and part of Chapter 6 reported and discussed the answer to the first research question: "How do supply chain professionals perceive the SCIV state in the New Zealand pharmaceutical supply chain?". The chapter reported that in the context of New Zealand-based SMEs, practitioners perceive SCIV in the supply chain as having an end-to-end transparent view of what is happening across the supply chain. For the supply-chain decision-makers, the end-to-end SCIV can exist at two broad levels: the internal SCIV and the external SCIV. While

internal SCIV is associated with having a transparent view of what is happening within a firm, external visibility is referred to being informed of what is happening in other parts of the supply chain by external supply chain partners. The findings illustrate the characteristics of SCIV levels and make recommendations for SCIV development in the New Zealand pharmaceutical context.

7.3.1.1. Supply Chain Information Visibility: Characteristics and Recommendations for Development

One level of information visibility is internal visibility which refers to the extent to which what is happening across functional departments within a firm is transparent to the pharmaceutical decision-makers. Participants reported that their firms had a relatively sufficient level of supply chain information visibility (SCIV) across their internal business functions because they could build an open communication environment between individuals within their firms. As such, internal SCIV was mainly achieved through personal interaction. Personal interaction relates to personal regular communication based on close and long-term relationships that foster mutual trust to enhance the sharing of high-quality and proprietary information and knowledge that are not captured in the information systems. While information systems can only provide users with fragmented raw data, what the practitioners need is applicable knowledge for their decision-making.

The findings show that pharmaceutical decision-makers prefer to rely on personal communication channels to share information across different business functions rather than acquiring and sharing information via the information systems. Participants stated that their companies have systems that are set up for them to exchange information across departments within a company; however, their concern lies in the difficulty to locate and acquire

information from information systems due to its complexity and the lack of information systems and data literacy.

The participants explained the barriers to the development of SCIV include pharmaceutical decision-makers' reluctance to use information systems. The participants reported that the reluctance is due to the complexity of the technologies, and the lack of information systems among the decision-makers, as well as limited financial resources for implementing advanced information systems. Accordingly, the participants complained that their existing information systems are inappropriate for their firm's business processes. They were unable to independently select the most appropriate information systems for their business needs because they had to follow the multination corporations' global information systems standards and had an insufficient interest or financial resources to invest in information systems customization. The study's participants recommend that New Zealand firms need to find and adopt appropriate information systems that are specifically designed for small and medium-sized enterprises' processes and at a reasonable price.

7.3.1.2. External Supply Chain Information Visibility: Characteristics and Recommendations for Development

External SCIV refers to having a transparent view of what is happening in a firm's external environment including customers and suppliers. The pharmaceutical decision-makers who participated in this study commonly stated that the main issue with their pharmaceutical firms was that there was limited visibility of the external supply chain partners in terms of both information quantity and quality. For these pharmaceutical decision-makers, external SCIV refers to the timely sharing of inventory information, especially exception events happening across the supply chain among members.

Pharmaceutical SCM aims to avoid any possible risks that might lead to the unavailability of products. In addition, in the context of New Zealand with geographic isolation, heavy dependence on overseas production, and tendering policy in sourcing medicines (discussed in section 1.3), pharmaceutical firms are faced with the dilemma in inventory management where firms simultaneously try to reduce costs to get supply contracts and carry a huge inventory to ensure 100% product availability demands. As such, sharing information of exception events helps to mitigate the possibilities and/or the consequences of supply chain risks that might occur in both upstream and downstream parts, which results in serious consequences for the supply chain (Nooraie & Mellat Parast, 2015).

Apart from having inventory visibility, the participants described the limited level of external SCIV due to dependence asymmetry in the relationship between their firms and external supply chain actors and unavailability of IOIS. New Zealand pharmaceutical companies have difficulties in getting information shared from both suppliers and customers. Even if they were able to access the partner's information, the shared information was not of high quality.

First, there is a high-level of dependence asymmetry between New Zealand pharmaceutical companies and their external suppliers. Particularly, the external partners are not necessarily dependent on New Zealand companies while New Zealand companies are more dependent on external partners. Thus, external partners appeared not to be interested in sharing information with the New Zealand companies in the presence of dependence asymmetry.

Second, the external visibility is limited due to the lack of New Zealand pharmaceutical companies' ability to set up IOIS with external partners. One possible reason could be the unwillingness of external partners to invest in partnership with SME companies that have low business values. Another reasoning is the limited financial resources of New Zealand SMEs. Prior studies have reported the importance of IOIS in enhancing access and sharing of high-quality information between supply chain partners (Kim et al., 2011; Lee et al., 2014). In the

New Zealand pharmaceutical industry, companies are unable to develop IOIS with external suppliers and customers, thus the level of external SCIV is limited. In the absence of IOIS, the participants emphasize the importance of proactive personal communication with external partners to get updated and high-quality information from external sources. Participants emphasized that being small players in the supply chain, they need to proactively open and express their commitment with their external partners rather than stay isolated and waiting. Proactive communication might contribute to reducing the risk of opportunistic behaviour and simultaneously build mutual trust as the critical condition for information/knowledge sharing.

7.3.2. The Theoretical Model of Pharmaceutical Supply Chain Information-based Decision-making

Chapter 5 presented the findings that address the second research question: "How do supply chain professionals make informed supply chain decisions?". The findings presented in Chapters 4 and 5 were discussed in Chapter 6 and a model of a theoretical model of pharmaceutical supply chain information-based decision-making. The model explains how pharmaceutical decision-makers make operational supply chain decisions at the individual level using the availability of information in their supply chain.

Whereas the previous supply chain decision-making studies typically chose a firm or single decision as the unit of analysis (Mantel et al., 2006), this current research chose individual decision-makers as to the unit of analysis. The unit of analysis in this study is individual decision-maker because the decisions are made by a human, not a firm. Furthermore, the theoretical model is a pharmaceutical supply chain domain-specific and provides a unique contribution to the literature by laying the foundation for building the theory of information-based decision-making.

According to the model, the pharmaceutical operational decision-making is an information-based multi-phase decision-making process driven by the informative engaging process. Informative engaging emerges as the pivotal mechanism for the execution of pharmaceutical information-based decision-making, acting as the core category of this exploratory study. The informative engaging mechanism consists of three aspects: engaging with self, engaging with relevant stakeholders, and engaging with technological tools. Through informative engaging, decision-makers acquire, interpret, and transform quality information into decisions that ensure high-levels of agreement amongst relevant stakeholders. The informative engaging process and the phases of the operational decision-making as presented by the theoretical model are discussed below.

7.3.2.1. Informative Engaging

Informative Engaging refers to the proactive process where decision-makers deliberately and actively engage with information systems, relevant stakeholders, and themselves in gathering, interpreting, and transforming quality information and knowledge into an actionable and agreeable decision. The findings pointed out that through the informative engaging process, the decision-makers guide the supply chain information-based decision-making by determining (1) what, how, and from whom information is acquired to inform the decision-maker, (2) how the information is processed to generate options, and (3) how the information is used to get agreement on the final decision.

The Information Engaging is the construct that represents the underlying mechanism driving pharmaceutical information-based decision-making. It is characterized by the three aspects: engaging with self, engaging with relevant stakeholders, and engaging with technological tools. This process guides the individual decision-maker in how to get informed, generate options,

and align different stakeholders' interests in selecting the final option through using and leveraging the three sub-mechanisms. These phases are discussed below.

7.3.2.2. The Phases of the Pharmaceutical Information-Based Decision-Making Process

The information-based decision-making in the pharmaceutical supply chain is a multi-phase process of informing, option generating and aligning (Figure 6.2 in the previous chapter). The *Informing* phase refers to the process of acquiring and interpreting quality information by engaging with multiple data sources. In this phase, while it is a rational process in searching and accessing multiple information sources, the decision-maker's experience-based intuition acts as the input and guidance in what, how, and from whom information is noticed and acquired. The combination of rationality and intuition enables the decision-maker to acquire sufficient information while avoiding information overload that might lead to "analysis paralysis". In this informing phase, the decision-maker should listen to stakeholders for each party's decision requirements/concerns and information inputs.

The *Option generating* phase refers to the decision-maker analysis of the acquired information to better understanding the decision situation and identifies a comprehensive choice set of alternatives. This phase is mainly driven by rationality through conducting a careful process of extensive information analysis using both human and technological factors in generating possible options. In addition, the decision makers engage different internal stakeholders in the discovery and generation of options.

The *Aligning phase* refers to the decision selecting process that ensures all the relevant stakeholders' concerns to be addressed to achieve a decision that satisfies as many decision-makers and relevant stakeholders as possible. The decision-maker engages with multiple relevant stakeholders in eliciting different criteria and in reconciling the differences to reach

an agreement when evaluating alternatives. This phase in and of itself is a social process because the final option must be accepted by multiple stakeholders to ensure their buy-in and commitment to the decision execution. If the decision-makers ground their justification on relevant facts and objective evidence, the decision is more reliable and acceptable.

The theoretical model shows the pharmaceutical supply chain decision-making process that is information-based, transparent and participatory for achieving operational decisions with a high-level of agreement among relevant stakeholders and authorities for improving internal supply chain coordination (The model has been discussed in detail in Section 6.4 in Chapter 6).

7.4. Theoretical Contribution

The model indicates that the supply chain decision-making is a rationally bounded and social process. It is a highly comprehensive decision-making process by engaging with multiple sources during the decision-making process. It is also featured as a social process in terms of engaging multiple relevant stakeholders in different phases of the process that may increase the level of acceptance and its implementation coordination (Vroom, 2000).

This study contributes to the extant literature of supply chain information visibility and behavioral operation management in the pharmaceutical industry in a context (in this case, New Zealand) where the pharmaceutical products are mostly imported from other countries rather than produced in-house. This research broadens the understanding of supply chain information visibility in a supply chain context with the unique features (highly regulated and vulnerable) that merit a separate research undertaking (Handfield, 2017). In addition, the findings expand the behavioral operation management body of knowledge by generating the descriptive model of pharmaceutical supply chain operational decision-making with empirical exploration (Donohue et al., 2020). This section specifically discusses the contribution of the study to the field of SCIV and behavioral operations management.

7.4.1. Contribution To Supply Chain Visibility Literature

This study contributes to the supply chain visibility literature in the following ways.

The findings complement prior research exploring the SCIV construct (Barratt & Oke, 2007; Brandon-Jones et al., 2014; Kim et al., 2011) by elaborating upon the SCIV construct at both internal and external level in the pharmaceutical industry. The findings provide a holistic approach to understanding the SCIV construct on both internal and external (inter-organizational) levels compared to the previous SCIV research that has largely ignored the internal visibility. In addition, the findings add empirical evidence to prior findings that emphasize the importance of both internal and external information visibility in managing supply chains (Barratt & Barratt, 2011; Bode & Macdonald, 2017; Messina et al., 2020). For example, Barratt and Barratt (2011) assert that the visibility obtained through the integration of internal and external information flows allows supply chain actors to be aware of the context in which they operate and thus discover disruptions in the supply chain faster. Thus both internal and external information visibility are of critical importance for managing the pharmaceutical supply chain (Wang & Jie, 2020).

In addition, to the researcher's best knowledge, previous SCIV studies have predominantly described SCIV on the external level (inter-organizational level). Most of the previous studies were conducted in the context of supply chains in the UK, Korea, Europe… (Barratt & Oke, 2007; Caridi et al., 2010; Kim et al., 2011; Klueber & O'Keefe, 2013) where the researched firms are large corporations and tend to have powerful influences in their supply chain, compared to inferior positions of the New Zealand-based firms in the pharmaceutical supply chain. Accordingly, this study contributes to the extant literature in that it explored the perception of SCIV in the context of New Zealand-based firms who are in inferior positions in their supply chains and are under-researched.

Particularly, the current study provides practical and original understanding of SCIV characteristics in New Zealand-based pharmaceutical firms, from both and intra- and inter-organizational perspectives. With the low level of information systems usability in the New Zealand pharmaceutical firms, personal communication is considered the more efficient and effective way to share information among and within organizations to enhance information visibility. The finding provides empirical support for prior studies in SCM in the New Zealand context that discuss that personal communication play a more important the role than the information systems in managing supply chains. For instance, Basnet and Wisner (2012) found that the adoption of enterprise information systems for information sharing was not related to achieving internal company integration in New Zealand companies. Luo et al. (2018) found that New Zealand firms do not rely on information systems to support information communication but relied on personal communication because of the firm structure and culture. This finding can lead to the extended contribution that highlights the fact that the pharmaceutical supply chain can be so contextual bound (culturally and socially) that may require inductive and highly culturally sensitive research designs to provide an accurate understanding of the complexities of human interactions and information exchanges.

In the extant SCIV literature, researchers have called for SCIV studies on different industry contexts to support the development of and our understanding of SCIV (Kim et al., 2011; Klueber & O’ Keefe, 2013; Musa et al., 2014). In addition, the extant SCIV literate in the pharmaceutical industry remained analytical or theoretical (Zhang et al., 2011). Consequently, this study contributes to the extant literature through empirically exploring SCIV in the pharmaceutical industry that is forced to ensure information visibility to comply with regulations and respond to supply disruption risks (Klueber & O’ Keefe, 2013; Musa et al., 2014; Papert et al., 2016).

This study contributes to the pharmaceutical supply chain management in emphasizing exception visibility as an important part of SCIV. Exception visibility refers to having access to information regarding exception events across the supply chain to assist a firm to respond to disruptions. This finding adds empirical evidence to prior theoretical studies that conceptualize SCIV from the exception management perspective. It also provides empirical support for prior studies that highlight the necessity of ensuring SCIV through gathering, processing, and sharing information among the supply chain partners to build supply chain resilience.

7.4.2. Contribution to the Behavioral Operations Management

The study contributes to the behavioral operations management literature that studies human behavior and cognition in the supply chain context (Donohue et al., 2020; Fahimnia et al., 2019; Tokar, 2010). Better integrating human behavior into our understanding of supply chain decision-making continues to be an exciting avenue for research (Fahimnia et al., 2019; Wieland, Handfield, & Durach, 2016). Behavioral operations management aims at understanding how decision-makers actually make decisions and using this understanding to generate interventions to improve business operations (Fahimnia et al., 2019; Katsikopoulos & Gigerenzer, 2013). Camerer and Loewenstein (2003) suggest that behavioral research enhances theoretical insights and predictions of human behavior, thereby contributing to theory development.

Accordingly, the study contributes to the behavioral operations management literature through the development of a theoretical model of the pharmaceutical supply chain information-based decision-making based on empirical data (Figure 6-2). The model responds to the call of Schorsch et al. (2017) that future behavioral operations management research should take a more inclusive approach by integrating the multiple steps of decision-making and problem-solving. Whenever people make decisions or solve problems, their activities involve multiple

steps; hence, cognitive activities ought to be viewed holistically (Schorsch et al., 2017). The Pharmaceutical Supply Chain Information-Based Decision-Making model provides a holistic view of the pharmaceutical supply chain decision-making at the individual level. This novel theoretical model explains multiple steps of the pharmaceutical supply chain decision-making process and how behavioral factors elaborate in each step of the decision-making process. The pharmaceutical supply chain decision-making is driven by an Informative Engaging process that refers to the proactive process where decision-makers deliberately and actively engage with information systems, relevant stakeholders, and themselves across multiple decision-making steps, including informing, option generating, and aligning. As such, the influence of behavioral factors (both the individual cognition and social psychological factors (Gino & Pisano, 2008) is explained through the Informative Engaging process.

For example, in the informing phase, the model shows that decision-makers acquire information from both personal and information systems-based sources. However, they prefer to acquire information from personal sources through consulting with relevant internal stakeholders because of the perceived convenience, better information quality, and a higher level of trust. Decision-makers also prefer personal information sources because of the perception of future outcomes that if they engage with relevant stakeholders who influence the decision, the possibility of decision buy-in would be higher. The findings also respond to the call for more research on how information is acquired and on the role of feedback and the perception of future outcomes, given the strong focus on the information processing part of the decision-making process in past behavioral operations management research (Schorsch et al., 2017).

Second, the study findings indicate that the pharmaceutical supply chain decision-making in practice is rationally bounded, and is heavily influenced by human behavior, even with the existence of advanced algorithms in information systems. There always requires a human

element that links data in the information systems to decision-making through the decision-maker's behaviour in acquiring, processing, and interpreting of data from information systems-based sources. Especially, in making certain operational supply chain decisions, the decision-makers can engage with analytic tools in information systems that might automatically generate insights and potential options. However, human interventions are highly required to correct any inherent errors. The findings in this study agree with previous research in identifying that highly automated algorithms in information systems in inventory management and forecasting decision-making often rely on human interventions to allow correcting for their inherent incompleteness (Fahimnia et al., 2019; Kremer et al., 2011; Kremer, Siemsen, & Thomas, 2016; Van Donselaar, Gaur, Van Woensel, Broekmeulen, & Fransoo, 2010). Thus, this study supports David Ferruci, IBM's lead who views the future of decision-making as a combination of human judgment and algorithms (Tetlock & Gardner, 2016).

Third, this study contributes to enrich behavioral operations management literature through utilizing constructivist grounded theory as the research method. Denk, Kaufmann & Carter (2012) suggest that grounded theory is an appropriate research method for investigating behavioral and social aspects of organizations and inter-organizational relationships, and thus should be utilized more frequently in future behavioral operations management research. However, the grounded theory method is the least applied in the behavioral operations management literature (Schorsch et al., 2017). According to the reviews of the distribution of research methods, the grounded theory method only accounts for 4% while laboratory experiments and surveys are the most dominant methods (accounted for 37% and 17% respectively) (Schorsch et al., 2017, p. 246). Another recent review confirms the domination of applying the laboratory experiment method in the behavioral operations management literature (Fahimnia et al., 2019). Therefore, it is suggested that being saturated with laboratory experiments, the research space is ripe for insights derived from alternative methods (Perera et

al., 2020). Particularly, it is believed that rich contributions can be made to the body of knowledge in this space through future studies complementing existing work with heretofore underutilized research approaches (Donohue et al., 2020; Perera et al., 2020).

Finally, another key theoretical contribution of this study to behavioral operations management is the identification of the constructive aspect of political behavior in the pharmaceutical supply chain decision-making process whereas most of the existing decision-making studies have largely paid attention to the negative aspect (Elbanna, 2018). The study findings show that, despite conflicting incentives, decision-makers and different stakeholders behave constructively in the decision-making process to achieve positive decision-making performance. During the decision-making process, the decision-makers actively engage with multiple stakeholders to have access and decode information, to understand different stakeholders' specific needs and perspectives so that they can collectively serve their stakeholders' needs and get feedback about the utility of different problem-solving strategies, and expand the group knowledge about the decision context (Elbanna, 2018). In addition, through the constructive engagement process, the stakeholders are motived to engage in the decision-making process to make an influence on the decision, to have increased explicit ownership of the decision which then promotes the alignment and decision buy-in. Therefore, constructive political behavior creates a positive impact on decision-making performance.

7.5. Practical Implications

This study offers practical perspectives on achieving SCIV. The findings of this study have implications for managers who plan to (further) develop SCIV in their companies, particularly, in the pharmaceutical industry.

First, the findings indicate that managers in pharmaceutical firms should pay attention to building SCIV on both internal and external levels. Particularly, when facing difficulties in

developing external information visibility in the presence of asymmetrical dependence, developing intra-organizational SCIV appears to be a useful tactic to fill the gap of inaccessibility to information from external supply chain parties to some extent. For example, internal stakeholders such as experts and front-line people such as marketing or brand managers, sales representatives are useful sources to acquire information of external part of the supply chain.

Second, this research suggests that the managers understand that human-to-human interaction is the critical determinant of SCIV achievement. Managers should pay more attention to building trust with external partners through constant and proactive communication to enhance external information visibility. Furthermore, it is critical for manager to understand that investment in information systems per se does not guarantee to improve information sharing within and across firms' boundaries. Instead, it is a compatible, user-friendly accessibility (easy-to-access) system can render values.

Third, due to the complexity and numerous regulatory pressures to ensure pharmaceuticals quality and 100% supply availability, pharmaceutical firms should pay close attention to building exception visibility on both internal and external level. Exception visibility assists a firm to actively encounter both internal and external disruption risks through early identification and thus elevating the ability to reduce the likelihood and the impact of these events (Mubarik et al., 2021).

Second, the findings of this study reveal barriers that may inhibit the development of SCIV and propose recommendations for firms that have inferior positions in the supply chain. Barriers to achieving SCIV at the inter-organization level include the risk of opportunism and dependence asymmetry. The antidote to these barriers is proactively building close relationships with powerful external partners via constant and active communication to build mutual trust that paves the way for information/knowledge sharing. Proactive communication with external

partners, therefore, includes regularly sharing high-quality information with partners and asking for needed information from them. Proactive communication can earn firms' trust and accurate information shared promptly from their external partners. the barriers to achieving intra-organization visibility include functional silos, clunky information systems, and a lack of information systems literacy among supply chain practitioners can be addressed in at least two ways. The first recommendation is the provision of constant staff training on information systems literacy. The second suggestion is there is not one-size-fits-all information system; that the choice of specific systems or software should be determined by its relevance to a company's requirements. An advanced and complex system might not fit a small-sized company requirement and result in users' unwillingness to use the system resulting in the invisibility of information, although it may be available in the information systems.

Another practical relevance of this study is the model of pharmaceutical supply chain information-based decision-making. This model explicates a useful decision-making model that integrates both bounded rationality and social interaction for the pharmaceutical supply chain decision-makers to follow to achieve comprehensive and effective decisions. The practical implication of the model is two-fold. First, the study findings show that the pharmaceutical decision-making process is heavily influenced by human behavior. Understanding the effect of human behavioral factors including both human cognitive behavior and human social behavior will support supply chain professionals appropriately designing or implementing changes to the pharmaceutical decision-making process to improve supply chain operations. The decision-making process should be an open, transparent, and participatory one that encourages different stakeholders to constructively engage in the process to achieve high levels of decision agreement and decision buy-in that ensure greater understanding of the decision and better coordination needed for successful execution in the pharmaceutical supply chain context. Second, understanding that functional and background diversity impacts

constructive engagement with stakeholders in the decision-making will help the decision-makers determine who to engage within making supply chain decisions.

In addition, the study findings help to guide the managers in practice as they seek a solution in the implementation of automated tools in their information systems to support inventory management and forecasting decisions. It is important to note that the decision-making process should be a combination of both comprehensive rationality and human intuition. Thus, managers need to identify when and under what conditions human intuition should be encouraged in the decision-making process to ensure comprehensive and sound decisions. For example, while the firm's supply chain system might automatedly create supply and demand forecasts based on historical data, it is unable to incorporate contextual information which may not be quantifiable, such as political pressures, conflicts among stakeholders, as well as social responsibilities in dealing with unprecedented issues such as the COVID-19 pandemic. In such situations, human intuition is encouraged to make necessary intervention to the automated generated options. The combination of rationality and intuition in the decision-making process can result in significant improvement in decision accuracy.

Although the outbreak of the Covid-19 happened when this research was in the writing-up stage, it is worthy to mention the risks of the pandemic in the pharmaceutical supply chain, one of the most suffered industries due to the Covid-19 effects, to better illustrate the importance supply chain visibility in the pharmaceutical supply chain. The Covid-19 pandemic has brought the long-standing vulnerability of the pharmaceutical supply chain into sharp focus (Miller et al., 2021). In the wake of the Covid-19 pandemic, the availability and production of pharmaceutical products are drastically reduced, and a huge mismatch between supply and demand is observed (Kumar et al., 2020). The pandemic disrupts the supply of medications for the increasing demand and the supply of other critical pharmaceuticals leading to high pressures for both governments and pharmaceutical firms (Keskinocak & Ozkaya, 2020; Miller

et al., 2021). Such supply shortages are likely to grow rapidly as more patients need medications to fight the disease, while economic damage and blocked transportation decrease the supply (Keskinocak & Ozkaya, 2020; Sharma & Shanks, 2011). Under this circumstances, the unavailability or inaccessibility to the key information of what is going on across the supply network is leading to a reactive, unorganized, and subtle response to the unprecedented disruptions, thus compromising the supply chain resilience to a greater extent (Esper, 2021).

7.6. Limitations of the Study

The present study has some limitations which can provide avenues for future research. First, the findings may not be statistically generalizable to a large population because of the qualitative nature of the study. However, the deep and thorough insight that the findings of this study offer can provide guidelines for future research design and objectives for exploring SCIV in different contexts. Moreover, future researchers are highly encouraged to use larger sample sizes. Although large-scale surveys can be useful to deductively confirm the findings of this study, it may be advisable that such quantitative studies be conducted in combination with qualitative research designs to consider the cultural and social aspects involved in business processes such as exemplified by the highly complex and multi-layered pharmaceutical supply-chain. In addition, the current findings may be analytically generalized to the New Zealand pharmaceutical supply chain context but are not representative of the general population. Future studies need to explore supply chain visibility in other geographical regions and countries.

Second, this study has examined the supply chain professionals of exemplary New Zealand-based companies in the pharmaceutical industry only; thus, the findings of the study may not be representative of companies operating in other industries.

Third, while every attempt has been made to ensure the quality and rigor of the research, the data analysis has been conducted and completed by a single researcher (which is a requirement for a Ph.D. study), which raises concerns of research bias. Coding and category development have been carried out solely by the researcher (though defended with supervisors), thus the issue of single research bias may not be eliminated from the research findings.

7.7. Future Research Recommendation

Based on the foundation provided by this study, multiple avenues may be paved for in future studies. Some of the more interesting areas for further research are as follows.

The key elements of the theoretical model in this study need to be empirically verified and tested by conducting a large-scale survey in the pharmaceutical industry and in other industries such as aviation, food industry in New Zealand as well as other geographical regions. Supply chain decision-making theory testing is critical to understanding to what degree the findings of the current study can be generalized. Moreover, a timely recommendation for future research is to explore the application of this theoretical model – a behavioral decision-making model in supply chain decision-making in the context of the Covid-19 pandemic. According to Davenport (2020), decision-making becomes more critical and challenging during periods of stress and most difficult when future outcomes are uncertain as in the times of the Covid-19 pandemic. In the fast-changing Covid-19 situation, the decision-makers are required to make unfamiliar decisions in a short time frame with limited past data or trustworthy rules to employ automated decisions (Davenport, 2020). Consequently, decision-making during this Covid-19 pandemic time mainly relies on human diligent efforts (Davenport, 2020). In making unfamiliar decisions in uncertain times, Alexander, De Smet, and Weiss (2020, p. 3) theoretically suggest the “fishbowl” decision-making approach. Using this approach, the decision-makers involve many stakeholders and encourage different views and debate to make

sure the decision-makers are not missing something important (Alexander et al., 2020). The "fishbowl" approach can lead to smarter decisions without sacrificing speed by removing a communication step of explaining the decision to different stakeholders who will execute it (Alexander et al., 2020). Along with this anecdotal evidence, further empirical studies are needed to understand the applications of the model proposed in this research in supply chain decision-making in the Covid-19 pandemic.

The current study has proposed a theoretical model of the pharmaceutical supply chain decision-making process. To provide researchers and managers with a more realistic picture of the effectiveness of the proposed decision-making process, future studies need to investigate the perceptions of relevant stakeholders regarding the supply chain decision-making process to see if they align with that of the supply chain decision-makers. Furthermore, to complete the model of supply chain decision-making, future studies might take a step further to examine the relationship between the supply chain information-based decision-making process and its effectiveness in the pharmaceutical context. Also, to contribute to the behavioral decision-making literature, future studies may examine the contextual, personal, and task-related factors such as relationships between individuals in supply chains, or the role of culture that influence the pharmaceutical supply chain information-based decision-making process, and its impact on the decision quality.

In the model of information-based pharmaceutical decision making, the researcher discussed 'engagement with self' with a focus on intuition and the role it plays in decision making. However, one might imagine that ethical considerations begin with one's engagement with self. Also, the pharmaceutical industry is, by nature, a sector where responsibility towards patients and ethical behavior are omnipresent, while making a profit to reward shareholders is required (Valverde, 2012). Thus, further research might investigate the ethical dilemmas that

pharmaceutical decision makers have to face with and how they integrate ethical concerns in making pharmaceutical decisions.

Furthermore, although the relationship between SCIV and a firm's performance is out of this study's scope, the researcher suggests that future studies conduct empirical research to investigate the impact of internal SCIV and external SCIV on a firm's performance. This research direction will enhance the understanding of the critical importance of both internal and external SCIV capabilities in achieving performance-related competitive advantage. Further research on the relationship between internal and external SCIV would be important to better understand how to successfully develop SCIV in a supply chain.

Lastly, As suggested in section 7.5, pharmaceutical firms prioritize building SCIV, exception visibility (in particular) to assist their preparedness to potential risks, even in a stable business context as in the New Zealand pharmaceutical industry. More importantly, achieving SCIV might not only crucial in assisting a firm to actively encounter the supply chain disruption risks during normal condition but also vital in elevating a firm to respond quickly to minimize the immediate impacts in the unprecedented turbulent situation such as the Covid-19 pandemic (Chowdhury et al., 2021). In the wake of the Covid-19 pandemic, the availability and production of pharmaceutical products are drastically reduced, and a huge mismatch between supply and demand is observed (Kumar et al., 2020). Such supply shortages are likely to grow rapidly as more patients drive up demand while pharmaceuticals production is disrupted due the economic damage and blocked transportation (Keskinocak & Ozkaya, 2020). Thus, it is critical to conduct empirical studies to explore how SCIV supports pharmaceutical supply chain actors to respond to the disruption impacts of the Covid-19 pandemic. Moreover, the geographic isolation and a high level of dependence on foreign suppliers would make the New Zealand-based firms' pharmaceutical supply chains more vulnerable to the pandemic impacts. Thus, further research in the pharmaceutical firms context, and in the New Zealand

pharmaceutical industry, in particular, is called for to understand the contributions of SCIV to mitigation of the disruption effects and assurance the supply of pharmaceutical products in the turbulent times.

7.8. The PhD Journey Reflection

I would like to finish this dissertation with a reflection on my PhD journey, which is the journey of gradually transforming from a positivist researcher to a social constructionist researcher. My upbringing and education in an Asian country has set me into a positivist position where I have always been told what to do, what are the rules and standards to follow, what are the right things to do instead being able to do things in my own way. My background has set my belief and understanding of the world. When I started my PhD program at Massey University, I expected that I would follow a given research path with supervisors' guidance. I then realized that I had to take the lead in this journey. At that time, I experienced a feeling of confusion and being overwhelmed in the academic world. Making decision was hard and to some extent scary for me because I was afraid of making incorrect decisions and being judged to be incompetent. I was searching for the perfect research topic and the perfect research design. I consulted with supervisors, with other respected scholars in my school, searched extensively, and read every paper that is relevant to my interested field. I found out that positivism and quantitative research approach are dominant in supply chain management and information systems field. I decided to choose quantitative as my research approach. However, I was struggling a lot in developing propositions to test because of the limited variables, and I was questioning and thinking of various variables and angles. I kept reading and spending a lot of time to again find the best propositions and found they were not good enough to move forward. Having seen me struggling with my research proposal, my supervisor suggested that I should meditate to calm my busy and anxious mind. I started to meditate, and I realized that in addition to searching for knowledge out there, I should search inside myself to understand what I really needed to do. I

found out that my main interests since I was a child has been my curiosity of exploring and understanding other people. I have always been interested in listening to people's stories and understanding how humans give meaning to what happens to themselves. However, my education has enveloped my beliefs and put limitation to my curiosity.

Then, I went back to the research methods literature, and I found social constructionism aligned with my world view in which I believe that the social phenomena are constructed and subjective to the social actors. I proceeded with adopting the exploratory approach that is suited to exploring complex problems and interpreting the experiences and interpretations of relevant actors.

My journey was not yet smooth after this decision because it was not easy to let go all the long-built beliefs that I was set in. I took social constructionist as my chair in conducting the research, however, to some extent it was affected by the positivist position. I was trying my best to be mindful on the transformation journey from a positivist to a social constructionist researcher. The PhD journey is not purely a PhD journey per se, but it is a valuable opportunity for me to connect deeply with my inner self and accept it without judgement.

7.9. Chapter Summary

Overall, this study adopted an exploratory research design to address two research questions: (1) How do supply chain professionals perceive information visibility in the pharmaceutical supply chain? and (2) How do supply chain professionals make informed supply chain decisions? Twenty-one managers and decision-makers from ten pharmaceutical firms operating in New Zealand were interviewed. The data from the semi-structured interviews were analyzed using the constructivist grounded theory (Charmaz, 2006). Based on the findings a model of pharmaceutical supply chain information-based decision-making was developed. The model explains an information-based decision-making process driven by the informative

engaging process. The informative engaging mechanism consists of three aspects: engaging with self, engaging with relevant stakeholders, and engaging with technological tools. Through the informative engaging process, decision-makers acquire, interpret, and transform quality information into decisions through three main phases informing, option generating, and aligning to achieve a high level of agreement on the decision.

The theoretical contribution and practical contribution of the study were discussed in this chapter. The limitations of the study were also explained and directions for future research were offered. This chapter provided a summary of the whole research project and findings.

The two major theoretical contributions of this study are two folds. First, the study provides a practical and original understanding of SCIV in pharmaceutical firms in New Zealand, from both an internal and external perspective. Second, the research findings expand the knowledge in the field of behavioral operations management by illustrating the pharmaceutical supply chain information-based decision-making at the individual decision-maker level.

The study also proposes several practical implications for managers, especially the ones in pharmaceutical firms. Recommendations for future studies are also offered. It is worthy to emphasize the recommendations for further studies that are crucially needed to assist firms to counter the pharmaceutical supply chain disruption risks caused by the Covid-19 pandemic.

References

Abedalla, R. W. (2014). The silo effect of information technology on the organizational productivity: A qualitative research study. *International Journal of Computer, 15*(1), 42-50.

Alexander, A., De Smet, A., & Weiss, L. (2020). Decision making in uncertain times. *McKinsey Quarterly Magazine [Internet]. https://www.mckinsey. com/business-functions/organization/our-insights/decision-making-in-uncertain-times (2020)*

Alfalla-Luque, R., & Medina-López, C. (2009). Supply Chain Management: Unheard of in the 1970s, core to today's company. *Business History, 51*(2), 202-221.

Amason, A. C. (1996). Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: Resolving a paradox for top management teams. *Academy of Management Journal, 39*(1), 123-148.

Arshinder, Kanda, A., & Deshmukh, S. G. (2008). Supply chain coordination: Perspectives, empirical studies and research directions. *International Journal of Production Economics, 115*(2), 316-335.

Auster, E., & Choo, C. W. (1994). CEOs, information, and decision making: scanning the environment for strategic advantage. *Library trends, 43*(2), 206-225.

Bakker, M. (2006). Is trust really social capital? Knowledge sharing in product development projects. *The Learning Organization, 13*(6), 594-605.

Balasubramanian, U., Diab, M., Mabry, K., Moore, D., Nghe, N.-V., & Tunstall, M. (2002). Information visibility nondifferentiated products. *Production & Inventory Management Journal*, 69-89.

Barney, J. B. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management, 17*(1), 99-120.

Barratt, M., & Barratt, R. (2011). Exploring internal and external supply chain linkages: Evidence from the field. *Journal of Operations Management, 29*(5), 514-528.

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.

Bartlett, P. A., Julien, D. M., & Baines, T. S. (2007). Improving supply chain performance through improved visibility. *The International Journal of Logistics Management, 18*(2), 294-313.

Barua, A., Konana, P., Whinston, A. B., & Yin, F. (2004). An Empirical Investigation of Net-Enabled Business Value. *MIS Quarterly, 28*(4), 585-620.

Basnet, C. (2003). Benchmarking supply chain management practice in New Zealand. *Supply Chain Management: An International Journal, 8*(1), 57-64.

Basnet, C., Childerhouse, P., Foulds, L., & Martin, V. (2006). Sustaining supply chain management in New Zealand. *International Journal of Logistics Systems and Management, 2*(3), 217-229.

Basnet, C., & Wisner, J. (2012). Nurturing internal supply chain integration. *Operations and Supply Chain Management: An International Journal, 5*(1), 27-41.

Bazerman, M., & Moore, D. (2013). *Judgment in Managerial Decision Making* (8th ed): Wiley & Sons

Beck, P., & Hofmann, E. (2012). Multiple criteria decision making in supply chain management–currently available methods and possibilities for future research. *Die Unternehmung, 66*(2), 180-213.

Becker, K. H. (2016). An outlook on behavioural OR–Three tasks, three pitfalls, one definition. *European Journal of Operational Research, 249*(3), 806-815.

Bell, S. T., Villado, A. J., Lukasik, M. A., Belau, L., & Briggs, A. L. (2011). Getting Specific about Demographic Diversity Variable and Team Performance Relationships: A Meta-Analysis. *Journal of Management, 37*(3), 709-743.

Bendoly, E., Croson, R., Goncalves, P., & Schultz, K. (2010). Bodies of knowledge for research in behavioral operations. *Production and Operations Management, 19*(4), 434-452.

Bendoly, E., Donohue, K., & Schultz, K. L. (2006). Behavior in operations management: Assessing recent findings and revisiting old assumptions. *Journal of Operations Management, 24*(6), 737-752.

Betsch, T., & Glöckner, A. (2010). Intuition in Judgment and Decision Making: Extensive Thinking without Effort. *Psychological Inquiry, 21*(4), 279–294.

Bharadwaj, S., Bharadwaj, A., & Bendoly, E. (2007). The Performance Effects of Complementarities Between Information Systems, Marketing, Manufacturing, and Supply Chain Processes. *Information Systems Research, 18*(4), 437-453.

Bode, C., & Macdonald, J. R. (2017). Stages of Supply Chain Disruption Response: Direct, Constraining, and Mediating Factors for Impact Mitigation. *Decision Sciences, 48*(5), 836-874.

Boehme, T., Childerhouse, P., & Corner, J. (2007). *Supply chain integration in New Zealand: fact or fantasy?* Paper presented at the 11th Annual Waikato Management School Student Research Conference, Hamilton, New Zealand.

Boehme, T., Childerhouse, P., Deakins, E., & Corner, J. (2008). Balancing power and dependency in buyer-supplier relationships. *International Journal of Electronic Customer Relationship Management, 2*(3), 195-214.

Boehme, T., Childerhouse, P., Deakins, E., & Towill, D. (2011). Supply chain integration and pathways of least resistance, 453-462.

Bonabeau, E. (2003). Don't trust your gut. *Harvard Business Review, 81*(5), 116-123, 130.

Bourgeois, L. J., & Eisenhardt, K. M. (1988). Strategic Decision Processes in High Velocity Environments: Four Cases in the Microcomputer Industry. *Management Science, 34*(7), 816-835.

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.

Brocklesby, J. (2016). The what, the why and the how of behavioural operational research—An invitation to potential sceptics. *European Journal of Operational Research, 249*(3), 796-805.

Brown, R. (2004). Consideration of the origin of Herbert Simon's theory of "satisficing" (1933-1947). *Management Decision, 42*(10), 1240-1256.

Brown, S., & Eisenhardt, K. (1998). *Competing on the edge: strategy as structured chaos* (Vol. null).

Brusset, X. (2016). Does supply chain visibility enhance agility? *International Journal of Production Economics, 171*(Part 1), 46-59.

Bryman, A., & Bell, E. (2015). *Business Research Methods*: Oxford University Press, USA.

Burns, L. R. (2002). The health care value chain. *John Wilet and Sons, San Francisco, CA*.

Büyüközkan, G., & Göçer, F. (2018). Digital Supply Chain: Literature review and a proposed framework for future research. *Computers in Industry, 97*, 157-177.

Camerer, C. F., & Loewenstein, G. (2003). Behavioral economics: Past, present, future. In C. F. Camerer, G. Loewenstein, & M. Rabin (Eds.), *Advances in Behavioral Economics*. Princeton, NJ.: Princeton University Press.

Cantor, D. E., & Macdonald, J. R. (2009). Decision-making in the supply chain: Examining problem solving approaches and information availability. *Journal of Operations Management, 27*(3), 220-232.

Caridi, M., Crippa, L., Perego, A., Sianesi, A., & Tumino, A. (2010). Do virtuality and complexity affect supply chain visibility? *International Journal of Production Economics, 127*(2), 372-383.

Caridi, M., Moretto, A., Perego, A., & Tumino, A. (2014). The benefits of supply chain visibility: A value assessment model. *International Journal of Production Economics, 151*, 1-19.

Carr, A. S., & Kaynak, H. (2007). Communication methods, information sharing, supplier development and performance: An empirical study of their relationships. *International Journal of Operations & Production Management, 27*(4), 346-370.

Carter, C. R., Kaufmann, L., & Wagner, C. M. (2017). Reconceptualizing Intuition in Supply Chain Management. *Journal of Business Logistics, 38*(2), 80-95.

Charmaz, K. (2000). Constructivist and objectivist grounded theory. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2th ed., pp. 509-535). Thousand Oaks, California: Sage.

Charmaz, K. (2002). Qualitative Interviewing and Grounded Theory Analysis. In J. F. Gubrium & J. A. Holstein (Eds.), *Handbook of interview research: context and method* (pp. 675-694): Sage.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative research*. London: SagePublications Ltd, .

Charmaz, K. (2008). Grounded Theory as an emergent method. In S. N. Hesse-Biber & P. Leavy (Eds.), *Handbook of emergent methods*. New York: Guilford Press.
Charmaz, K. (2011). Grounded theory as an emergent method. In *The Sage handbook of qualitative research*, 4, pp. 359-380).
Charmaz, K. (2014). *Constructing Grounded Theory* (2nd Ed.): Sage.
Charmaz, K., & Thornberg, R. (2020). The pursuit of quality in grounded theory. *Qualitative Research in Psychology*, 1-23.
Chen, I. J., & Paulraj, A. (2004a). Towards a theory of supply chain management: the constructs and measurements. *Journal of Operations Management, 22*(2), 119-150.
Chen, I. J., & Paulraj, A. (2004b). Understanding supply chain management: critical research and a theoretical framework. *International Journal of Production Research, 42*(1), 131-163.
Child, J., & Tsai, T. (2005). The Dynamic Between Firms' Environmental Strategies and Institutional Constraints in Emerging Economies: Evidence from China and Taiwan. *Journal of Management Studies, 42*(1), 95-125.
Childerhouse, P. (2011). Supply chain integration: an international comparison of maturity. *Asia Pacific Journal of Marketing and Logistics, 23*(4), 531-552.
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*, 102271-102271.
Christopher, M., & Lee, H. (2004). Mitigating supply chain risk through improved confidence. *International Journal of Physical Distribution & Logistics Management, 34*(5), 388-396. d
Clare, B., Shadbolt, N., & Reid, J. (2002). *Supply base relationships in the New Zealand red meat industry: a case study.* Paper presented at the Paradoxes in food chains and networks. Proceedings of the Fifth International Conference on Chain and Network Management in Agribusiness and the Food Industry, Noordwijk, Netherlands, 6-8 June 2002.
Closs, D. J., & Mollenkopf, D. A. (2004). A global supply chain framework. *Industrial Marketing Management, 33*(1), 37-44.
Collis, J., & Hussey, R. (2009). *Business Research: A Practical Guide for Undergraduate and Postgraduate Students*: Palgrave Macmillan.
Costa, E., Soares, A. L., & De Sousa, J. P. (2016). Information, knowledge and collaboration management in the internationalisation of SMEs: A systematic literature review. *International Journal of Information Management, 36*(4), 557-569.
Creswell, J. W. (2013). *Qualitative inquiry & research design : choosing among five approaches* (3rd ed.): Los Angeles : Sage.
Croson, R., Schultz, K., Siemsen, E., & Yeo, M. (2013). Behavioral operations: the state of the field. *Journal of Operations Management, 31*(1-2), 1-5.
Crotty, M. (1998). *The foundations of social research : meaning and perspective in the research process*. St Leonards, NSW: Allen & Unwin.
Crowder, M. (2013). *Decision-making in practice: The use of cognitive heuristics by senior managers.* (PhD). University of Chester, Retrieved from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.820.5419&rep=rep1&type=pdf
Daft, R. L., & Weick, K. (1984). Toward a Model of Organizations as Interpretation Systems. *The Academy of Management Review, 9*(2), 284-295.
Dane, E., & Pratt, M. G. (2007). Exploring Intuition and Its Role in Managerial Decision Making. *Academy of Management Review, 32*(1), 33-54.
Das, T. & Teng B. (1999). Cognitive biases and strategic decision processes: An integrative perspective, *Journal of Management Studies*, 36(6), 757–778.
Davenport, T. (2020). How to make better decisions about coronavirus. *MIT Sloan Management Review. April, 8*.
Dayan, M., & Elbanna, S. (2011). Antecedents of team intuition and its impact on the success of new product development projects. *Journal of Product Innovation Management, 28*(s1), 159-174.
De Dreu, C. K., & West, M. A. (2001). Minority dissent and team innovation: The importance of participation in decision making. *Journal of Applied Psychology, 86*(6), 1191.
Dean, J. W., & Sharfman, M. P. (1993). The Relationship between Procedural Rationality and Political Behavior in Strategic Decision Making. *Decision Sciences, 24*(6), 1069-1083.

Dean, J. W., & Sharfman, M. P. (1996). Does Decision Process Matter? A Study of Strategic Decision-Making Effectiveness. *The Academy of Management Journal, 39*(2), 368-396.
Delen, D., Hardgrave, B. C., & Sharda, R. (2007). RFID for Better Supply-Chain Management through Enhanced Information Visibility. *Production and Operations Management, 16*(5), 613-624.
Denzin, N. K., & Lincoln, Y. S. (2008). *Strategies of qualitative inquiry*: Los Angeles : Sage Publications, c2008, 3rd ed.
Denzin, N. K., & Lincoln, Y. S. (2011). Introduction: The discipline and practice of qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (4th ed.): Thousand Oaks : Sage.
Dey, I. (1999). *Grounding Grounded Theory: Guidelines for Qualitative Inquiry* (Vol. 282): Academic Press San Diego, CA.
Dey, I. (2007). Grounding Categories. In A. Bryant & K. Charmaz (Eds.), *The SAGE handbook of grounded theory* (pp. 167-190): Sage Publications.
DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education, 40*(4), 314-321.
Dong, S., Xu, S. X., & Zhu, K. X. (2009). Research note—information technology in supply chains: The value of it-enabled resources under competition. *Information Systems Research, 20*(1), 18-32.
Donohue, K., Özer, Ö., & Zheng, Y. (2020). Behavioral operations: Past, present, and future. *Manufacturing & Service Operations Management, 22*(1), 191-202.
Dyer, J., & Singh, H. (1998). The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage. *The Academy of Management Review, 23*(4), 660-679.
Eisenhardt, K. M., & Bourgeois, L. J. (1988). Politics of strategic decision making in high-velocity environments: Toward a midrange theory. *Academy of Management Journal, 31*(4), 737-770.
Eisenhardt, K. M., & Zbaracki, M. J. (1992). Strategic decision making. *Strategic Management Journal, 13*, 17-17.
Elbanna, S. (2006). Strategic decision-making: Process perspectives. *International Journal of Management Reviews, 8*(1), 1-20.
Elbanna, S. (2018). The constructive aspect of political behavior in strategic decision-making: The role of diversity. *European Management Journal, 36*(5), 616-626.
Elbanna, S., Child, J., & Dayan, M. (2013). A Model of Antecedents and Consequences of Intuition in Strategic Decision-making: Evidence from Egypt. *Long Range Planning, 46*(1), 149-176.
Elbanna, S., Di Benedetto, C. A., & Gherib, J. (2015). Do environment and intuition matter in the relationship between decision politics and success? *Journal of Management and Organization, 21*(1), 60.
Elbanna, S., Kapoutsis, I., & Mellahi, K. (2017). Positive politics and strategic decision making outcomes: The role of macro-economic uncertainty. *Management Decision, 55*(10), 2218-2236.
Esper, T. L. (2021). Supply chain management amid the coronavirus pandemic. *Journal of Public Policy & Marketing, 40*(1), 101-102.
Fahimnia, B., Pournader, M., Siemsen, E., Bendoly, E., & Wang, C. (2019). Behavioral operations and supply chain management–a review and literature mapping. *Decision Sciences, 50*(6), 1127-1183.
Farhoomand, A. F., & Drury, D. H. (2002). Managerial information overload. *Communications of the ACM, 45*(10), 127-131.
Fawcett, S. E., Osterhaus, P., Magnan, G. M., Brau, J. C., & McCarter, M. W. (2007). Information sharing and supply chain performance: the role of connectivity and willingness. *Supply Chain Management: An International Journal, 12*(5), 358-368.
Fawcett, S. E., Wallin, C., Allred, C., Fawcett, A. M., & Magnan, G. M. (2011). Information technology as an enabler of supply chain collaboration: a dynamic-capabilities perspective *Journal of Supply Chain Management, 47*(1), 38-59.
Flynn, B. B., Huo, B., & Zhao, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of Operations Management, 28*(1), 58-71.
Francis, V. (2008). Supply chain visibility: lost in translation? *Supply Chain Management: An International Journal, 13*(3), 180-184. doi:10.1108/13598540810871226

French, S., Maule, J., & Papamichail, N. (2009). *Decision behaviour, analysis and support*: Cambridge University Press.
Gardner, A., McCutcheon, H., & Fedoruk, M. (2012). Discovering constructivist grounded theory's fit and relevance to researching contemporary mental health nursing practice. *Australian Journal of Advanced Nursing, The, 30*(2), 66-74.
Gartner. (2015). Evolving Concepts in Supply Chain Visibility. Retrieved from http://hughfinerty.com/wp-content/uploads/2015/03/Gartner-Evolving-Concepts-in-Supply-Chain-Visibility.pdf
Gino, F., & Pisano, G. (2008). Toward a theory of behavioral operations. *Manufacturing & Service Operations Management, 10*(4), 676-691.
Glaser, B. G. (1978). *Theoretical Sensitivity* Mill Valley, CA: The Sociology Press.
Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: strategies and qualitative research*. Chicago; New York: Aldine.
Goh, M., De Souza, R., Zhang, A., He, W., & Tan, P. (2009). *Supply chain visibility: A decision making perspective.* Paper presented at the 4th IEEE Conference on Industrial Electronics and Applications (ICIEA).
Golicic, S. L., Davis, D. F., McCarthy, T. M., & Mentzer, J. T. (2002). The impact of e-commerce on supply chain relationships. *International Journal of Physical Distribution & Logistics Management, 32*(10), 851-871.
Goswami, S., Engel, T., & Krcmar, H. (2013). A comparative analysis of information visibility in two supply chain management information systems. *Journal of Enterprise Information Management, 26*(3), 276-294.
Greenberg, J. & Baron, R. A. (2008). *Behavior in Organizations* (9th ed): Pearson Education, London.
Griffiths, J., Phelan, A., Osman, K., & Furness, A. (2007). *Using item-attendant information and communications technologies to improve supply chain visibility*.
Grötsch, V. M., Blome, C., & Schleper, M. C. (2013). Antecedents of proactive supply chain risk management – a contingency theory perspective. *International Journal of Production Research, 51*(10), 2842-2867.
Gunasekaran, A., & Ngai, E. W. T. (2004). Information systems in supply chain integration and management. *European Journal of Operational Research, 159*(2), 269-295.
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*.
Hämäläinen, R. P., Luoma, J., & Saarinen, E. (2013). On the importance of behavioral operational research: The case of understanding and communicating about dynamic systems. *European Journal of Operational Research, 228*(3), 623-634.
Handfield, R. (2017). Preparing for the Era of the Digitally Transparent Supply Chain: A Call to Research in a New Kind of Journal. *Logistics, 1*(1), 2.
Handfield, R., & Bechtel, C. (2002). The role of trust and relationship structure in improving supply chain responsiveness. *Industrial Marketing Management, 31*(4), 367-382.
Hodgkinson, G. P., Sadler-Smith, E., Burke, L. A., Claxton, G., & Sparrow, P. R. (2009). Intuition in organizations: Implications for strategic management. *Long Range Planning, 42*(3), 277-297.
Holcomb, M. C., Ponomarov, S. Y., & Manrodt, K. B. (2011). The Relationship of Supply Chain Visibility to Firm Performance. *Supply Chain Forum: An International Journal, 12*(2), 32-45.
Hong, I. B. (2002). A new framework for interorganizational systems based on the linkage of participants' roles. *Information & Management, 39*(4), 261-270.
Hosack, B., Hall, D., Paradice, D., & Courtney, J. F. (2012). A Look Toward the Future: Decision Support Systems Research is Alive and Well. *Journal of the Association for Information Systems, 13*(5), 315-340.
Hudson, L. A., & Ozanne, J. L. (1988). Alternative ways of seeking knowledge in consumer research. *Journal of Consumer Research, 14*(4), 508-521.
Hutchinson, J. M., & Gigerenzer, G. (2005). Simple heuristics and rules of thumb: Where psychologists and behavioural biologists might meet. *Behavioural processes, 69*(2), 97-124.
Intezari, A., & Pauleen, D. (2019). *Wisdom, Analytics and Wicked Problems: Integral Decision Making for the Data Age*: Gower.

Intezari, A., & Pauleen, D. J. (2018). Conceptualizing Wise Management Decision-Making: A Grounded Theory Approach. *Decision Sciences, 49*(2), 335-400.
Ireland, R. D., & Webb, J. W. (2007). A multi-theoretic perspective on trust and power in strategic supply chains. *Journal of Operations Management, 25*(2), 482-497.
Ivanov, D., & Dolgui, A. (2020). A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0. *Production Planning & Control*, 1-14.
Ivanov, D., Tsipoulanidis, A., & Schönberger, J. (2019). *Global supply chain and operations management* (2nd ed.). Switzerland: Springer Nature.
Jaberidoost, M., Nikfar, S., Abdollahiasl, A., & Dinarvand, R. (2013). Pharmaceutical supply chain risks: a systematic review. *Daru : journal of Faculty of Pharmacy, Tehran University of Medical Sciences, 21*(1), 69-69.
Jain, V., & Benyoucef, L. (2008). Managing long supply chain networks: some emerging issues and challenges. *Journal of Manufacturing Technology Management, 19*(4), 469-496.
Jansen, R. J. G., Curşeu, P. L., Vermeulen, P. A. M., Geurts, J. L. A., & Gibcus, P. (2013). Information processing and strategic decision-making in small and medium-sized enterprises: The role of human and social capital in attaining decision effectiveness. *International Small Business Journal, 31*(2), 192-216.
Jeyaraj, A., & Sethi, V. (2012). Implementation of Information Systems Infrastructures for Supply Chain Visibility in Organizations. *Journal of Information Science and Technology, 9*(1), 3-23.
Johnson, P., & Duberley, J. (2003). Reflexivity in Management Research. *Journal of Management Studies, 40*(5), 1279-1303.
Jones, J. W., & McLeod, R. (1986). The structure of executive information systems: An exploratory analysis *Decision Sciences, 17*(2), 220-249.
Kahneman, D., & Klein, G. (2009). Conditions for intuitive expertise: a failure to disagree. *American psychologist, 64*(6), 515.
Kaipia, R., & Hartiala, H. (2006a). How to benefit from visibility in supply chains. *IJAM, 9*(1).
Kaipia, R., & Hartiala, H. (2006b). Information-sharing in supply chains: five proposals on how to proceed. *The International Journal of Logistics Management, 17*(3), 377-393.
Katsikopoulos, K. V., & Gigerenzer, G. (2013). Behavioral operations management: A blind spot and a research program. *Journal of Supply Chain Management, 49*(1), 3-7.
Kaufmann, L., Kreft, S., Ehrgott, M., & Reimann, F. (2012). Rationality in supplier selection decisions: The effect of the buyer's national task environment. *Journal of Purchasing and Supply Management, 18*(2), 76-91.
Kaufmann, L., Meschnig, G., & Reimann, F. (2014). Rational and intuitive decision-making in sourcing teams: Effects on decision outcomes. *Journal of Purchasing and Supply Management, 20*(2), 104-112.
Kembro, J., & Näslund, D. (2014). Information sharing in supply chains, myth or reality? A critical analysis of empirical literature. *International Journal of Physical Distribution & Logistics Management, 44*(3), 179-200.
Keskinocak, P., & Ozkaya, E. (2020). US pharmaceutical supply chain unprepared for COVID-19. *Healio News, 27*.
Khan, S. A., Chaabane, A., & Dweiri, F. T. (2018). Multi-criteria decision-making methods application in supply chain management: A systematic literature. *Multi-criteria methods and techniques applied to supply chain management, 1*.
Khatri, N., & Ng, A. (2000). The Role of Intuition in Strategic Decision Making. *Human Relations, 53*(1), 57-86.
Kim, K., Ryoo, Y., & Jung, D. (2011). Inter-organizational information systems visibility in buyer–supplier relationships: The case of telecommunication equipment component manufacturing industry. *Omega, 39*(6), 667-676.
Kim, K., Umanath, N., Kim, J. Y., Ahrens, F., & Kim, B. (2012). Knowledge complementarity and knowledge exchange in supply channel relationships. *International Journal of Information Management, 32*(1), 35-49.
Klein, G. A. (2008). Naturalistic Decision-making. *Human Factors*, 50(30), 456-460.
Klein, G. A., Orasanu, J., Calderwood, R., and Zsambok, C.E. (1993). *Decision-making in Action: Models and Methods*. Norwood, NJ: Ablex.

Klein, R., & Rai, A. (2009). Interfirm strategic information flows in logistics supply chain relationships. *MIS Quarterly, 33*(4), 735-762.
Klueber, R., & O'Keefe, R. M. (2013). Defining and assessing requisite supply chain visibility in regulated industries. *Journal of Enterprise Information Management, 26*(3), 295-315.
Knemeyer, A. M., & Naylor, R. W. (2011). Using Behavioral Experiments to Expand Our Horizons and Deepen Our Understanding of Logistics and Supply Chain Decision Making. *Journal of Business Logistics, 32*(4), 296-302.
Koçoğlu, İ., İmamoğlu, S. Z., İnce, H., & Keskin, H. (2011). The effect of supply chain integration on information sharing:Enhancing the supply chain performance. *Procedia - Social and Behavioral Sciences, 24*, 1630-1649.
Koh, S., & Maguire, S. (2004). Identifying the adoption of e-business and knowledge management within SMEs. *Journal of small business and enterprise development*.
Koka, B. R., & Prescott, J. E. (2002). Strategic alliances as social capital: A multidimensional view. *Strategic Management Journal, 23*(9), 795-816.
Koufteros, X., Vonderembse, M., & Jayaram, J. (2005). Internal and External Integration for Product Development: The Contingency Effects of Uncertainty, Equivocality, and Platform Strategy. *Decision Sciences, 36*(1), 97-133.
Kremer, M., Moritz, B., & Siemsen, E. (2011). Demand forecasting behavior: System neglect and change detection. *Management Science, 57*(10), 1827-1843.
Kremer, M., Siemsen, E., & Thomas, D. J. (2016). The sum and its parts: Judgmental hierarchical forecasting. *Management Science, 62*(9), 2745-2764.
Kumar, A., Luthra, S., Mangla, S. K., & Kazançoğlu, Y. (2020). COVID-19 impact on sustainable production and operations management. *Sustainable Operations and Computers, 1*, 1-7.
Lambert, D. M., & Cooper, M. C. (2000). Issues in Supply Chain Management. *Industrial Marketing Management, 29*(1), 65-83.
Landells, E. M., & Albrecht, S. L. (2017). The Positives and Negatives of Organizational Politics: A Qualitative Study. *Journal of Business and Psychology, 32*(1), 41-58.
Larrick, R. P. (2016). The Social Context of Decisions. *Annual Review of Organizational Psychology and Organizational Behavior, 3*(1), 441-467.
LeBoeuf, R. A. & Shafir, E. (2005). Anchoring on the Here and Now: Insufficient Adjustment in Time and Distance Estimates. *Advances in Consumer Research, 32*(1), 126-127.
Lee, H., Kim, M. S., & Kim, K. (2014). Interorganizational information systems visibility and supply chain performance. *International Journal of Information Management, 34*(2), 285-295.
Lee, H., & Whang, S. (1999). Decentralized Multi-Echelon Supply Chains: Incentives and Information. *Management Science, 45*(5), 633-640.
Lee, H., & Whang, S. (2000). Information sharing in a supply chain. *International Journal of Manufacturing Technology and Management, 1*(1), 79-93.
Liberman-Yaconi, L., Hooper, T., & Hutchings, K. (2010). Toward a model of understanding strategic decision-making in micro-firms: exploring the Australian information technology sector. *Journal of Small Business Management, 48*(1), 70-95.
Lin, Y., Cole, C., & Dalkir, K. (2014). The relationship between perceived value and information source use during KM strategic decision-making: A study of 17 Chinese business managers. *Information Processing & Management, 50*(1), 156-174.
Lincoln, Y. S., Lynham, S. A., & Guba, E. G. (2011). Paradigmatic controversies, contradictions, and emerging confluences, revisited. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (4th ed., pp. 97-128): Sage.
Lindblom, C. E. (1959). The Science of Muddling Through. *Public Administration Review 19*, 79-99.
Liu, S., Leat, M., Moizer, J., Megicks, P., & Kasturiratne, D. (2013). A decision-focused knowledge management framework to support collaborative decision making for lean supply chain management. *International Journal of Production Research, 51*(7), 2123-2137.
Loch, C. H., & Wu, Y. (2007). *Behavioral operations management*: Now Publishers Inc.
Loh, T., & Koh, S. (2004). Critical elements for a successful enterprise resource planning implementation in small-and medium-sized enterprises. *International Journal of Production Research, 42*(17), 3433-3455.

Luo, W., Shi, Y., & Venkatesh, V. G. (2018). Exploring the factors of achieving supply chain excellence: a New Zealand perspective. *Production Planning & Control, 29*(8), 655-667.
Lycett, M. (2013). 'Datafication': Making sense of (big) data in a complex world. In: Taylor & Francis.
MacKay, P. (2005). Is PHARMAC's sole-supply tendering policy harming the health of New Zealanders? *The New Zealand Medical Journal (Online), 118*(1214).
Malhotra, A., Gosain, S., & Sawy, O. A. E. (2005). Absorptive Capacity Configurations in Supply Chains: Gearing for Partner-Enabled Market Knowledge Creation. *MIS Quarterly, 29*(1), 145-187.
Mantel, S. P., Tatikonda, M. V., & Liao, Y. (2006). A behavioral study of supply manager decision-making: Factors influencing make versus buy evaluation. *Journal of Operations Management, 24*(6), 822-838.
Manuj, I., & Pohlen, T. L. (2012). A reviewer's guide to the grounded theory methodology in logistics and supply chain management research. *International Journal of Physical Distribution & Logistics Management, 42*(8/9), 784-803.
Manuj, I., & Sahin, F. (2011). A model of supply chain and supply chain decision-making complexity. *International Journal of Physical Distribution & Logistics Management, 41*(5), 511-549.
Marshall, C., & Rossman, G. B. (2014). *Designing qualitative research*: Sage publications.
McAfee, A., Brynjolfsson, E., Davenport, T. H., Patil, D., & Barton, D. (2012). Big data: the management revolution. *Harvard Business Review, 90*(10), 60-68.
McCrea, B. (2005). EMS completes the visibility picture. *Logistics Management, 44*(6), 57-61.
McElhinney, D. & Proctor, T. (2005). Concept of entrapment and decision-making. *Management Decision*, 43(2), 189-202
McIntire, M. J. (2014). *Supply Chain Visibility: From Theory to Practice*: Ashgate Publishing, Ltd.
Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining supply chain management *Journal of Business Logistics, 22*(2), 1-25.
Messina, D., Barros, A. C., Soares, A. L., & Matopoulos, A. (2020). An information management approach for supply chain disruption recovery. *The International Journal of Logistics Management, 31*(3), 489-519.
Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: an expanded sourcebook* (2nd ed.): Thousand Oaks : Sage.
Miller, F. A., Young, S. B., Dobrow, M., & Shojania, K. G. (2021). Vulnerability of the medical product supply chain: the wake-up call of COVID-19. *BMJ Quality & Safety, 30*(4), 331.
Moberg, C. R., Cutler, B. D., Gross, A., & Speh, T. W. (2002). Identifying antecedents of information exchange within supply chains. *International Journal of Physical Distribution & Logistics Management, 32*(9), 755-770.
Mollenkopf, D., & Dapiran, G. P. (2005). The importance of developing logistics competencies: a study of Australian and New Zealand firms. *International Journal of Logistics: research and applications, 8*(1), 1-14.
Moore, D., Matosin, N., Rook, H., & Weber, J.-C. (2015). Strategic think piece on pharmaceutical margins. Retrieved from: http://srgexpert.com/wp-content/uploads/2017/11/Sapere-pharmaceuticalmarginsFinal-Report-09102015-public-as-sent.pdf
Moorman, C., Deshpande, R., & Zaltman, G. (1993). Factors affecting trust in market research relationships. *Journal of Marketing, 57*(1), 81-101.
Morgan, S., & Boothe, K. (2010). Prescription drug subsidies in Australia and New Zealand. *Aust Prescr, 33*, 2-4.
Morse, J. M. (1995). *The significance of saturation*. Thousand Oaks, CA: Sage Publications.
Msimangira, K., & Venkatraman, S. (2014). Supply chain management integration: Critical problems and solutions. *Operations and Supply Chain Management: An International Journal, 7*(1), 23-31.
Mubarik, M. S., Naghavi, N., Mubarik, M., Kusi-Sarpong, S., Khan, S. A., Zaman, S. I., & Kazmi, S. H. A. (2021). Resilience and cleaner production in industry 4.0: Role of supply chain mapping and visibility. *Journal of Cleaner Production, 292*, 126058.
Musa, A., Gunasekaran, A., & Yusuf, Y. (2014). Supply chain product visibility: Methods, systems and impacts. *Expert Systems with Applications, 41*(1), 176-194.

Myers, M. D. (2013). *Qualitative esearch in business and management* (2nd ed.). London: Sage Publications.

New Zealand Small Business Council. (2019). Defining Small Business. Retrieved from https://www.mbie.govt.nz/assets/defining-small-business.pdf

Nooraie, S. V., & Mellat Parast, M. (2015). A multi-objective approach to supply chain risk management: Integrating visibility with supply and demand risk. *International Journal of Production Economics, 161*, 192-200.

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.

O'Reilly, C. A. (1983). The use of information in organizational decision making: A model and some propositions. *Research in organizational behavior*.

Oliva, R., & Watson, N. (2011). Cross-functional alignment in supply chain planning: A case study of sales and operations planning. *Journal of Operations Management, 29*(5), 434-448.

Olson, B. J., Parayitam, S., & Bao, Y. (2007). Strategic Decision Making: The Effects of Cognitive Diversity, Conflict, and Trust on Decision Outcomes. *Journal of Management, 33*(2), 196-222.

Özer, Ö., Subramanian, U., & Wang, Y. (2018). Information sharing, advice provision, or delegation: what leads to higher trust and trustworthiness? *Management Science, 64*(1), 474-493.

Papert, M., Rimpler, P., & Pflaum, A. (2016). Enhancing supply chain visibility in a pharmaceutical supply chain: Solutions based on automatic identification technology. *International Journal of Physical Distribution & Logistics Management, 46*(9), 859-884.

Patnayakuni, R., Rai, A., & Seth, N. (2006). Relational Antecedents of Information Flow Integration for Supply Chain Coordination. *Journal of Management Information Systems, 23*(1), 13-49.

Pauleen, D. J., & Wang, W. Y. (2017). Does big data mean big knowledge? KM perspectives on big data and analytics. *Journal of Knowledge Management, 21*(1), 1-6.

Payne, J. W., Bettman, J. R. & Johnson, E. J. (1993). *The Adaptive Decision-maker*: Cambridge University Press.

Pedroso, M. C., & Nakano, D. (2009). Knowledge and information flows in supply chains: A study on pharmaceutical companies. *International Journal of Production Economics, 122*(1), 376-384.

Perera, N., Fahimnia, B., & Tokar, T. (2020). Inventory and ordering decisions: a systematic review on research driven through behavioral experiments. *International Journal of Operations & Production Management*.

Perera, N., Hurley, J., Fahimnia, B., & Reisi, M. (2019). The human factor in supply chain forecasting: A systematic review. *European Journal of Operational Research, 274*(2), 574-600.

Pfahl, L., & Moxham, C. (2014). Achieving sustained competitive advantage by integrating ECR, RFID and visibility in retail supply chains: a conceptual framework. *Production Planning & Control, 25*(7), 548-571.

Pharmac. (2020). Managing medicine supply. Retrieved from https://pharmac.govt.nz/medicine-funding-and-supply/medicine-supply-management/managing-medicine-supply/

Polanyi, M. (2009). *The tacit dimension*: University of Chicago press.

Ponomarov, S. Y., & Holcomb, M. C. (2009). Understanding the concept of supply chain resilience. *The International Journal of Logistics Management, 20*(1), 124-143.

Porac, J., & Tschang, F. T. (2013). Unbounding the Managerial Mind:It's Time to Abandon the Image of Managers As "Small Brains". *Journal of Management Inquiry, 22*(2), 250-254.

Prajogo, D., & Olhager, J. (2012). Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration. *International Journal of Production Economics, 135*(1), 514-522.

Priyan, S., & Uthayakumar, R. (2014). Optimal inventory management strategies for pharmaceutical company and hospital supply chain in a fuzzy–stochastic environment. *Operations Research for Health Care, 3*(4), 177-190.

Ragupathy, R., Kilpatrick, K., & Babar, Z.-U.-D. (2015). Pharmaceutical Pricing in New Zealand. In Z.-U.-D. Babar (Ed.), *Pharmaceutical Prices in the 21st Century* (pp. 189-207). Cham: Springer International Publishing.

Rai, A., Patnayakuni, R., & Seth, N. (2006). Firm Performance Impacts of Digitally Enabled Supply Chain Integration Capabilities. *MIS Quarterly, 30*(2), 225-246.

Rai, A., Pavlou, P., Im, G., & Du, S. (2012). Interfirm IT capability profiles and communications for cocreating relational value: evidence from the logistics industry. *MIS Q., 36*(1), 233-262.
Ranganathan, C., & Sethi, V. (2002). Rationality in Strategic Information Technology Decisions: The Impact of Shared Domain Knowledge and IT Unit Structure. *Decision Sciences, 33*(1), 59-86.
Rao, S. (2004). Supply chain management: Strengthening the weakest link. Retrieved from: http://hosteddocs.ittoolbox.com/SR032604.pdf
Riedl, D. F., Kaufmann, L., Zimmermann, C., & Perols, J. L. (2013). Reducing uncertainty in supplier selection decisions: Antecedents and outcomes of procedural rationality. *Journal of Operations Management, 31*(1–2), 24-36.
Robson, C., & McCartan, K. (2016). *Real world research*: John Wiley & Sons.
Rosenzweig, E. D., Roth, A. V., & Dean Jr, J. W. (2003). The influence of an integration strategy on competitive capabilities and business performance: an exploratory study of consumer products manufacturers. *Journal of Operations Management, 21*(4), 437-456.
Rubin, H. J., & Rubin, I. S. (2011). *Qualitative Interviewing: The Art of Hearing Data* (3rd ed.): Sage.
Rudnicka, P. (2002), A review of naturalistic decision making research with some implications for knowledge management, *Journal of Knowledge Management, 6*(1), 63-73.
Sadler-Smith, E., & Shefy, E. (2004). The intuitive executive: Understanding and applying 'gut feel'in decision-making. *Academy of Management Perspectives, 18*(4), 76-91.
Sahin, F., & Robinson, E. P. (2002). Flow Coordination and Information Sharing in Supply Chains: Review, Implications, and Directions for Future Research. *Decision Sciences, 33*(4), 505-536.
Salas, E., Rosen, M. A., & DiazGranados, D. (2010). Expertise-Based Intuition and Decision Making in Organizations. *Journal of Management, 36*(4), 941-973.
Sambamurthy, V., Bharadwaj, A., & Grover, V. (2003). Shaping Agility through Digital Options: Reconceptualizing the Role of Information Technology in Contemporary Firms. *MIS Quarterly, 27*(2), 237-263.
Sanbonmatsu, D. M., Kardes, F. R., & Herr, P. M. (1992). The role of prior knowledge and missing information in multiattribute evaluation. *Organizational Behavior and Human Decision Processes, 51*(1), 76-91.
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*(4), 1893-1907.
Saunders, C., & Jones, J. W. (1990). Temporal Sequences in Information Acquisition for Decision Making: A Focus on Source and Medium. *The Academy of Management Review, 15*(1), 29-46.
Schoenherr, T., & Swink, M. (2012). Revisiting the arcs of integration: Cross-validations and extensions. *Journal of Operations Management, 30*(1), 99-115.
Schorsch, T., Wallenburg, C. M., & Wieland, A. (2017). The human factor in SCM: Introducing a meta-theory of behavioral supply chain management. *International Journal of Physical Distribution & Logistics Management, 47*(4), 238-262.
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.
Schwarber, P. D. (2005). Leaders and the decision-making process. *Management Decision, 43*(7/8), 1086-1092.
Shah, N. (2004). Pharmaceutical supply chains: key issues and strategies for optimisation. *Computers & Chemical Engineering, 28*(6), 929-941.
Sharma, R., Mithas, S., & Kankanhalli, A. (2014). Transforming decision-making processes: a research agenda for understanding the impact of business analytics on organisations. *European Journal of Information Systems, 23*(4), 433-441.
Sharma, R., & Shanks, G. (2011). *The role of dynamic capabilities in creating business value from IS assets*. Paper presented at the 17th Americas Conference on Information Systems Detroit, Michigan, USA.
Simatupang, T. M., Wright, A. C., & Sridharan, R. (2002). The knowledge of coordination for supply chain integration. *Business Process Management Journal, 8*(3), 289-308.
Simon, H. A. (1955). A Behavioral Model of Rational Choice. *The Quarterly Journal of Economics, 69*(1), 99-118.

Simon, H. A. (1978). Rationality as Process and as Product of Thought. *The American Economic Review, 68*(2), 1-16.
Simon, H. A. (1992). What is an "explanation" of behavior? *Psychological science, 3*(3), 150-161.
Simon, H. A. (1997). *Administrative behavior: A study of decision-making processes in administrative organizations* (4th ed.). New York: Free Press.
Simon, H. A., Dantzig, G. B., Hogarth, R., Plott, C. R., Raiffa, H., Schelling, T. C., Winter, S. (1992). Decision making and problem solving. In M. Zey (Ed.), *Decision making: alternatives to rational choice models* (pp. 32-53). Newbury Park, Calif.: Sage.
Singh, R., & Benyoucef, L. (2013). A consensus based group decision making methodology for strategic selection problems of supply chain coordination. *Engineering Applications of Artificial Intelligence, 26*(1), 122-134.
Slotegraaf, R. J., & Atuahene-Gima, K. (2011). Product Development Team Stability and New Product Advantage: The Role of Decision-Making Processes. *Journal of Marketing, 75*(1), 96-108.
Smith, J., Larkin, M. H., & Flowers, P. (2009). *Interpretative phenomenological analysis: theory, method and research*. Los Angeles; London: SAGE.
Snowden, D. J., & Boone, M. E. (2007). A leader's framework for decision making. *Harvard Business Review, 85*(11), 68.
Sodhi, M. S., & Tang, C. S. (2019). Research Opportunities in Supply Chain Transparency. *Production and Operations Management, 28*(12), 2946-2959.
Somapa, S., Cools, M., & Dullaert, W. (2018). Characterizing supply chain visibility – a literature review. *The International Journal of Logistics Management, 29*(1), 308-339.
Stanczyk, A., Foerstl, K., Busse, C., & Blome, C. (2015). Global Sourcing Decision-Making Processes: Politics, Intuition, and Procedural Rationality. *Journal of Business Logistics, 36*(2), 160-181.
Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate? *Behavioral and brain sciences, 23*(5), 645-665.
Stenmark, D. (2002). *Information vs. knowledge: The role of intranets in knowledge management.* Paper presented at the Proceedings of the 35th Annual Hawaii International Conference on System Sciences.
Strauss, A., & Corbin, J. (1990). Basics of Qualitative Research: Grounded Theory Procedures and Techniques. In: Sage Publications.
Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory*: Sage Publications, Inc.
Subrahmanyam, A. (2008). Behavioural Finance: A Review and Synthesis. *European Financial Management, 14*(1), 12-29.
Swift, C., Guide Jr., V. D. R., & Muthulingam, S. (2019). Does supply chain visibility affect operating performance? Evidence from conflict minerals disclosures. *Journal of Operations Management, 65*(5), 406-429.
Tarokh, M. J., & Soroor, J. (2006). *Supply chain management information systems critical failure factors.* Paper presented at the 2006 IEEE international conference on service operations and logistics, and informatics.
Tarter, C. J., & Hoy, W. K. (1998). Toward a contingency theory of decision making. *Journal of educational administration*.
Tatoglu, E., Bayraktar, E., Golgeci, I., Koh, S., Demirbag, M., & Zaim, S. (2016). How do supply chain management and information systems practices influence operational performance? Evidence from emerging country SMEs. *International Journal of Logistics Research and Applications, 19*(3), 181-199.
Tetlock, P. E., & Gardner, D. (2016). *Superforecasting: The art and science of prediction*: Random House.
Thaler, R. (1980). Toward a positive theory of consumer choice. *Journal of economic behavior & organization, 1*(1), 39-60.
Tohamy, N., Orlov, L., & Herbert, L. (2003). Supply chain visibility defined. *Forrester Research, Cambridge, MA*.
Tokar, T. (2010). Behavioural research in logistics and supply chain management. *The International Journal of Logistics Management, 21*(1), 89-103. doi:doi:10.1108/09574091011042197

Tran, H. T. T., Childerhouse, P., & Deakins, E. (2016). Supply chain information sharing: challenges and risk mitigation strategies. *Journal of Manufacturing Technology Management, 27*(8), 1102-1126.

Tsanis, K. (2013). *Examination of political behavior by middle managers in international partnerships: a strategy process approach.* (PhD). University of Edinburgh Business School, Edinburgh.

Tse, Y. K., & Tan, K. H. (2012). Managing product quality risk and visibility in multi-layer supply chain. *International Journal of Production Economics, 139*(1), 49-57.

Urquhart, C. (2013). *Grounded theory for qualitative research: A practical guide*. Thousand Oaks: Sage.

Uthayakumar, R., & Priyan, S. (2013). Pharmaceutical supply chain and inventory management strategies: Optimization for a pharmaceutical company and a hospital. *Operations Research for Health Care, 2*(3), 52-64.

Valverde, J. L. (2012). Ethical challenges in the pharmaceutical industry. *Pharmaceuticals Policy and Law, 14* (2012), 123–127.

Van Donselaar, K. H., Gaur, V., Van Woensel, T., Broekmeulen, R. A., & Fransoo, J. C. (2010). Ordering behavior in retail stores and implications for automated replenishment. *Management Science, 56*(5), 766-784.

Van Knippenberg, D., De Dreu, C. K., & Homan, A. C. (2004). Work group diversity and group performance: an integrative model and research agenda. *Journal of Applied Psychology, 89*(6), 1008.

Venkitachalam, K., & Busch, P. (2012). Tacit knowledge: review and possible research directions. *Journal of Knowledge Management, 16*(2), 357-372.

Vickery, S. K., Jayaram, J., Droge, C., & Calantone, R. (2003). The effects of an integrative supply chain strategy on customer service and financial performance: an analysis of direct versus indirect relationships. *Journal of Operations Management, 21*(5), 523-539.

Vijayasarathy, L. R. (2010). Supply integration: an investigation of its multi-dimensionality and relational antecedents. *International Journal of Production Economics, 124*(2), 489-505.

Vilasini, N., Neitzert, T., Rotimi, J. O., & Windapo, A. O. (2012). A framework for sub-contractor integration in alliance contracts.

Vitasek, K. (2006). Supply chain and logistics terms and glossary. Retrieved from http://cscmp.org/Downloads/Public/ Resources/glossary03.pdf, 2006

Vogler, S., Kilpatrick, K., & Babar, Z.-U.-D. (2015). Analysis of Medicine Prices in New Zealand and 16 European Countries. *Value in Health, 18*(4), 484-492.

Vroom, V. H. (2000). Leadership and the decision-making process. *Organizational dynamics, 28*(4), 82-94.

Vroom, V. H., & Jago, A. G. (1974). Decision Making as a Social Process: Normative and Descriptive Models of Leader Behavior. *Decision Sciences, 5*(4), 743-769.

Wang, M. & Jie, F. (2020). Managing supply chain uncertainty and risk in the pharmaceutical industry. *Health services management research, 33*(3), 156-164.

Wang, E. & Wei, H. L. (2007). Interorganizational Governance Value Creation: Coordinating for Information Visibility and Flexibility in Supply Chains. *Decision Sciences, 38*(4), 647-674.

Wei, H. L., & Wang, E. (2010). The strategic value of supply chain visibility: increasing the ability to reconfigure. *European Journal of Information Systems, 19*(2), 238-249.

Weill, P., & Vitale, M. (2002). What IT infrastructure capabilities are needed to implement e-business models? *MIS Quarterly, 1*(1), 17.

White, L. (2016). Behavioural operational research: Towards a framework for understanding behaviour in OR interventions. *European Journal of Operational Research, 249*(3), 827-841.

Wieland, A., Handfield, R., & Durach, C. F. (2016). Mapping the Landscape of Future Research Themes in Supply Chain Management. *Journal of Business Logistics, 37*(3), 205-212.

Wilkinson, S., Joffe, H., & Yardley, L. (2004). Qualitative data collection: Interviews and focus groups. In D. Marks & L. Yardley (Eds.), *Research methods for clinical and health psychology* (pp. 39-55): London : SAGE, 2004.

Williams, B. D., Roh, J., Tokar, T., & Swink, M. (2013). Leveraging supply chain visibility for responsiveness: The moderating role of internal integration. *Journal of Operations Management, 31*(7–8), 543-554.

Wilson, T. H., & Sankaran, J. K. (2001). *Vendor-manufacturer partnerships in the supply chain: An inductive case study from New Zealand*: Department of Management Science and Information Systems, University of Auckland.

Wong, C., Lai, K., & Cheng, T. (2011). Value of Information Integration to Supply Chain Management: Roles of Internal and External Contingencies. *Journal of Management Information Systems, 28*(3), 161-200.

Wong, C., Lai, K., Cheng, T., & Lun, Y. (2015). The role of IT-enabled collaborative decision making in inter-organizational information integration to improve customer service performance. *International Journal of Production Economics, 159*(0), 56-65. d

Wu, J., Iyer, A., & Preckel, P. V. (2016). Information visibility and its impact in a supply chain. *Operations Research Letters, 44*(1), 74-79.

Xu, Z., Elomri, A., Kerbache, L., & Omri, A. E. (2020). Impacts of COVID-19 on Global Supply Chains: Facts and Perspectives. *IEEE Engineering Management Review, 48*(3), 153-166.

Yang, T. & Maxwell, T. A. (2011). Information-sharing in public organizations: A literature review of interpersonal, intra-organizational and inter-organizational success factors. *Government Information Quarterly, 28*(2), 164-175.

Yang, J., Xie, H., Yu, G., & Liu, M. (2021). Antecedents and consequences of supply chain risk management capabilities: an investigation in the post-coronavirus crisis. *International Journal of Production Research, 59*(5), 1573-1585.

Yousefi, N., & Alibabaei, A. (2015). Information flow in the pharmaceutical supply chain. *Iranian journal of pharmaceutical research : IJPR, 14*(4), 1299-1303.

Yu, M., & Goh, M. (2014). A multi-objective approach to supply chain visibility and risk. *European Journal of Operational Research, 233*(1), 125-130.

Zaheer, N., & Trkman, P. (2017). An information sharing theory perspective on willingness to share information in supply chains. *The International Journal of Logistics Management, 28*(2), 417-443.

Zhang, Goh, M., & Meng, F. (2010). *Inventory visibility assessment for pharmaceutical supply chains.* Paper presented at the Management of Innovation and Technology (ICMIT), 2010 IEEE International Conference on.

Zhang, A., Goh, M., & Meng, F. (2011). Conceptual modelling for supply chain inventory visibility. *International Journal of Production Economics, 133*(2), 578-585.

Zhang, M. & Huo, B. (2013). The impact of dependence and trust on supply chain integration. *International Journal of Physical Distribution & Logistics Management*.

Zhou, H., & Benton Jr, W. C. (2007). Supply chain practice and information sharing. *Journal of Operations Management, 25*(6), 1348-1365.

Zimmer, J. C., Henry, R. M., & Butler, B. S. (2007). Determinants of the Use of Relational and Nonrelational Information Sources. *Journal of Management Information Systems, 24*(3), 297-331.

Appendix 1: Interview Protocol

Section A: Working Experience

1. What company are you working for? What industry is your company in?

2. As your company is part of a supply chain(s), what is the position (s) of your company? Could you please tell me what are the main responsibilities of your company in the supply chain?

3. What is your current position in the company? How long have you been in this position?

4. How many years have you been working in supply chain management? In what roles?

5. How many years have you been working in the role in your current position?

6. Can you describe your roles and responsibilities in the company?

Section B: Supply Chain Visibility Perception

1. Have you come across the term "supply chain information visibility"? What does it mean to you?

2. How would you describe "supply chain information visibility" in your company?

(Prompt)

As a decision- maker, do you think that the current level of supply chain information visibility is sufficient for supporting supply chain decision-making?

How would you describe the desired level of supply chain information visibility in your company?

3. Could you please describe supply chain information visibility initiative(s) in your company?

(Prompt)

Please tell me what are the expected benefits?

How did other parties in your company's supply chain(s) involve in?

Section C: The supply chain decision-making process

4.1. What are the main types of decisions that you have been making as a supply chain manager?

4.2. How could you describe each type of supply chain decision?

4.3. Based on your experience, could you describe how supply chain decisions are made? Please give some examples.

(Prompt)

Please elaborate on different steps in your decision-making process.

Please elaborate on who you would involve in your decision-making process?

Please describe the requirements of information for use in decision- making process (e.g.: what characters of information do you search for? What are the preferred information sources?)

Please elaborate on the decision result.

4.4. How would you evaluate the influence of supply chain information visibility on supply chain decision making?

Appendix 2: Demographic Information

Participant	Position	Years of Experience	Firm Type
Participant 2	Procurement Manager	20 years plus	Large MNC Affiliate
Participant 3	Head of Supply Chain	15 years plus	
Participant 4	Pipeline Manager	25 years	
Participant 20	Logistic Manager	16 years	
Participant 5	Export Manager	7 years plus	
Participant 1	Demand Planner	> 5 years	
Participant 10	Head of Supply Chain	30 years	Small MNC Affiliate
Participant 11	Country Manager	30 years plus	
Participant 12	Senior Inventory & Distribution Manager	28 years	
Participant 14	Market Planner	10 years plus	
Participant 15	Supply Chain Lead	n/a	
Participant 17	Quality Manager	12 years	
Participant 16	General Supply Chain Manager	20 years plus	Large Local Firm
Participant 13	Forecasting and Planning Coordinator	> 5 years	
Participant 21	Procurement and Contract Specialist	> 5 years	
Participant 7	Managing Director	30 years plus	Small Local Firm
Participant 18	Managing Director	20 years plus	
Participant 19	Inventory Manager	Less than 5 years	
Participant 6	Supply Chain Manager	20 years plus	Hospital
Participant 7&8	Pharmacy Lead - Contract Manager & Senior Technician	20 years plus	

Appendix 3: Snowballed Participants

Snowballed Participant	**Referred by**
Participant 5	Participant 4
Participant 7&8	Participant 6
Participant 10	Participant 11
Participant 17	Participant 12
Participant 19	Participant 18
Participant 21	Participant 16

Appendix 4: Ethics Approval

Human Ethics Notification - 4000017001

humanethics@massey.ac.nz <humanethics@massey.ac.nz>

Thu 12/8/2016 7:28 PM

To: Lindsay, Alice <A.Lindsay@massey.ac.nz>; Thi.Thanh.Hoa.Nguyen.1@uni.massey.ac.nz <Thi.Thanh.Hoa.Nguyen.1@uni.massey.ac.nz>; Pauleen, David <D.Pauleen@massey.ac.nz>; Taskin, Nazim <N.Taskin@massey.ac.nz>; Scahill, Shane <S.Scahill@massey.ac.nz>; Jeffrey, Lynn <L.M.Jeffrey@massey.ac.nz>; Bentley, Tim <T.A.Bentley@massey.ac.nz>
Cc: Thomas Vincent, Miralie <M.E.Thomas@massey.ac.nz>

HoU Review Group
A/Pro Lynn Jeffrey
Prof Tim Bentley

Ethics Notification Number: 4000017001
Title: Supply chain visibility and its linkage to decision-making improvement: An exploratory study in the New Zealand context.

Thank you for your notification which you have assessed as Low Risk.

Your project has been recorded in our system which is reported in the Annual Report of the Massey University Human Ethics Committee.

The low risk notification for this project is valid for a maximum of three years.

If situations subsequently occur which cause you to reconsider your ethical analysis, please log on to http://rims.massey.ac.nz and register the changes in order that they be assessed as safe to proceed.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

"This project has been evaluated by peer review and judged to be low risk. Consequently it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.
If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director (Research Ethics), email humanethics@massey.ac.nz. "

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish require evidence of committee approval (with an approval number), you will have to complete the application form again answering yes to the publication question to provide more information to go before one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

You are reminded that staff researchers and supervisors are fully responsible for ensuring that the information in the low risk notification has met the requirements and guidelines for submission of a low

risk notification.

If you wish to print an official copy of this letter, please login to the RIMS system, and under the Reporting section, View Reports you will find a link to run the LR Report.

Yours sincerely

Dr Brian Finch
Chair, Human Ethics Chairs' Committee and
Director (Research Ethics)

Appendix 5: Participant Consent Form

MASSEY UNIVERSITY
UNIVERSITY OF NEW ZEALAND
MASSEY BUSINESS SCHOOL

PARTICIPANT CONSENT FORM – INDIVIDUAL

Project Title: ***Supply chain information visibility and its linkage to decision-making improvement: An exploratory study in the New Zealand pharmaceutical context***

Researcher Name: Nguyen Thi Thanh Hoa (Hilary Nguyen)

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time. (YES | NO)

I understand the nature of the research and why I have been asked to participate in the study. (YES | NO)

I agree to the interview being sound recorded. (YES | NO)

I understand the recording of the interview can be stopped at any time on request by me. (YES | NO)

I understand that my participation is completely voluntary. (YES | NO)

I understand that I may request a summary of the results from this project to be emailed to me. (YES | NO)

I agree to participate in this study under the conditions set out in the Information Sheet. (YES | NO)

Signature: ..... **Date:** .....

Full Name .....

Appendix 6: Information Sheet

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

MASSEY BUSINESS SCHOOL

Supply chain information visibility and its linkage to decision-making improvement: An exploratory study in the New Zealand pharmaceutical context

INFORMATION SHEET

Researcher Introduction

I, Hilary Nguyen (Nguyen Thi Thanh Hoa), am the student researcher of this study which is carried out as a part of my PhD (Management) research at Massey University.

Project Description

This study aims to explore how supply chain professionals perceive supply chain information visibility, and how supply chain decision-making is made using the visible information. Increasing supply chain complexity, along with the explosion of technological advances has led to the exponential increase and diversity of information being created, captured and exchanged in supply chains. Under this circumstance, how to effectively manage and share the available information within a supply chain for better support decision-making has become a critical issue in supply chain management. The research seeks to explore the supply chain professionals' understanding of supply chain information visibility and their experiences in making decisions using information

Your participation in this study will contribute to better understanding of information visibility for supply chain decision-making support as well as of how to help supply chain professionals make better decisions using information.

An Invitation

You are invited to share your understanding about information visibility within the supply chain context, and your experiences of acquiring and using information in the decision-making process. I am hoping to gather valuable views of people who are supply chain professionals to gain an in-depth understanding of the mentioned issues.

Project Procedures

I would like to interview you in person, over the phone or by Skype for about 60 minutes. I would highly appreciate for your sharing additional documents relating to information management and decision-making. In addition, I would like to contact with you after the interview by email, in case there are some details needed to be confirmed or added for proper understanding.

Data Management

The interviews will be audio recorded, then transcribed verbatim and returned to you for checking and editing if you choose. Electronic data collected will be kept secure on password protected devices. After five years post write-up, data collected in interviews will be deleted.

Information about you will remain confidential and any identifying details about you or the organization for which you work will be removed from the transcript and from my thesis and any subsequent publications.

Te Kunenga ki Pūrehuroa

School of Management
Massey University, Private Bag 102904, Auckland 0745 T +64 9 414 0800 http://management.massey.ac.nz

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study (up until one week following the interview);
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- if you wish, you will be given access to a summary of the research findings when it is concluded.

If you'd like to participate in this research please contact me by email, and I will get back to you to organize a meeting. My details are given below along with details of my supervisors. Please contact me or the supervisors if you have any questions about this project.

Project Contacts

Student Researcher: Nguyen Thi Thanh Hoa
Phone: +64 9 414 0800 ext. 43062
Mobile: [redacted]
Email: T.T.H.NGUYEN@massey.ac.nz

Supervisor: Associate Prof David Pauleen
Phone: +64 9 414 0800 ext. 43385
Email: d.pauleen@massey.ac.nz

Supervisor: Dr Shane Scahill
Phone: +64 9 414 0800 ext. 43394
Email:s.scahill@massey.ac.nz

Supervisor: Dr Nazim Taskin
Phone: +64 9 414 0800 ext. 43402
Email:n.taskin@massey.ac.nz

Ethics

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher named above is responsible for the ethical conduct of this research.
If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director, Research Ethics, telephone 06 356 9099 ext 86015, email humanethics@massey.ac.nz