Enhancing Business Data Sharing in the Supply Chain Domain: A Framework of Infrastructural and Institutional Instruments

Master Thesis

by

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Enhancing Business Data Sharing in the Supply Chain Domain: A Framework of Infrastructural and Institutional Instruments

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TUDelft

Preface

I want to start by expressing how amazing my master's journey has been— one wild roller coaster ride! Choosing to come to the Netherlands, away from my family, was a gutsy decision for me. But looking back, I'm so glad I took that leap of faith to pursue higher education here. It's been so much more than just studying and learning. I've grown immensely on a personal level, developing invaluable interpersonal skills and becoming more empathetic towards others around me, as I realized everyone had their struggles to deal with.

My program in Management of Technology has given me the ability to excel not only in tech-related positions but also when working with various stakeholders. That's why I decided to focus on supply chain management for my thesis— I've seen firsthand the challenges of sharing data in supply chains. Hence, I was deeply determined to dive deep into this topic, hence the long and intensive thesis (haha!).

I can't thank my first supervisor and chair, Anneke Zuiderwijk, enough. She's been my rock throughout this whole journey. Her feedback, support, and encouragement have given me the confidence to consider pursuing a PhD in my favourite fields. I'm thrilled to announce that with her support, I am currently working on a research paper that builds upon the findings of this thesis. This opportunity brings me one step closer to realizing my dream of conducting industrial-level research. I'm beyond grateful for her kindness and the immense support she's shown me, especially during tough times in my personal life as well. And then there's my second supervisor, Wijnand Veeneman, who's been a guiding light during my thesis. He challenged me to think differently and consider various perspectives when I was stuck in my ways. Thanks to him, the quality of my thesis exceeded my expectations. Also, I would like to sincerely thank all the interviewees who graciously accepted to be a part of my research.

A special thanks goes out to my unwavering pillars of support: my beloved parents, cherished brother, and wise grandfather, whose unwavering belief in me has been a beacon of strength. And, of course, my deepest gratitude goes to my dearest friends Revanth, Aditi, Sofia, and Stefan. They've been there for me emotionally throughout the whole thesis process and the past two challenging years. I also want to express my gratitude to the Almighty for always providing me solace and support. Also, I want to give graceful thanks to all the other well-wishers who've supported me virtually when I needed it the most. This journey has been nothing short of beautiful, and I owe it all to my incredible family and friends!

I hope you enjoy reading the thesis and find it both enlightening and enjoyable. And please forgive me if any unintentional mistakes slipped through.

To wrap it up, I want to share my life's motto with you: ***Be optimistic to a level where the universe has no choice but to transform your dreams into dazzling realities!***

Rishika Abbineni
Delft, August 2023

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Executive Summary

In today's interconnected and rapidly evolving business landscape, effective data sharing plays a pivotal role in optimizing supply chain management and driving operational excellence. Sharing data enables organizations to synchronize their actions with supply chain partners, leading to improved performance and coordination. However, there are barriers to effective data sharing, such as insufficient sharing among partners and challenges in communication and data exchange. To address these barriers, a systematic framework is needed to identify and mitigate them, allowing for efficient supply chain data sharing and optimization of outcomes. The research objective is to develop a framework of infrastructural and institutional instruments that can enhance data sharing by addressing feasible barriers. The framework aims to optimize data sharing practices in the high-tech supply chain organizations. Additionally, the research emphasizes the importance of technology implementation, adherence to standards, and establishment of legal frameworks to empower companies in harnessing the full benefits of supply chain data sharing.

The research design implemented in this thesis provides a solid foundation for conducting a comprehensive investigation into the barriers and potential solutions related to data sharing in supply chains. By conducting a literature review, categorizing the identified solutions, and employing a single case study approach, the research aims to contribute new knowledge to the field of supply chain management. The use of 14 semi-structured interviews and 5 validation interviews further strengthens the research by obtaining diverse perspectives and expert opinions. Furthermore, the careful selection of the target population, based on criteria such as industry sector, company size, geographical location, and participant attributes, ensures that the findings can be applied to relevant contexts and have broader applicability. Additionally, ethical considerations, including obtaining informed consent and protecting participant privacy, have been addressed through the approval of the research by the Human Research and Ethics Committee (HREC).

This literature review provides a comprehensive understanding of the benefits and barriers of data sharing in the supply chain. The benefits include inventory reduction, cost reduction, improved resource utilization, increased productivity, early problem detection, building social bonds, better tracing and tracking, earlier time to market, expanded network, and optimized capacity utilization. However, barriers such as data privacy concerns, lack of trust, technology reliability and cost, capability challenges, limited willingness to share, real-time data challenges, data misinterpretation, lack of standardized methodology, and financial and capability constraints pose challenges to data sharing in supply chains.

While competitive factors have been identified as a significant barrier, they are considered infeasible to mitigate within the scope of this study. However, feasible barriers related to trust, privacy, technology, and governance support have been classified using the proposed *Barrier Quadrant*. Moving forward, the literature review has laid the foundation for further investigation into potential solutions to mitigate the feasible barriers. Instruments such as emerging technologies (e.g., blockchain), advanced technologies (e.g., Artificial Intelligence, Machine Learning), data standardization, data security measures, cultural factors, trust-building techniques, legal agreements, learning programs, the role of leadership, and ethical and responsible data sharing have been identified as potential avenues to address the barriers.

Subsequently, the single case study interview findings explores the extent to which a combination of institutional and infrastructural instruments can overcome barriers in data sharing within the supply chain domain. Through transcribed interviews, the analysis reveals the benefits of data sharing, including improved

collaboration, accurate forecasting, enhanced supply chain management, and resilience against disruptions. However, challenges such as data security, trust and transparency, technical complexities, and standardized interfaces need to be addressed. To maximize benefits and overcome these challenges, companies should establish guidelines, invest in data security, and build trust-based relationships. Emerging technologies like ICT and Blockchain have a significant impact, but implementation and standardization issues persist. Advanced technologies like AI and ML offer potential benefits but require attention to data quality, privacy, and standardization. Cultural factors, trust, collaboration, privacy concerns, legal protections, data governance policies, education, and leadership also play crucial roles in promoting data sharing. An integrated approach focusing on demand forecasting, AI, standardized frameworks, and data quality is necessary, along with collaboration, responsible practices, and robust security measures. Overcoming geopolitical trends and communication barriers will be essential for widespread adoption of data sharing in the supply chain.

The subsequent findings from the validation interview examine the extent to which the combined institutional and infrastructural instruments can be generalized to high-tech supply chains. The validators' responses reveal positive perceptions regarding certain instruments that enhance data sharing in the supply chain. Standardization of data formats, interoperability, data security measures, and technologies like blockchain, ICT, AI, and ML are viewed as important. Leadership is considered the most positively perceived institutional instrument, followed by education and training programs, contractual agreements, data governance policies, and cultural factors. Trust is recognized as crucial for the success of both institutional and infrastructural instruments. While ethical and responsible data sharing is acknowledged, it is not given as high a priority. These findings offer valuable insights into effective data sharing in the supply chain and highlight areas for further investigation.

The thesis offers a research contribution that focuses on developing a strategic deployment plan for infrastructural and institutional instruments to enhance data sharing in supply chains. The proposed deployment plan offers a structured approach to address the challenges of data sharing and contributes to a deeper understanding of data sharing dynamics in supply chains. Also, from an academic perspective, the research highlights the importance of considering risk as a comprehensive concept that encompasses trust, technology, privacy, and governance-related barriers. However, further research is necessary to validate the effectiveness of the deployment plan and explore its practical applicability, as well as to expand the academic knowledge in the field of data sharing within supply chains.

In summary, the research findings align with the existing literature, confirming the importance of technology integration, standardization, and data security in enhancing data sharing within supply chains. These findings contribute to our understanding of effective data sharing practices and highlight the need to address implementation challenges and balance security with innovation. Further exploration of trust as a complex and multifaceted concept is recommended to deepen our understanding of its role in facilitating data sharing. The research provides valuable insights for supply chain professionals and sets the foundation for future studies in this field.

Nomenclature

Abbreviations

Abbreviation	Definition
AI	Artificial Intelligence
CEO	Chief Executive Officer
CFPR	Collaborative Planning, Forecasting and Replenishment
CIA	Confidentiality, Integrity, Availability
CIAS	Confidentiality, Integrity, Availability, Security
CIO	Chief Information Officer
DSA	Data Sharing Agreements
EAN	European Article Number
EDI	Electronic Data Interchange
ESG	Environmental Social, and Governance
EU	European Union
GDPR	General Data Protection Regulation
GTIN	Global Trade Item Number
HR	Human Resources
HREC	Human Research and Ethics Committee
ICT	Information and Communication Technology
IDSI	International Data Sharing Initiative
IoT	Internet of Things
IT	Information Technology
ML	Machine Learning
NDA(s)	Non Disclosure Agreement(s)
OT	Operational Technology
RFID	Radio Frequency Identification
SC(s)	Supply Chain(s)
SCO	Supply Chain Officer
SCM	Supply Chain Management
SME(s)	Small and Medium-sized Enterprises
S&OP	Sales and Operations Planning
UI(s)	User Interface(s)
VMI	Vendor Managed Inventory
WIP	Work In Progress

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Introduction

1.1. Background

In the context of Supply Chain Management (SCM), a Supply Chain (SC) is a system of interconnected organizations involved in various processes that create value in the form of goods and services for the end consumer (Christopher, 2005). This system involves two or more legally distinct entities that are connected through material, information, and financial flows, which can include companies that manufacture parts, components, and final products, logistics service providers and end consumers (also referred to as customers) (Stadtler, 2015).

Coordination of material, data, and financial flows for any company, especially product-based, remains a formidable task (Stadtler, 2015). The complexity of supply chain management is further compounded by the fact that modern supply chains often involve multiple organizations and stakeholders. This includes suppliers, distributors, and consumers who are involved in various operations and procedures to manufacture goods and services for end-users. Hence, a supply chain comprises a sequence of entities that participate in these operations and procedures, both in the upstream and downstream (Lotfi et al., 2013). As seen in Figure 1.1(a), an example of a supply chain coined by Stadtler (2015), the dotted link between the organizations refers to information flow which is facilitated via data sharing between the supply chain partners. It can be understood that a large number of parties distribute and control (their usage, sharing, and tracking) data in a digital supply chain. An in-depth understanding of the data sharing, both internally and externally between the SC parties can be seen in Figure 1.1(b) (Bhargava et al., 2013). This implies that both intra-organizational and inter-organizational stakeholders are always engaged in the scope of supply chain data sharing.
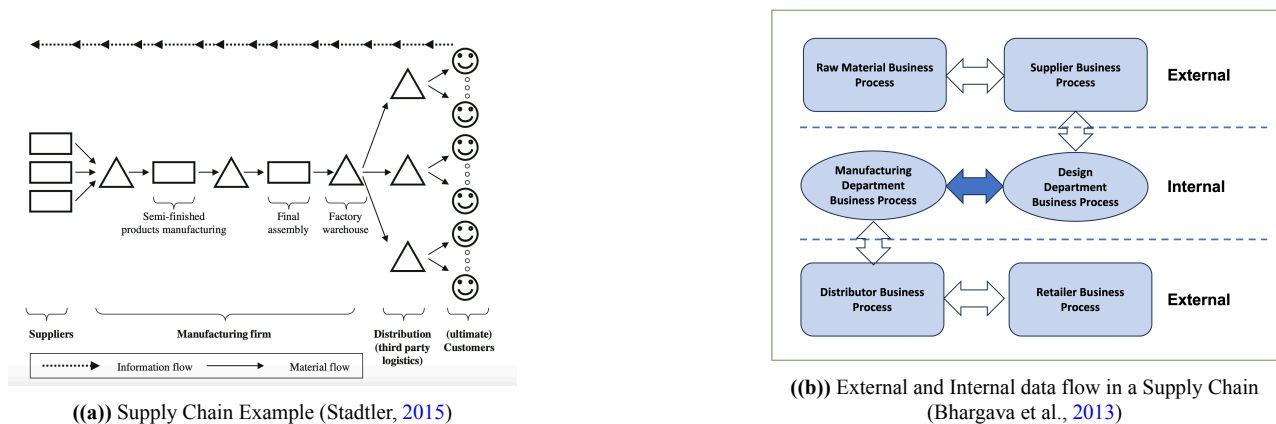

((a)) Supply Chain Example (Stadtler, 2015)

((b)) External and Internal data flow in a Supply Chain (Bhargava et al., 2013)

Figure 1.1: Data flow in Supply Chain

In recent years, businesses have increasingly recognized the immense value of data and the benefits it brings through sharing. Data sharing has become a crucial method for enhancing the overall performance of supply chains. By sharing data, businesses can effectively synchronize their actions with supply chain partners, leading to improved performance (Baihaqi and Sohal, 2013). Notably, a significant volume of data is currently exchanged among various entities in the supply chain, including producers and sellers, sellers and buyers, corporations and investors, and even among peers at the same stage of the supply chain (Li, 2002). Sharing data, encompassing knowledge, skills, and resources, plays a critical role in establishing an effective supply chain. It acts as a bridge to mitigate coordination challenges, as highlighted by Fawcett et al. (2008). Through data sharing, organizations can swiftly respond to evolving customer needs (Sukati et al., 2012). Data sharing is instrumental in enabling supply chain partners to enhance their competitive advantages and thrive in today's economy. The true value of data sharing lies in the fact that the benefits obtained outweigh the associated costs (Lee et al., 1997).

Despite the prevalence of data sharing, according to Fawcett et al. (2008), one of the biggest barriers to a successful strategic supply chain is insufficient data sharing among partners. To address these barriers, both the academic and business communities have been focusing on the issues of coordination and integration in SCM for quite some time. As the current economic climate becomes increasingly competitive, it is more important than ever for supply chain partners to enhance their competitive edge through the exchange of data (Lotfi et al., 2013). However, it is essential to strike a balance, as excessive data sharing can potentially lead to companies losing business to competitors and compromising their negotiation power with suppliers and other supply chain partners (Li, 2002). Therefore, it is crucial to optimize data-sharing practices in a way that maximizes the benefits for companies while preserving healthy competition in the market. Additionally, many businesses still face challenges in communication and data exchange, hampering effective coordination across different organizational units (Lotfi et al., 2013). To tackle these challenges, it is crucial to prioritize the resolution of data-sharing barriers. This can be achieved by emphasizing the implementation of technology, adherence to standards, and establishment of legal frameworks that empower companies to harness the full benefits of supply chain data sharing.

1.2. Research Objective

Overcoming data sharing barriers is essential to unlocking the full potential of data sharing in the supply chain, as highlighted in section 1.1. To achieve this, a systematic approach is required to identify and mitigate the barriers that hinder effective data sharing. Unfortunately, organizations often struggle to address these barriers in a structured manner, leading to inaccurate results and limited benefits for all involved parties. Therefore, there is a critical need for a systematic framework that can identify and mitigate these barriers, enabling efficient supply chain data sharing and optimizing outcomes. While some barriers may initially seem daunting, careful efforts can effectively tackle these obstacles. By recognizing and actively working to mitigate these barriers, organizations can enhance the precision of their outcomes and optimize the advantages derived from data sharing.

The objective of this thesis is to develop a framework of potential solutions or tools (can be referred to as infrastructural and institutional arrangements later) that can improve data sharing and address the barriers faced by supply chain stakeholders in data sharing. It is important to note that while certain barriers may not be completely diminished, suitable infrastructural and institutional arrangements can help mitigate their negative impact, as supported by previous studies (Altayar (2018); Zuiderwijk (2015)). Infrastructural instruments, such as standardized data formats and transfer protocols, along with policies and procedures ensuring data privacy and security, can play a crucial role in addressing these concerns. On the other hand, institutional instruments encompass formal and informal structures and operational mechanisms that encourage cooperation between firms and facilitate data sharing. Research suggests that a combination of infrastructural and institutional instruments proves effective in promoting data sharing (Zuiderwijk, 2015; Gend and Zuiderwijk, 2022).

By identifying and developing such instruments, supply chain stakeholders can address concerns surrounding data privacy and security while promoting cooperation and collaboration between partners. This approach ultimately leads to enhanced data sharing in the supply chain, benefiting all stakeholders involved. Therefore, the research objective of this thesis is to find a combination of infrastructural and institutional instruments that serve as solutions to the identified data-sharing barriers from existing literature. This developed framework can then be applied to supply chain-focused companies, helping them enhance their supply chain data-sharing practices. To obtain this research objective, it is important to define the scope of the research. It is crucial to emphasize that the research concentrates on identifying and addressing *mitigable* barriers associated with technology, infrastructure, legalities, and similar aspects. However, it does not encompass barriers *that may not be mitigated* within the scope of this study, such as competitive factors or loss of negotiation power, among others. A pictorial representation of the scope of this research can be seen in Figure 1.2.
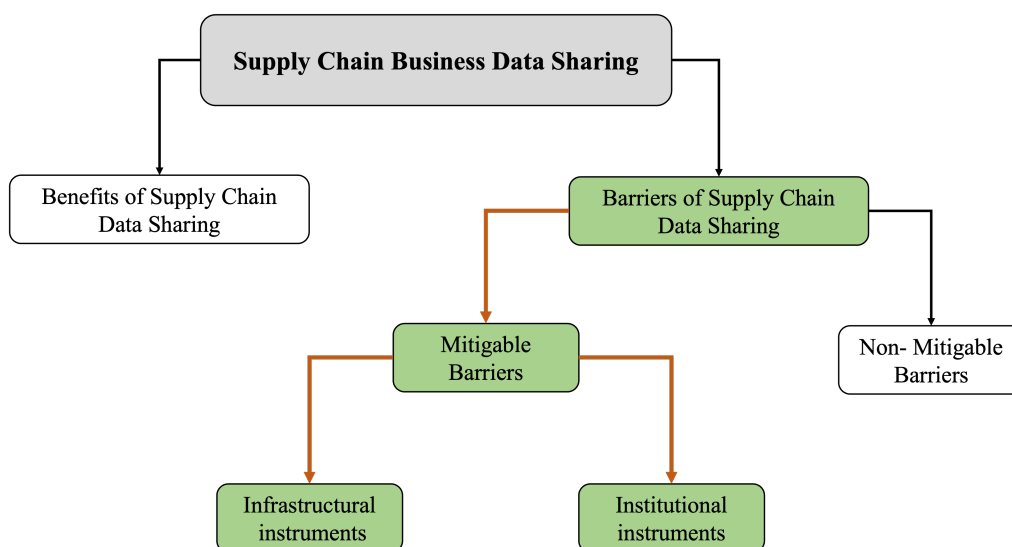
Figure 1.2: Scope of the research

1.3. Research Questions

After carefully reviewing and analyzing the scope of the research, the main research question has been identified. This research question serves as the foundation for the entire study and directs the focus towards achieving the research objective. It also guides the selection of appropriate research methods and helps in the systematic collection and analysis of relevant data. Additionally, the main research question provides a framework for addressing the sub-questions that arise during the research process.

Hence, the main research question that arises from this context is:

RQ: What combination of infrastructural and institutional instruments enhances data sharing in a supply chain network by addressing the mitigable barriers?

To answer the main research questions, the following sub-research questions also need to be answered in a flow:

SQ1: *What are the benefits and barriers of data sharing in the supply chain?*

This sub-question seeks to investigate the benefits and challenges of sharing data across various supply chain entities. It is critical to first understand the existing pros and cons in order to better understand why the research is necessary in the first place. In practice, understanding the benefits and barriers to data

sharing can help improve supply chain efficiency by facilitating better decision-making and coordination among various stakeholders.

SQ2: *What barriers are mitigable and unmitigable by the supply chain organizations?*
 The understanding gained from the first sub-question can be used to identify which barriers to data sharing are mitigable and which are not. This particular sub-question is critical because the research's foundation is based on removing mitigable barriers and improving data sharing between companies when those barriers are encountered. In practice, supply chain organizations can develop targeted solutions and allocate resources more effectively by focusing on the mitigable barriers.

SQ3: *What combination of infrastructural and institutional instruments could address the mitigable barriers of data sharing in supply chain?*
 Now that the potential barriers have been identified, it is critical to fully understand the factors that could positively influence data sharing in the supply chain. However, picking random factors that may or may not be effective is not the way to go. As a result, developing a structured framework of potential instruments from both an infrastructure and an institutional standpoint could prove to be the most effective way to proceed with the research.

SQ4: *To what extent can the derived combination of infrastructural and institutional instruments be employed to address the identified mitigable barriers?*
 This sub-question is critical because it examines the correctness and application of the framework derived from sub-research question 3. This serves as the final input to the main research question in determining the combination of institutional and infrastructural instruments that can positively enhance data sharing in the supply chain, thereby addressing the mitigable barriers identified in sub-question 2.

SQ5: *To what extent can the derived combination of infrastructural and institutional instruments be generalized to the high-tech supply chains?*
 This sub-question is significant because it seeks to understand the applicability of the proposed combination of institutional and infrastructural instruments in a specific context, namely high-tech supply chains. High-tech industries heavily depend on cutting-edge technologies and digital systems to streamline their supply chain operations. Consequently, data sharing holds immense significance and relevance in their daily functions, becoming a crucial aspect within these industries. By concentrating on high-tech companies, the study can delve into the distinctive obstacles, prospects, and optimal approaches concerning data sharing within a technologically advanced supply chain environment. This question can help researchers and practitioners to determine the extent to which the proposed instruments can be useful in addressing challenges specific to high-tech supply chains. The answer to this question can provide insights into the effectiveness and limitations of the proposed instruments in this context, and guide future research and practical applications.

1.4. Academic and practical relevance

There is a lot of potential for academic and practical value in the research that improves business data sharing among firms by utilizing infrastructural and institutional arrangements in the supply chain domain. They will be discussed in the subsequent sub-sections.

1.4.1. Academic relevance

The research objective of enhancing business data sharing among firms in the supply chain domain through infrastructural and institutional arrangements holds academic significance for several reasons. In terms of the supply chain, despite existing research efforts addressing data sharing enhancement, there is a limited or even absent systematic evaluation of a combination of different instruments and their impact on SC data sharing. For example, Kaipia and Hartiala (2006) emphasize the efficient utilization of real demand

and market trend information, sharing it with suppliers to improve SC visibility. Additionally, the authors propose that only information contributing to SC performance should be shared. Moreover, Du et al. (2012) investigates factors influencing companies' willingness to share information from a partnership-data-process perspective. While these studies provide valuable insights, there is a lack of comprehensive understanding regarding how these potential solutions interrelate. This thesis aims to contribute to the existing literature by examining a meticulous combination of instruments that influence SC data sharing, while also presenting an implementation plan for these instruments to work synergistically rather than in isolation. This approach acknowledges the reality that a single solution may not adequately address all data-sharing barriers in practical SC contexts.

As mentioned in section 1.2, previous studies such as those conducted by Zuiderwijk (2015) and Altayar (2018) emphasize the significance of appropriate infrastructural and institutional arrangements for facilitating data sharing, albeit within the context of open research data sharing and reuse. Intrigued by the framework proposed in their research, I seek to draw inspiration from it and apply it specifically to the domain of supply chain data sharing. Given the complexity of the topic, I believe that there are additional instruments yet to be explored in SC research. Furthermore, there is a scarcity of research addressing important aspects such as the impact of education and training programs, cultural factors, and ethical considerations on SC data-sharing practices. Through this thesis, my intention is to investigate the influence of these factors on supply chains, as I firmly believe that data sharing extends beyond technology and contractual agreements. By doing so, I aim to contribute to the academic relevance of this field of study.

1.4.2. Practical relevance

The research objective of enhancing business data sharing among firms using infrastructural and institutional arrangements in the supply chain domain also has practical significance in several ways. Firstly, the objective recognizes that data sharing is an important issue for organizations operating in the supply chain domain. The proposed combination of the instruments along with its implementation plan has the ability to help organizations overcome the barriers to data sharing, which can improve decision-making and increase efficiency in the supply chain. Furthermore, this implementation framework can be used by organizations to identify the appropriate technical and governance instruments needed to facilitate data sharing, as well as the formal and informal structures and operational mechanisms required for effective data sharing. Lastly, the objective highlights the importance of collaboration and partnerships in promoting data sharing among firms.

1.5. Connection to Management of Technology

The study *Management of Technology* at TU Delft focuses on effectively managing technology resources and processes in organizations to enhance organizational performance, innovation, and competitiveness. This includes implementing technology infrastructure and governance mechanisms to optimize business operations. The research discussed in this context directly relates to this study by addressing the management of technological resources and processes, specifically in the domain of data sharing within the supply chain. It aims to identify and develop suitable instruments to overcome barriers to data sharing in the supply chain. This research provides valuable insights into the effective management of technology to promote better data sharing in the supply chain, which is a significant aspect of technology management. By aligning with the objectives of the study, which emphasizes the importance of effective instrument management to achieve desired outcomes, this research contributes to the broader goals of the field.

1.6. Report structure

First and foremost, a detailed flow chart representation of the report structure can be seen in Figure 1.3. The report following this chapter starts with the research methods chapter, which introduces the research design along with the chosen research methods for the thesis. It proceeds to outline the data collection methods

and the criteria used for selecting these methods, ending in a brief overview of the data analysis. In the next chapter of the thesis, I start by conducting a literature review. This phase involves exploring the existing body of knowledge and ends in the development of a combination of infrastructural and institutional instruments' framework, which serves as a foundation for the next chapter on single case study interviews. In this chapter, the findings from the interviews are presented, and the distinct perspectives of the interviewees are framed as input for the following chapter.

Moving forward, the next chapter presents the findings from the validation interviews and discusses the generalizability of the perspectives and overall instrument. Following this, the chapter on research contribution focuses on my interpretation of the findings and the ultimate contributions made to both the practical and academic realms of research. Finally, the thesis concludes with a discussion and conclusion chapter, where the research questions are answered, the literature review is addressed in line with the research findings, and more importantly, I present my key takeaway from the entire thesis journey.
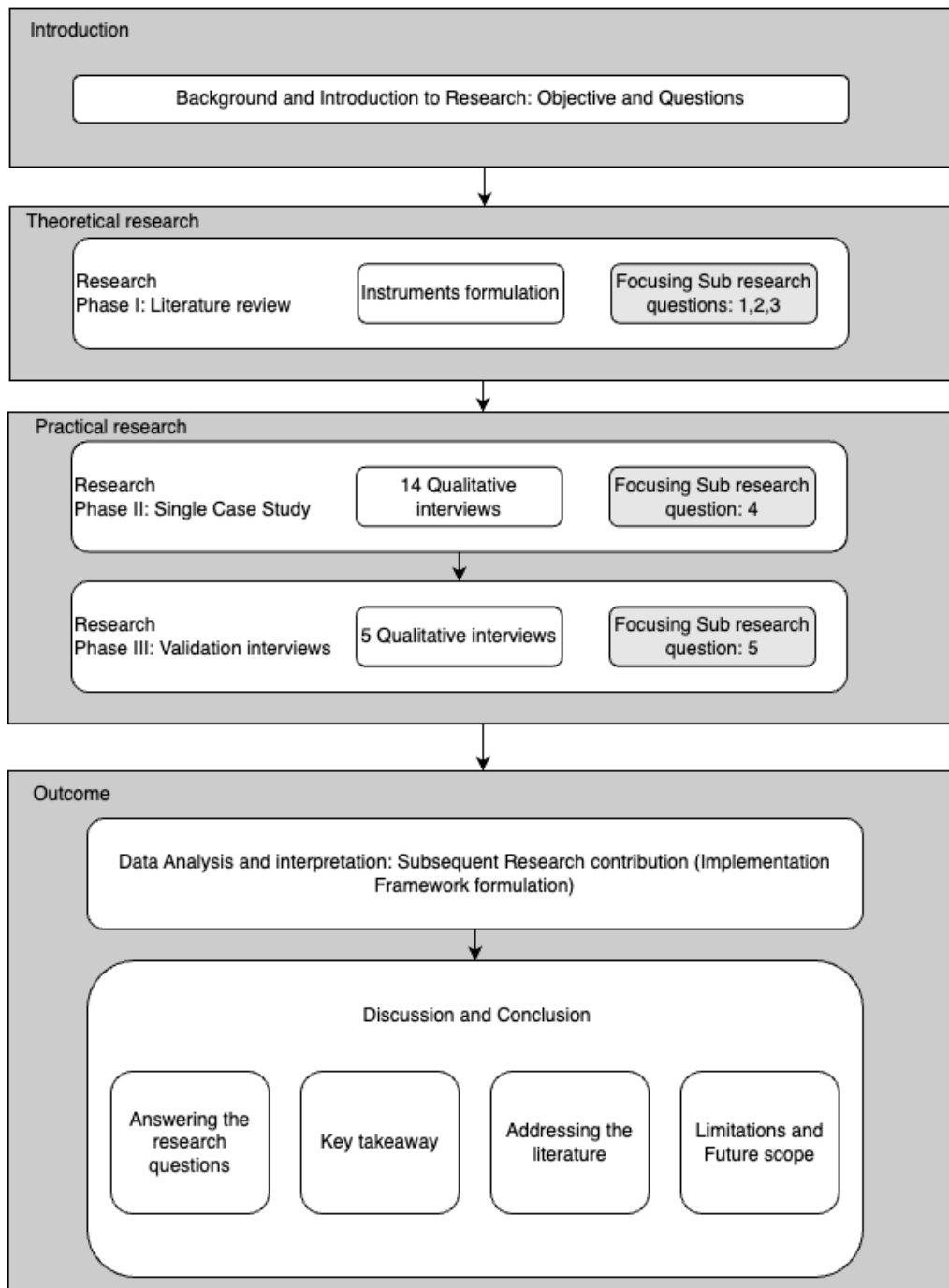
Figure 1.3: Report structure

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Research Methods

This chapter outlines the research methodology adopted for the thesis, which follows a qualitative approach. The methodology comprises a combination of theoretical and practical research methods such as literature review, single case study, and validation. Each method is described below, along with the reasoning behind its inclusion. Additionally, this chapter covers the selection of the target population for both the single case study phase and the validation phase. Each aspect is described below in detail.

2.1. Research Design

2.1.1. Research Framework

The research framework consists of three research methods as mentioned previously. It consists of three phases: literature review, single-case study, and validation interviews, as seen in Figure 2.1.
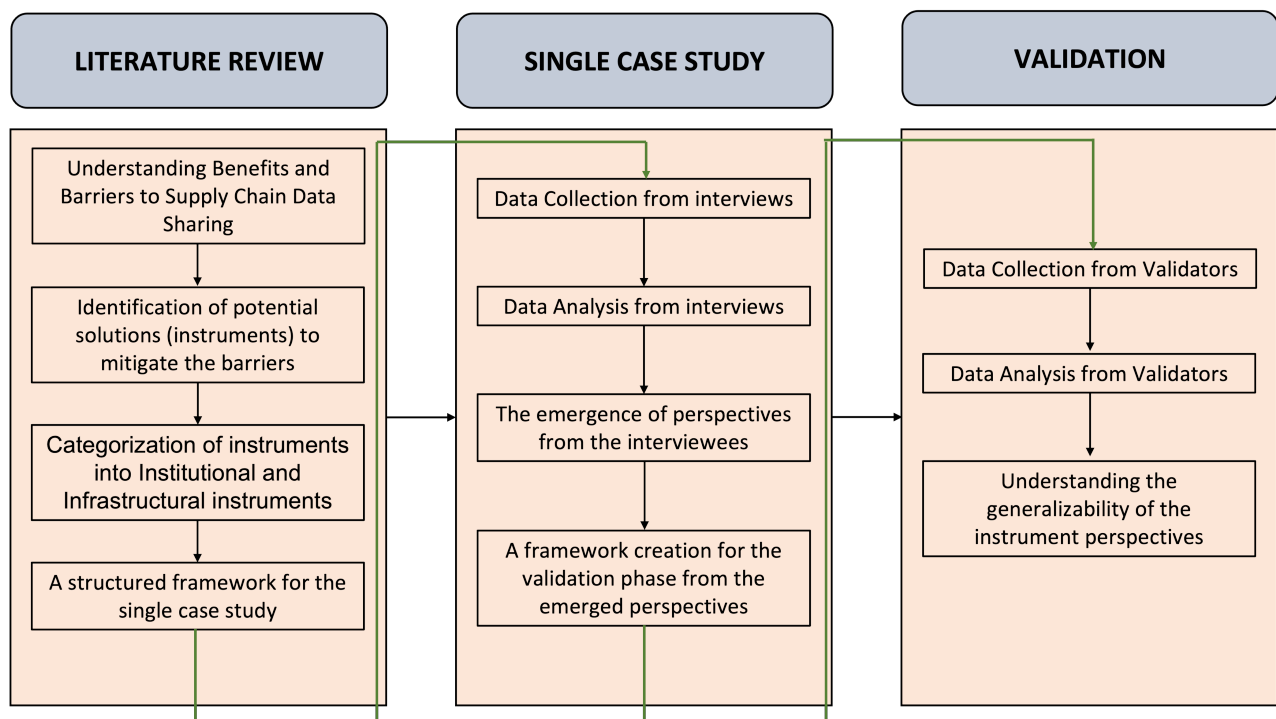
Figure 2.1: Research Framework

1. **Phase I: Literature review:** The first research method used in this thesis is a theoretical literature review. It involves examining existing knowledge to establish a foundation for the research and to expand on the current understanding of the subject matter. It serves as an essential foundation for research, ensuring its relevance, significance, and potential for contributing new knowledge to the field (Sekaran and Bougie, 2016). As will be seen in chapter 3, potential solutions to mitigate some barriers faced in SC data sharing will be extensively discussed. Then, based on the definitions and categorization available in the literature about infrastructural and institutional arrangements as proposed by Zuiderwijk (2015), the identified solutions will be categorized into institutional and infrastructural instruments. This categorization serves as the protocol for the subsequent research method: the single case study. The literature review is essential because it establishes a foundation of existing knowledge and identifies gaps in the current understanding of data sharing in supply chains. By categorizing the instruments, the review provides a structured framework for conducting a single case study.

2. **Phase II: Single case study:** A case study can be defined as a research strategy that entails an empirical investigation of a specific contemporary phenomenon within its real-life context using multiple data collection methods (Aberdeen, 2013). The approach of case studies involves gathering data on a particular object, event, or activity, which could be a specific business unit or organization (Sekaran and Bougie, 2016). The primary aim of a case study is to obtain a comprehensive understanding of a problem by analyzing the real-life situation from multiple perspectives using various data collection techniques. Furthermore, the case study is qualitative since this type of research is characterized by the qualities of rigour, credibility, and trustworthiness in the process of data collection (Lowhorn, 2007).

   According to Aberdeen (2013), a single-case study can be chosen when the research objective is to obtain an in-depth understanding of a particular phenomenon. The case study for this thesis focuses on a high-tech company with strong supply chain operations facing challenges in achieving efficient data sharing with its supply chain collaborators. Hence, the second research method employed in this thesis is a *single case study*. The use of a single-case study approach enables researchers to analyze a complex phenomenon in its real-life context and to explore the multiple perspectives and angles associated with it. In this way, a single-case study approach can provide rich and detailed data, which can lead to comprehensive insights and a deeper understanding of the phenomenon being studied (Aberdeen, 2013). Therefore, a single-case study can be an appropriate research design when the aim is to explore a complex, unique phenomenon in its real-life context, and when the insights gained from studying this particular case have significant potential for contributing to the field. To ensure confidentiality and privacy, the company's identity and participants' personal details are anonymized in the report.

   The single case study involves conducting semi-structured interviews with 14 participants *(the selection strategy of the target population shall be explained further in the section 2.2)* from the company. An interview is an intentional and structured conversation that takes place between two or more individuals (Sekaran and Bougie, 2016). This is a common approach in business research, especially for case studies, where respondents are interviewed to obtain information on a topic of interest. Aberdeen (2013) recommends using semi-structured interviews in case study research as it allows for flexibility in questioning and enables the researcher to delve deeper into specific topics. This approach also permits follow-up questions to be asked based on interesting or unexpected responses, resulting in more detailed information being gathered on the research topic. Additionally, using open-ended questions in semi-structured interviews allows participants to share their views and perspectives in their own words, thus providing rich and detailed data for analysis. These interviews are based on the categorization of instruments derived from the literature review. The participants will be asked to express their perspectives on the influence of the identified instruments on data sharing in supply chains. The responses obtained from the interviews will be analyzed to derive distinct perspectives for

each instrument.

3. **Phase III: Validation Interviews:** The final research method employed in this thesis is the validation phase, which aims to ensure the generalizability of the perspectives obtained from the interviews. This phase is crucial because a single case study has inherent limitations in terms of generalizability (Lowhorn, 2007). To address this limitation, validation is necessary to verify the applicability of the findings beyond the specific case study. In this phase, the derived perspectives from the single case study will be presented to a group of validators. The validators consist of professors and PhD researchers specializing in the domains of data sharing, supply chain, and data security *(the selection strategy of the target population shall be explained further in the section 2.2)*. This phase has 5 semi-structured interviews with the validators providing a holistic and unbiased opinion on the generalizability of the perspectives to other high-tech firms with similar supply chains. The validation phase aims to enhance the credibility and soundness of the research findings by obtaining expert opinions. The inclusion of academic experts adds an additional layer of rigour and academic relevance to the research. By involving academia, the research aims to contribute to the existing body of knowledge in the field of supply chain operations and data sharing. The responses from the validators will be analyzed and discussed, providing additional insights and strengthening the overall research conclusions.

2.2. Data collection

I. Case study selection criteria

The careful selection of the target population and a sample is an essential element of research methodology because it directly impacts the validity and generalizability of the study's findings. A pictorial representation of the sample selection can be seen in Figure 2.2. By focusing on supply chain-focused companies, which are businesses that prioritize and heavily incorporate supply chain practices in their operations, this thesis aims to investigate the specific population that aligns with this characteristic. To conduct a single case study, I chose a company that operates in the high-tech industry and is based in Europe. This selection ensures that the findings and conclusions drawn from the case study are relevant to companies within that specific context.

The sample population for this study comprises both supply chain employees and data security employees, for a holistic view of the research topic. The information collected from the sample will be carefully examined, and the final qualitative findings can then be applied to the population of interest, which ensures a sense of generalizability. It is crucial that the sample is a true reflection of the population of interest, which can be achieved by defining the correct sampling frame and employing a suitable sampling technique (Casteel and Bridier, 2021).

Sampling Strategy:

High-tech industry sector: High-tech industries heavily rely on advanced technologies and digital systems to optimize their supply chain operations. As a result, data sharing plays a critical role in their day-to-day activities, making it an area of high relevance and importance within these industries. By focusing on high-tech companies, the research can explore the unique challenges, opportunities, and best practices related to data sharing in a technologically advanced supply chain setting. Additionally, high-tech industries are known for being at the forefront of innovation and technology adoption (*Trends in the Information Technology sector,* 2019). By examining data-sharing practices within these industries, the research can uncover cutting-edge approaches and emerging trends.

Size of the company: In this study, the operationalization of company size was based on established criteria commonly used in academic research and industry practice. The distinction between large-sized companies and small or medium-sized enterprises (SMEs) is well-established in the literature. Large-sized companies are characterized by their complex and extensive supply chain networks, involving multiple stakeholders, various

departments, and a higher volume of data exchange (Chopra and Meindl, 2019). Furthermore, studies have consistently shown that large-sized companies typically possess dedicated resources, including personnel, technologies, and infrastructure, specifically designed to support data-sharing activities. These resources enable them to engage in more sophisticated data-sharing practices compared to SMEs, which often face resource constraints (Dwivedi and Pawsey, 2023). Moreover, research focusing on large-sized companies provides valuable insights due to their broader applicability and generalizability. While organizational contexts may differ, the challenges and complexities of data sharing in the supply chain domain are prevalent across companies of varying sizes (Cao and Zhang, 2013). By studying large-sized companies, this research aims to extract knowledge and recommendations that can be extrapolated to benefit the entire supply chain domain, including SMEs facing similar issues but on a smaller scale (Fawcett et al., 2007).

Geographical location of the company: Data sharing practices within the supply chain domain can exhibit variation across regions and countries, emphasizing the need to assess the potential impact of the proposed instruments aimed at enhancing data sharing. To focus the research, Europe has been chosen as the specific region for investigation, driven by several compelling reasons like economic significance, comprehensive data protection regulations such as the General Data Protection Regulation (GDPR), and cultural and geographic diversity.

Participant attributes: As mentioned previously, in this study, the sample population encompasses individuals from both the supply chain and data security sectors. This inclusive approach enables a thorough exploration of the research topic without favouring a singular focus on improving data sharing alone. By incorporating data security employees, the study takes into account the essential viewpoint of safeguarding data integrity and confidentiality during intercompany data-sharing practices. Recognizing the significance of data security enhances the overall analysis and ensures a comprehensive understanding of the research topic. In this way, the data collection can be achieved with a high degree of quality. A pictorial representation of the sample selection along with their roles and attributes can be seen in Table 2.1.
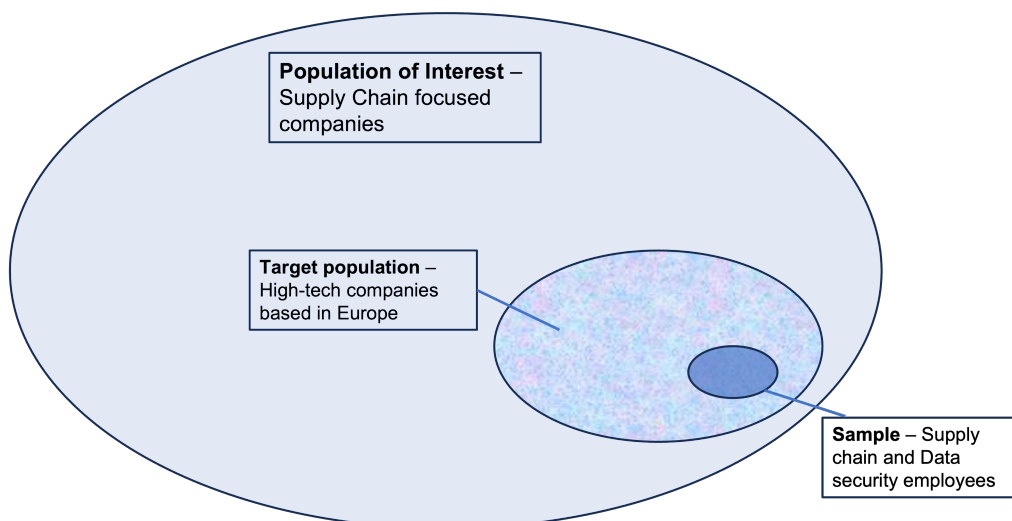
Figure 2.2: Sample selection (inspired by Casteel and Bridier, 2021)

Table 2.1: Participant attributes for Data Collection

Interviewee ID	Domain	Job role
Interviewee 1	Supply Chain	Supply Chain Lead
Interviewee 2	Supply Chain	Head of Global Supply Chain
Interviewee 3	Supply Chain	Customer Demand Planner
Interviewee 4	Supply Chain	Fulfilment Manager
Interviewee 5	Supply Chain	Global Collaboration Manager
Interviewee 6	Supply Chain	Supply Chain Innovation Lead
Interviewee 7	Supply Chain	Supply Chain Deployment Lead
Interviewee 8	Supply Chain	Fulfilment Manager
Interviewee 9	Supply Chain	Global Collaboration Manager
Interviewee 10	Data Security	Head of Enterprise Security Risk Management
Interviewee 11	Data Security	Data Security Domain Lead
Interviewee 12	Supply Chain	Customer Demand Planner
Interviewee 13	Data Security	Security Monitoring Service Delivery Manager
Interviewee 14	Supply Chain	Supply Chain Project Manager (Early Professional)

II. Validation interviewees selection criteria

As mentioned in subsection 2.1.1, the validation phase of the study involves the participation of both researchers and professors. By involving researchers and professors as validators, the study aims to enhance the generalizability of the findings in an academically robust manner while maintaining practical applicability. The participation of researchers and professors as validators brings several benefits to the data collection. Their expertise and knowledge of the subject matter contribute to the credibility and validity of the study. These individuals possess extensive academic backgrounds and a deep understanding of research methodologies, which enables them to critically assess the research methods, data analysis, and overall findings. Their involvement helps ensure that the study adheres to rigorous academic standards and maintains methodological rigour. The detailed description of the validator information can be found in Table 2.2, offering a comprehensive overview of the validators (referred to as interviewees) involved in the study.

Table 2.2: Validator attributes for Data Collection

Interviewee ID	Domain	Role
Interviewee 1	Data sharing	Post doctoral researcher
Interviewee 2	Data marketplaces	PhD researcher
Interviewee 3	Safety and Security Science	PhD researcher
Interviewee 4	Operations research, Supply Chain Management	Associate professor
Interviewee 5	Digital innovation, Supply Chain visibility	PhD researcher

2.3. Data Analysis

During the single case study phase of the research, a meticulous process was undertaken to ensure the confidentiality and anonymity of the participants. After conducting each interview, the transcripts were cleaned (using Atlas.ti), and carefully anonymized, removing any identifiable information that could link the responses to specific individuals. This step was crucial in upholding ethical standards and protecting the privacy of the interviewees.

Subsequently, a thorough thematic analysis was performed *manually* on these anonymized transcripts. The purpose of this manual analysis was because there was no need to code the transcripts since the focus was on the already existing instruments as themes. It is noteworthy that there were also time constraints because of the large data set of 19 interviews each almost an hour long. Running through software and feeding everything to the system would be a more hectic way. Also, learning new software in a short span of time and working with such extensive qualitative data was not possible. Furthermore, the interviewee's perspectives on data sharing, as well as their insights into the future of data sharing, were considered as separate categories during the analysis. This comprehensive approach allowed for a nuanced understanding of the interviewees' perspectives and contributed to the rich qualitative data obtained from the case study.

In the subsequent validation phase, the anonymization process was repeated for the transcripts. It involved a rigorous examination of the anonymized transcripts to identify commonalities, divergences, and potential limitations. This ensured the continued protection of the participants' identities. By subjecting the anonymized transcripts to scrutiny, the aim was to determine the extent to which the insights and conclusions derived from the specific case study could be applied to other similar contexts. This critical analysis allowed for an evaluation of the transferability of the research findings beyond the specific case study. By scrutinizing the generalizability of the perspectives, the research aimed to establish the broader applicability of the insights obtained and contribute to the development of a more comprehensive understanding of the research topic.

2.4. Ethics Approval

Respecting the autonomy and voluntary participation of individuals is an ethical imperative in research. By selecting a sample that is both accessible and willing to participate, the research ensures that participants are engaged willingly and have the opportunity to provide informed consent. This ethical approach promotes trust, respect, and protection of participants' rights throughout the research process.

The research conducted in this study received approval from the Human Research and Ethics Committee (HREC) of TU Delft, ensuring that ethical considerations were addressed. All participants willingly volunteered to take part in the study, demonstrating their informed consent and willingness to contribute to the research. To ensure proper data management, the data steward at TU Delft verified the data management plan for the study. This verification process ensured that appropriate protocols were in place for the handling and storage of data, adhering to data protection and privacy regulations.

The entire research process was conducted online using video calls via MS Teams. This approach provided a convenient and efficient means of communication between the researcher and the participants. Importantly, during data collection, a clear distinction was maintained between the collection of experimental data and personal data. This separation aimed to protect the privacy and confidentiality of the participants, preventing any unintended blending of personal and experimental information. By following these established protocols and leveraging online technology, the research was able to proceed smoothly while upholding ethical standards, ensuring data integrity, and safeguarding the privacy of the participants.

2.5. Conclusion

In conclusion, the research methodology employed in this thesis consisted of a qualitative approach that combined multiple research methods, including a literature review, single-case study interviews, and validation interviews. The literature review provided a comprehensive understanding of the state-of-the-art knowledge on data sharing in supply chains, identified gaps in the current understanding, and categorized the instruments for subsequent research. The single-case study allowed for an in-depth exploration of data-sharing practices in a high-tech company, providing rich and detailed data through semi-structured interviews with participants. The validation phase ensured the generalizability of the findings by obtaining expert opinions from researchers

and professors specialized in data sharing, supply chain, and data security. This methodology enabled the research to contribute to the existing body of knowledge, enhance credibility, and provide valuable insights for further improvement.

The careful selection of the target population and sample was crucial for the validity and generalizability of the study's findings. By focusing on high-tech companies in the European region, the research explored the unique challenges and opportunities related to data sharing in technologically advanced supply chains. The inclusion of participants from both the supply chain and data security sectors ensured a holistic view of the research topic. Additionally, involving validators who are researchers and professors was deemed important because of their current research and up-to-date knowledge in the domain. The thematic analysis of the collected data from interviews and the iterative anonymization process ensured confidentiality and privacy protection for the participants. Overall, this research methodology provided a robust framework for investigating data-sharing practices in supply chains and generating valuable insights.

3

Phase I: Literature Review

Gaining a comprehensive understanding of the outstanding benefits and barriers to data sharing in the supply chain is critical for delving deeper into the research on enhancing data sharing in the supply chain. Following this, once the barriers are identified, they need to be examined to determine their feasibility for mitigation. Concluding the literature review, a base research framework is presented, which examines potential solutions to mitigate the barriers. This chapter ultimately leads to an integrated input that will be presented to the next research phase, i.e., single case study interviews.

3.1. Literature review approach

The primary goal is to investigate the current state-of-the-art of academic research on information sharing in the supply chain. To ensure that all published literature is covered, the systematic literature review process is planned and summarized as shown in the Table 3.1. A systematic literature review approach is preferred because it provides detailed descriptions of search and selection procedures, inclusion and exclusion criteria, and validation techniques for a technical audience. (King et al., 2020).

Criteria	Systematic review
Choosing a research question	Begin with a specific question to be answered or hypothesis to be tested
Looking for relevant research	To reduce the impact of publication and other biases, try to locate all relevant published and unpublished studies
Choosing which studies to include and which to exclude	Include an explicit description of the types of studies that will be included to limit the reviewer's selection bias.
Evaluating the Study's Quality	Examine methods used in primary studies in a systematic manner, as well as potential biases in those studies and sources of heterogeneity between study results.
Putting study findings together	The conclusions are based on the most methodologically sound studies.

Table 3.1: Systematic Review Approach (Armitage and Keeble-Allen, 2008)

To facilitate the search process, I started a deep review of literature focusing on the advantages and challenges associated with data sharing in supply chains. Subsequently, I looked into exploring potential solutions aimed at mitigating the barriers identified in the earlier search. While conducting this search, I specifically examined the lens of technology, governance, privacy, and trust, among other factors, as these were identified as prominent barriers that could potentially be mitigated. I continued my search for potential solutions until

reaching a saturation point, wherein the identified solutions began to become repetitive. Among the range of available solutions, I carefully selected a few that aligned with the barriers I had identified. I would say that this approach allowed me to address my initial three sub-research questions effectively. Table 3.2 shows the keywords used up until identifying the solutions as a whole.

Search Term	Synonyms	Relevance
Data Sharing	Data collaboration, information sharing	To understand the concept of data sharing
Supply chain	SCM, logistics, logistics management	To understand the working of a supply chain
Supply chain performance factors	SC productivity, SC Key performance indicators	Trends/ performance indicators that enhance the overall supply chain performance
Relation between data sharing and supply chain performance	Role of data sharing in the supply chain, data sharing in SCM	To understand the positive/negative or neutral effect of data sharing on supply chain
Pros and Cons of data sharing in supply chain	Strengths and weaknesses, advantages and disadvantages, costs and benefits	To compare the pros and cons of data sharing in SC
Institutional and infrastructural arrangements in open data sharing	Factors influencing data sharing	To understand the implication of Institutional and infrastructural arrangements in data sharing
Solutions to enhanced data sharing in supply chains	Approaches, Techniques, Measures, Strategies	To form a base knowledge of various instruments that can aid to enhanced data sharing

Table 3.2: Search Description and relevance

The identified solutions (instruments) as mentioned above were specifically selected using the following keywords in databases like Google Scholar, and sometimes google itself: Role of (Information and Communication Technology *OR* Blockchain *OR* Artificial intelligence *OR* Machine Learning *OR* Data standardization *OR* Data Interoperability *OR* Data Security Measures *OR* Cultural factors and attitudes of employees *OR* Trust (Information and Communication Technology *OR* Contractual agreements *OR* Data governance policies *OR* Education and training programs *OR* Leadership, Senior Management *OR* Ethical and responsible data sharing) AND in supply chain data sharing. I followed inclusion and exclusion criteria while selecting the sources, as seen in Table 3.3.

While there were many relevant results in the course of understanding the instruments, some of them like cultural factors in data sharing, the role of leadership in data sharing, ethical data sharing, and the influence of education and training programs did not have many papers specifically in the field of supply chain. I took the liberty to extrapolate and view these perspectives from a supply chain view as well. The reason behind including them was the fact that their influence would be double-tested in two phases after this literature review and will also contribute to the existing literature, specifically in the supply chain domain.

Criteria	Inclusion	Exclusion
Paper Publication Date	Papers published after the year 2000	Papers published before the year 2000 (with an exception of formal definitions stated in the original research that might date back to previous times)
Language	English	Other languages
Type of publication	Scientific articles with published results, peer reviewed scientific journals	Websites, news articles, blogs
Setting/ Study design	Papers with case studies, surveys, focus groups and interviews	Papers with sheer observation

Table 3.3: Inclusion and Exclusion criterion

3.2. Benefits of data sharing

Many researchers believe that making un-distorted and up-to-date data available at every node in the supply chain is the key to achieving a seamless supply chain (Childerhouse and Towill, 2003). By taking available data and sharing it with other parties in the supply chain, an organization can improve the efficiency and effectiveness of the supply chain, as well as respond to changing customer needs more quickly. As a result, data sharing will provide the organization with a long-term competitive advantage (Li and Lin, 2006). Furthermore, there is adequate research to back up the idea that data sharing is at the heart of supply chain collaboration. This implies that more emphasis should be placed on data sharing which can be attained by a supply chain partnership. This affiliation can potentially be formed by increasing data sharing levels in order to reduce total costs and inventories (Min et al., 2005). Effective data sharing is heavily reliant on trust, which begins within the company and eventually extends to supply chain partners. The benefits of data sharing are only realized once trust is established. Following that, firms tend to become more to share sensitive data on costs, product development plans, and promotional schedules. An excellent example to support this reasoning is the automotive industry. Several automotive firms appoint tier-one lead suppliers, who then coordinate and sequence the work of secondary suppliers with optimum trust. This supply chain strategy has proven to reduce the cost and time required for automobile assembly significantly (Bowersox et al., 2000).

Enterprises may benefit from data sharing in a supply chain in a variety of ways. For example, the products more closely match consumer demand, and market changes may be anticipated. The widespread use of advanced data technologies in supply chains, such as Electronic Data Interchange (EDI) and Web technologies, demonstrates that organizations have come to recognize the value of data integration (Lotfi et al., 2013). It is actually interesting that many supply-chain issues arise as a result of a lack of data sharing among supply-chain members (Jingquan Li et al., 2001).

Collaboration among independent but related firms can share resources and capabilities to meet the most extraordinary needs of their customers. This is only possible through the sharing of resources and data. Also, timely demand data or advanced commitments from downstream customers assist in lowering inventory costs by offering price discounts, and this data can be used to replace lead time and inventory (Reddy and Rajendran, 2005). Inventory reductions and cost savings result from data-sharing policies (Yu et al., 2001). Cachon and Fisher (2000) presented a simulation-based comparative study that found that with a full data-sharing policy, SC costs are 2.2% lower on average than with traditional data policy, with a maximum difference of 12.1%. This also results in faster and less expensive order processing, which leads to shorter lead times.

Aside from cost savings, data sharing in a supply chain can benefit a variety of other factors as well. For exam-

ple, the flow of product capability data may aid in the deceleration of potential shortages of gaming behaviour and the avoidance of potential causes of the *bullwhip effect* (The bullwhip effect describes the phenomenon of increasing order variability as orders move upstream in the supply chain (Lee et al., 1997)). When manufacturers receive real demand from retailers, they can share data about new products to ensure a timely supply of goods from suppliers. All of this can lead to a more efficient supply chain. Members of a supply chain may have perfect data about themselves but may not have such perfect data about the other members. As a result of the lack of data exchange between the parties, uncertainties may arise. These uncertainties can be significantly reduced if members have the ability and willingness to share data with other members (Min et al., 2005). Additionally, sharing data on performance metrics such as lead times, quality specifications, return status, and so on assists supply chain partners in identifying and overcoming supply chain bottlenecks.

To summarize, a wide range of benefits were discovered during the course of this literature review, as shown in the table along with the references. This provides solid support for the notion that data sharing is critical in supply chain businesses.

Table 3.4: Overview of the benefits of business data sharing (Lotfi et al., 2013)

Benefits	Source
Inventory reduction, cost reduction and efficient inventory management	(Mourtzis, 2011)
Significant reduction or complete elimination of bullwhip effect	(Yu et al., 2001)
Improved resource utilization	(Mourtzis, 2011)
Increased productivity, Organizational efficiency and improved services	(Yang and Maxwell, 2011)
Early problem detection and Quick response	(Lee and Whang, 2004), (Jauhari, 2009)
Building and strengthening social bonds	(Bagchi and Skjøtt-Larsen, 2004)
Better tracing and tracking	(Bagchi and Skjøtt-Larsen, 2004)
Earlier time to market	(Lee and Whang, 2004)
Expanded network	(Lee and Whang, 2004)
Optimized capacity utilization	(Lee and Whang, 2004)

3.3. Barriers to data sharing

Given the preceding section, it is difficult to understand why organizations do not consistently choose collaborative efforts if collaboration and data sharing are considered the superior approach. Sharing data within a supply chain may present some difficulties. Concerns about data privacy may be one of the most significant barriers to interpersonal data sharing. Another challenge is the willingness of supply chain actors to share data and data with other supply chain actors. Studies on the unwillingness to share have found concerns about confidentiality (Li and Zhang, 2008), reliability (Lu et al., 2021), competition (Ha and science, 2008), and a lack of trust (Tran et al., 2016). This lack of trust is often caused due to data asymmetry which is frequently associated with opportunism. In this case, data is not fully shared among collaborative partners, leaving room for dishonesty between partners (Wan et al., 2020). As per losing competitive advantage, independent firms within a supply chain may be hesitant to share data or disclose their suppliers to each other, as it can potentially compromise their interests (Kumar and Pugazhendhi, 2012). This can further result in information hoarding and inefficiencies within the supply chain when one partner possesses exclusive information that others lack (Bilginoğlu, 2019). Moreover, concerns about jeopardizing competitive advantage or facing

criticism have led companies and suppliers to be cautious about sharing excessive information (Li, 2002). However, the absence of collaborative platforms and data-sharing mechanisms between private and public entities has significantly impeded achieving comprehensive visibility across the entire supply chain (Iakovou and III, 2022).

Another major factor is the reliability and cost of data technology and finally the development of capabilities that allow companies to effectively use the shared data (Zhao et al., 2002). A non-user-friendly and inefficient system would have a negative impact on data sharing, resulting in less data and knowledge being shared (Yang and Maxwell, 2011). Moreover, learning to use IT systems for individuals in a supply chain has been shown to take time and effort (Goodman and Darr, 1998). Other studies have investigated capability challenges to data sharing and report on a lack of know-how (Fan et al., 2017), a lack of a standardised data-sharing methodology, and security concerns about the sharing platform (Barkataki and Zeineddine, 2015). Despite research demonstrating how strategic data sharing involving the entire supply chain maximizes profitability for all (Zhou et al., 2017), the willingness of supply chain actors to share is frequently overlooked in data-sharing literature, with studies focusing more on capability or connectivity (Hannibal et al., 2022).

End-to-end visibility in multi-tier global supply chains can be difficult to achieve, and the impact of COVID-19 highlighted the need for increased supply chain resilience. Such resilience can be attained by utilizing real-time data (Nakasumi, 2017). By providing intelligence on sources of supply, work in progress (WIP), and distribution channels, real-time data improves visibility across multi-tier supply networks (Oliveira and Handfield, 2019). This data can then be used to identify alternative sources of supply and distribution. Accessing real-time data and improving end-to-end supply chain transparency go hand in hand (Hannibal et al., 2022). However, getting real-time data can be challenging. Not all firms in a supply network respond to supplier assurance requests in a timely manner, and they are frequently unable to meet data requests (Adobor, 2019). There is also a requirement for data-sharing standards. There appear to be countless mechanisms for presenting and sharing data in global multi-tier supply chains, which can present challenges for those sharing and receiving the data. One option is for all suppliers in a multi-tier supply chain to use interconnected software systems that share data in real time. Nevertheless, because firms in a multi-tier chain will have varying levels of financial resources and capability, achieving interconnectivity via software can be expensive (Hannibal et al., 2022). Another challenge in sharing data across supply networks is the possibility of data misinterpretation, especially when a high degree of accuracy is required (Zaheer and Trkman, 2017). Because not all supply chain actors may have information systems in place, they are limited in their ability to provide seamless connectivity (Wang-Mlynek and Foerstl, 2020).

3.4. Feasible and infeasible areas of data sharing - Author's reflection

Based on the insights gathered from the literature review, barriers to data sharing in the supply chain can be classified into several categories, namely trust, privacy concerns, competitive factors, governance-related factors, and technological factors. Among these, the competitive factors present numerous complexities and involve extensive internal and external negotiations and stakeholder meetings, making them challenging to address within the scope of this thesis (as discussed in section 3.3). Therefore, for the purpose of this study, competition-related barriers will be considered infeasible to mitigate.

However, focusing on the barriers that are deemed feasible to address, I have devised a framework which I like to call a ***Barrier Quadrant*** specifically tailored to data sharing in the supply chain, as illustrated in Figure 3.1. This framework encompasses barriers related to trust, privacy, technology, and governance support, which will serve as the primary focus for further investigation and mitigation strategies.

Now that the mitigable barriers are discussed, further literature review will try to look understand the potential solutions to mitigate these barriers in terms of instruments. These instruments could be infrastructural and

institutional arrangements can be implemented as mentioned in section 1.2
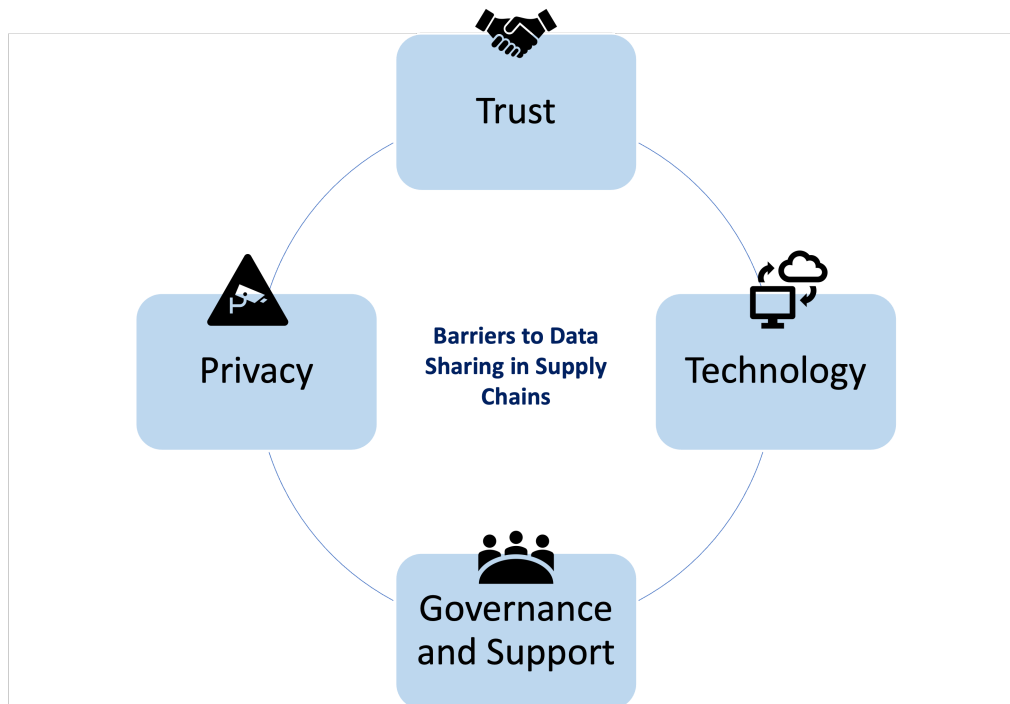
Figure 3.1: Barrier Quadrant

3.5. Base research framework: Instruments formulation from literature

3.5.1. Infrastructural instruments

1. **Emerging technologies like Information and Communication Technology (ICT) and Blockchain**

   The use of ICT has made it possible for various organizations within the supply chain to communicate and share data quickly and accurately. As a result, organizations are able to meet customer demands promptly and meet the expected customer service standards. To maintain a competitive edge, organizations are now expected to integrate ICT advancements into their daily operations (Apiyo and Kiarie, 2018). When dealing with intricate supply chain setups, ICT is believed to assist in decision-making regarding product specifications, scheduling, and material and capacity availability. Data sharing can be aided by the advancements in ICT, as they enable real-time sharing of data due to improved processing capabilities (Welker et al., 2008). Figure 3.2 from the work of Welker et al. (2008) shows an in-depth use of ICT in data sharing in supply chains. Achieving supply chain integration is often seen as contingent upon the use of ICT, as stated by Narasimhan and logistics (2001)
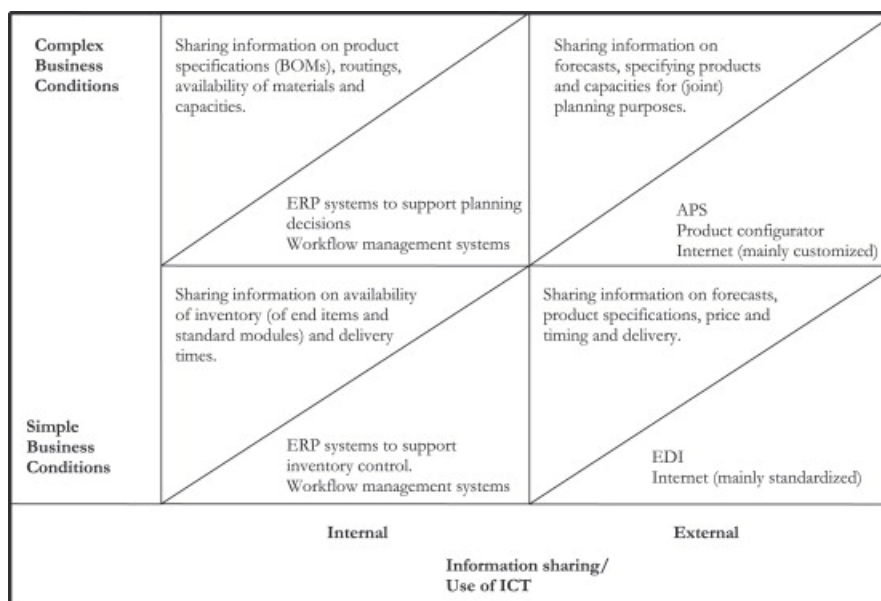
Figure 3.2: Implementation of ICT in data sharing in supply chain (Welker et al., 2008)

Even though ICT have led to a decrease in data asymmetry and greater collaboration between organizations, companies involved in a supply chain are hesitant to share sensitive data when they cannot completely trust their partners. Establishing trust within the supply chain using conventional ICT can be a costly and time-consuming process (Longo et al., 2019) with certain challenges. The primary obstacle involves the risk of divulging confidential data (Wang et al., 2021). Another issue concerns the equitable allocation of benefits derived from shared data to the providers (Shih et al., 2015). There is also a problem of distrust and disagreement among those involved in data sharing regarding the value and quality of the data being shared. In some cases, providers may even intentionally share misleading data, further exacerbating the challenges. To address these issues, a blockchain-based system could be implemented to establish a transparent, trustworthy, and equitable data-sharing protocol within a supply chain (Wang et al., 2021). Despite the potential economic and operational advantages, many supply chain companies lack familiarity with blockchain technology due to its novelty and limited usage and case studies (Longo et al., 2019).

Before delving deep, it is crucial to comprehend the significance and function of Blockchain. This technology utilizes methods such as cryptography and smart contracts to ensure that data and processes within data exchange are transparent and unchangeable (Banerjee et al., 2023). To maintain the safety and privacy of shared data, a reliable third-party platform is required, particularly when data buyers and sellers must come to a mutual agreement regarding data usage and worth. Blockchain's digital ledgers that are immutable make it possible to verify transactions throughout a peer-to-peer network, achieving key objectives such as security, transparency (audibility), low transaction cost, and automation (usually by using smart contracts). This technology is introducing novel ways for businesses to validate, store, and access data in a distributed ledger instead of in a centralized legacy system. Furthermore, blockchain has impacted and transformed the supply chain industry by allowing for trustless integration of capital, material, and data flow, thus allowing for the restructuring of business ecosystems (Wang et al., 2021).

However, as stated previously, many companies in the supply chain industry are not well-versed in blockchain technology. The reason for the challenges faced by blockchain in SCM could be attributed to the fact that the technology is still in its early stages of development and implementation, and needs more use cases. In order to ensure a high level of security, several obstacles must be overcome (Longo et al., 2019). In addition, the use of intermediaries in blockchain-based SCM can result in less transparent data, leading to increased costs and reduced performance. Therefore, it is clear that a robust infrastructure is

required for successful SCM, with blockchain providing potential optimization solutions. It's important to pinpoint the particular scenarios that necessitate the integration of blockchain technology to avoid squandering resources on unnecessary projects (Abidi et al., 2021).

2. **Advanced technologies like Artificial Intelligence (AI) and Machine Learning (ML)**

According to Butler Business Continuity Emergency (2018), resilient organizations should leverage technological advancements such as automation, AI, and ML to foster cooperation and collaboration both internally and externally, across vertical and horizontal levels. The utilization of AI-driven innovation can play a crucial role in designing resilient supply chains by facilitating data sharing, processing, and system integration, which have long been considered vital factors in improving supply chain performance and building resilience.

Supply chains that incorporate automation capabilities are sometimes referred to as smart supply chains, which rely on intelligent agents as their foundation (Xu et al., 2021). AI and ML have been utilized at various stages within supply chains, and their use can be broadly classified into three categories: gaining a competitive advantage, adding value to the supply chain, and addressing operational problems through these methods such as bullwhip effect reduction, inventory optimization, and scheduling problems (Younis et al., 2022). These algorithms are especially suitable for anticipating and predicting future system behaviour based on data events. These predictions, which are also known as training data inferences, are made with the goal of dealing with incoming events that have not yet been seen (Khan et al., 2012).

Companies that utilize AI-based data processing, including self-adaptive algorithms, prediction, and learning techniques, can improve their adaptive abilities and enhance their predictive and forecasting capabilities (Baryannis et al., 2018). They can also foster collaboration with partners by sharing real-time inventory and production capacity forecasts and notifying them of potential risks. This enables them to quickly adjust their strategies during disruptive events and collaborate with suppliers and customers through AI-driven, shared decision-making (Dubey et al., 2020). In addition, AI-powered supply chain intelligence enables companies to recover quickly after disruptions by utilizing adaptive algorithms and AI-enabled collaboration among supply chain partners (Belhadi et al., 2021).

Despite the considerable benefits of implementing AI and ML in supply chain operations, there exist significant challenges that need to be addressed. These challenges encompass a range of issues, including high implementation costs, data standardization problems, insufficient data security measures, inadequate training, and a lack of innovation, as noted in the research of Nayal et al. (2021). Therefore, it is essential to comprehend these challenges as potential factors (which will be seen in the coming sections) and assess their impact on the sharing of supply chain data. Overcoming these factors is crucial, as implementing AI and ML in supply chains can be viewed as icing on the cake once these fundamental challenges are addressed.

3. **Data Standardization and Interoperability between firms**

Interoperability is a term used in the literature to describe the concept of data-driven inter-organizational transparency. It encompasses an organization's ability to interact effectively with others towards mutually beneficial goals, involving the exchange of data and knowledge through data exchange facilitated by their ICT systems (Khan et al., 2012). To fully realize the potential of emerging technologies in supply chain practices, data must meet human and machine findability, accessibility, and interoperability standards (Kaviani et al., 2023), all of which could be achieved by standardizing the data formats.

Within the realm of interoperability, two closely related terms and concepts are data standardization and interoperability. Data standardization is achieved through technical and semantic interoperability. Technical interoperability refers to the capability of different IT systems to exchange and accept data without the need for additional mediation. This means that systems can communicate and share data seamlessly (Corcho et al., 2021). On the other hand, semantic interoperability refers to the ability to

transmit and receive data with a shared, unambiguous understanding. It ensures that the receiving system can interpret the data even if it is unfamiliar with the algorithms used by the transmitting system (Org et al., 2020).

Standardized data-sharing capabilities offer the potential for a long-term digital ecosystem governed by external agencies. This has prompted numerous international organizations to collaborate on developing standardized frameworks for interoperability. By achieving data visibility while maintaining organizational sovereignty, these frameworks aim to enhance data exchange and promote cooperation (Khan et al., 2012). One such initiative is Project GAIA-X, which focuses on data sharing and standardization across various sectors. GAIA-X emphasizes the importance of high-level interoperability, both in terms of technical and semantic standards, making IT network management more efficient. Additionally, the availability of shared data spaces can contribute to preventing lockouts during emergencies (Braud et al., 2021).

However, it should be noted that there may be some barriers to implementing standardized data formats to improve data sharing. According to Smith et al. (2012) research survey, one of the most frequently identified barriers to effective SCM are insufficient resources and outdated information technology. Also, key challenges have frequently been identified as a lack of capital and personnel. Concerns have also been raised about their data systems' incompatibility with universal data standards. According to the survey, many supply chain professionals believe that upgrading these systems would be costly and disruptive to daily operations. As a result, the perceived high cost and potential disruptions discouraged organizations from pursuing system upgrades, exacerbating SCM challenges. Much research is being done to find ways to mitigate these barriers because ultimately, the implementation of data standardization and interoperability would foster data sovereignty, addressing common trust issues among participating entities (Khan et al., 2012). By establishing a reliable and transparent data exchange framework, organizations can build trust, strengthen collaboration, and unlock the full potential of data-driven interactions.

4. **Data security measures like Encryption and Access controls**

Digital technologies have significantly transformed supply chains by enhancing information exchange, agility, and visibility, as highlighted by Miorandi et al. (2012). However, this digitalization has led to the integration of SCs among organizations through digital communication links. While this integration brings about a collective strength, where all members of the SC benefit from shared information and security arrangements, it also introduces new vulnerabilities. The primary threats in digital supply chains revolve around unauthorized disclosure and data leakage of shared information (Pandey et al., 2020).

The nature of the information exchanged within SCs is diverse, ranging from commercial information shared with advisors and lawyers to personally identifiable information about customers and employees, and intellectual property shared with suppliers. If such information is compromised, it can be distributed to other organizations, making it difficult to track its access and usage (Bhargava et al., 2013). This puts smaller organizations within SCs at a higher risk, as they are frequently targeted for cyber-attacks due to their relatively smaller size. Consequently, larger companies that have contracts with these small organizations to produce niche products are also exposed to specific risks. In this scenario, attackers only need to exploit the weakest link in the chain, while larger organizations must protect a wide range of technologies (Pandey et al., 2020).

Given these challenges, effective management and mitigation of risks in digital SCs become crucial. Various cyber-attacks on supply chains worldwide have compromised SCM functions. Criminal activities in SCs often involve stealing, accessing, and manipulating electronically exchanged information. To improve information security, firms can implement security management activities such as encryption and coding of information, regular backup of commercial data, and protection of business information from unauthorized access (Pandey et al., 2020). Many security incidents and breaches occur due to

serious breaches of access controls during information sharing, which can cause the sharing system to malfunction and disrupt operations. To ensure data security and privacy in supply chain data exchange, it is essential to restrict access to shared data between companies to specific users with appropriate permissions. Access control models, such as incorporating an access control model into the smart contract in the blockchain, can facilitate safe and efficient access to shared data (Jiatao Li et al., 2023).

It can be derived from the literature that managing and mitigating breaches in digital SCs requires a proactive and comprehensive approach. Organizations must invest in robust security measures, such as state-of-the-art security technologies, secure data storage and transmission mechanisms, and conduct regular audits and assessments to identify vulnerabilities promptly. Additionally, stringent protocols should be established to safeguard digital communication links and information exchange processes.

3.5.2. Institutional instruments
1. **Cultural: Attitude and personal perspectives of employees**

Culture plays a significant role in shaping the behaviour and practices of organizations, particularly in terms of data sharing with suppliers. The concept of culture refers to the shared values and beliefs held by a specific group of people. It helps to explain why some organizations in a particular country are more inclined to share data with suppliers compared to others (Shore, 2014). Cultural differences, which have become more pronounced in the era of globalization, can influence how work is conducted and how data is collected, processed, interpreted, and reported. In the context of supply chain relationships, there are two distinct types: short-term and long-term relationships. Short-term relationships are characterized by frequent rebidding, low levels of data sharing, limited relationship-specific investments, and low levels of trust. On the other hand, long-term relationships, often referred to as the 'partnership model,' involve less frequent rebidding, high levels of data sharing, substantial relationship-specific investments, and high levels of trust. These disparities arise due to the different individual perspectives on data sharing held by various actors within the supply chain (Shore and Venkatachalam, 2003).

The impact of data sharing on employees' professional lives necessitates their proper orientation toward impending changes. To ensure the successful adoption of new ways of functioning, employees must be persuaded to embrace change, be optimistic about the outcomes, and be committed to contributing to the change process. Readiness, openness, and commitment to change are crucial aspects in this regard. Openness to change is associated with the belief that forthcoming changes will bring benefits, resulting in support for the change (Bouckenooghe, 2010). Furthermore, power dynamics and justice within supply chain relationships significantly influence members' attitudes and behaviours toward one another. More powerful members tend to accumulate social credit of indebtedness, which enables them to exert influence and compliance within the relationships. Members' perceptions of justice demonstrated by the more powerful actors stimulate their exchange behaviours. Therefore, two major factors, power and justice, shape the dynamics of data exchange within supply chain relationships (Wu et al., 2014).

Chaudhry (2018) provides valuable insights into individual factors related to employees' attitudes. This can be further directed towards data sharing in the supply chain as follows: The identification of employees with the organization emerges as a central determinant of their data-sharing behaviour. When employees strongly identify with the organization, they are more likely to engage in data-sharing practices aligned with the organization's objectives and values. Trust in colleagues and leaders also plays a crucial role; when employees trust that sensitive data will be handled appropriately and used for the collective benefit of the supply chain, they are more willing to share such data. Additionally, employees' locus of control, specifically having an internal locus of control, influences their proactive engagement in data-sharing practices. Individuals with an internal locus of control believe they have control over their actions and outcomes, which leads to a greater willingness to share data. Finally, employees' satisfaction with HR practices, including training and development opportunities related to data sharing, can have an impact on their willingness to share data within the supply chain.

2. **Role of trust and trust-building techniques**

The concept of trust in business relationships revolves around a firm's expectation that its partners will act in a manner that benefits its interests, regardless of the ability to monitor or control those partners (Wu et al., 2014). In relationships characterized by high levels of trust, partners are willing to share all data openly and have confidence in the data received, leading to proactive contributions and actions (Kwon and Suh, 2005). Trust serves as a catalyst for strategic business interactions and facilitates the sharing of data among independent firms (Chen et al., 2014). It plays a pivotal role in fostering an improved working environment for partner firms within a supply chain. By instilling trust, several advantages arise, such as enhancing the dependability of contracts, promoting cooperative behaviour, and mitigating risks and uncertainties (Wu et al., 2014).

A considerable body of experimental and field research has extensively explored the impact of trust on business relationships. In negotiations, trust between parties plays a significant role in enabling data sharing, reducing uncertainty, and fostering cooperation. Similarly, within organizations, trust has been shown to promote employee cooperation. Some studies even suggest that trust can serve as a substitute for legally binding contracts, although further investigation is needed to confirm these findings (Ebrahim-Khanjari et al., 2011).

Similar to personal relationships, successful and enduring business relationships rely on a significant level of mutual trust and trustworthiness. An illustrative example of this is the vendor-managed inventory (VMI) initiative implemented by Wal-Mart and Procter Gamble, which thrived due to the remarkable trust existing between the two companies, facilitating the exchange of timely and credible data (Özer and Zheng, 2017). Recent comprehensive research analyzing numerous supply chain projects involving multinational firms across diverse industries, including VMI, EDI, Collaborative Planning, Forecasting and Replenishment (CPFR), and Radio Frequency Identification (RFID) projects, affirms that the triumph of such endeavours hinges on the degree of trust established between the participating parties (Brinkhoff et al., 2014). Moreover, scholarly literature suggests that distinctive national cultures, institutional environments, and recent societal shifts may contribute to the challenges associated with spontaneous trust formation within a country (Özer et al., 2014). Notably, countries and regions characterized by higher levels of overall trust and trustworthiness experience reduced friction in business transactions and enjoy more prosperous economic growth (Özer and Zheng, 2017). Further, as seen in Figure 3.3, Özer and Zheng (2017) proposes four building blocks of trust and trustworthiness, namely personal values and norms, market environment, business infrastructure, and business process design. These building blocks form the foundation for establishing trust between supply chain partners.
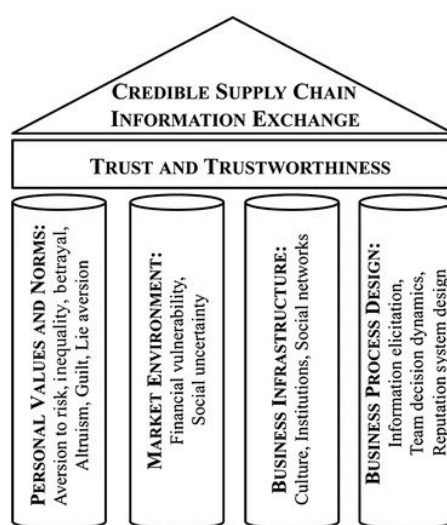

Figure 3.3: Building blocks of trust in supply chain data sharing (Özer and Zheng, 2017)

Kwon and Suh (2005) investigation of supply chain relationships emphasizes trust as a crucial factor in fostering commitment. They argue that commitment is essential for successful relationships, and trust serves as the underlying mechanism for nurturing commitment. Building trust is a vital element within social exchange processes, evolving over time as actors sequentially and mutually demonstrate their trustworthiness (Wu et al., 2014). However, human decision-makers, including supply chain managers, may be influenced by various behavioural motives that can either facilitate or hinder data sharing. Given the moral costs associated with deceiving and exploiting others, there is an inherent inclination among human decision-makers to be trustworthy and trusting in their data exchange (Erat and Science, 2012).

Despite the multitude of benefits associated with trust and its role in relationship-building, inherent risks are involved. Özer and Zheng (2017) proposes that trust involves accepting risks or vulnerabilities across three distinct dimensions: the risk of being worse off than not trusting, the risk of being worse off than the trusted party, and the risk of being betrayed by the trusted party. Consequently, companies must thoughtfully consider how to establish trust with their supply chain partners, taking into account the multifaceted nature of trust and the potential risks it entails.

3. **Contractual agreements or Data governance policies**

Optimal supply chain performance necessitates the implementation of a specific set of actions. However, these actions often conflict with the individual objectives of supply chain members, leading to sub-par performance (Cachon, 2003). To overcome this challenge, effective management of relationships among supply chain actors and the selection of appropriate governance structures are crucial (Denolf et al., 2015). A governance structure refers to the coordination mechanisms and safeguards that incentivize interaction and protect parties against opportunistic behaviour (Nicolaou, 2008). By coordinating through contracts and transfer payments, firms can align their objectives with those of the entire supply chain, ultimately achieving optimal performance (Cachon, 2003).

Previous research has identified various factors that influence the willingness of supply chain partners to share data. These factors include environmental and technological uncertainty, intra-organizational facilitators such as top management support, and inter-organizational relationships characterized by trust, shared vision, and connectivity (Fawcett et al., 2007). However, the governance of data, which encompasses smart contracts, cryptography, public and private keys, distributed ledgers, and consensus validation, can also influence the willingness to share data (Dahlberg and Nokkala, 2020). If we dig deeper, Raynaud et al. (2005) and Denolf et al. (2015)) have identified five governance structures as seen in Figure 3.4: spot market (rely on price mechanisms and tend to have a short-term orientation), verbal agreement, formal contract, equity-based contracts, and vertical integration (one actor possesses ownership of various stages within the supply chain) —that facilitate data sharing among supply chain partners.
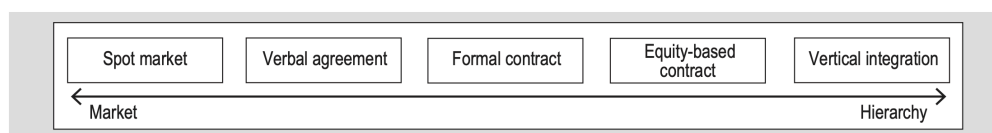
Figure 3.4: Governance structures in supply chain data sharing (Özer and Zheng, 2017, Denolf et al., 2015)

Data-sharing agreements (DSAs) share similarities with general agreements, encompassing descriptions of involved parties, availability constraints, and temporal constraints. DSAs also entail obligations incurred by parties in return for benefits, such as monetary payment, non-compete agreements, or providing proprietary data to competitors. However, the primary purpose of DSAs is to capture data-sharing clauses, including descriptions of shared data and the obligations constraining data providers and consumers (Swarup et al., 2006). In addition, agreed-upon document contents also outline data protection

and privacy considerations, forming the foundation for collaborative, automated data exchange within supply chain partner companies (Dahlberg and Nokkala, 2020).

The *double marginal effect* is a well-known phenomenon in SCM that hampers efficiency and effectiveness. It refers to the situation where the total profit of a supply chain under decentralized decision-making is lower than that under centralized decision-making. To mitigate this effect, supply chain members must enter into contracts that ensure cooperation and coordination in their decision-making processes (Zhang and Chen, 2013). Another crucial concept in SCM is the *spillover effect* of data sharing. This effect arises when outsiders gain valuable data from insiders, either directly through breaches of shared data confidentiality or indirectly by observing insiders' actions. While contracts can address the former type of data leakage, preventing the latter is challenging as shared data may influence insider behaviour observable to outsiders (Chen, 2003). Thus, contracts and agreements serve as the foundation for business data sharing, to some extent.

4. **Education and training programs**

Information technology has often been hailed as the solution to the various challenges faced by supply chain managers. While it is true that the integration of information technology is crucial for a successful supply chain, it is equally important to recognize the significance of people within the organizations (McCarter et al., 2005). People constitute the backbone of these organizations, and it is imperative for them to comprehend the impact and influence of data sharing in the supply chain.

To achieve this understanding, education and training programs play a vital role. Both researchers and practitioners acknowledge the strategic value of learning in the SCM systems and proclaimed that it improves SC management (Huo, Zia, et al., 2020). Supply chain learning refers to the process through which the focal firm acquires, assimilates, and leverages knowledge from its internal functions, as well as its major suppliers and customers (Huo, Haq, et al., 2020). Considering its significance in enhancing competitiveness, firms prioritize data sharing to learn from their supply chain partners.

In recent times, scholars have shown substantial interest in evaluating the value of data sharing in SCM (Kakhki and Production Research, 2019). The importance of this type of data sharing can be effectively conveyed through various education and training programs. McCarter et al., 2005 emphasizes that educational courses can improve training by enhancing collaboration between supply chain partners. Such courses help identify new challenges that require specific competencies within the supply chain. By empowering supply chain managers to share data, develop relationships, cooperate, and utilize collaborative skills with suppliers and internal/external customers, these educational programs foster effective collaboration.

Moreover, (Badea et al., 2015) proposes a model that advocates for education and training programs to support staff in acquiring essential skills for addressing risk factors that may disrupt collaboration within the supply chain. Such training is crucial because individuals often resist change, particularly when it involves relinquishing control, exposing weaknesses or sensitive data, and altering mindsets. Therefore, employee training programs play a pivotal role in facilitating better supply chain collaboration between firms. Ultimately, it is essential to recognize that people cannot be compelled to change; rather, they must be engaged and enrolled in the process. By generating buy-in and allowing their passions to manifest, individuals become active participants in driving the success of the supply chain. Therefore, education and training programs are integral in fostering an environment where people understand the value of data sharing and are motivated to contribute to the overall success of the supply chain (Badea et al., 2015).

5. **Leadership and senior management**

The effective utilization of the supply chain's workforce and their enthusiasm towards supply chain initiatives is hindered by the lack of an appropriate organizational culture. To address this issue, senior management holds the responsibility of creating a work environment that not only encourages participation but also highly values it. This environment empowers employees to experiment, take risks, and

solve problems while fostering a culture of constant, lifelong learning and knowledge sharing (McCarter et al., 2005).

Research conducted by Youn et al. (2012) has introduced the concept of integrative leadership, involving three key senior leadership roles: Chief Executive Officer (CEO), Chief Information Officer (CIO), and Supply Chain Officer (SCO). Integrative leadership plays a vital role in the successful implementation of supply chain data sharing. Additionally, it influences operational-level data sharing. Effective CEOs, CIOs, and SCOs demonstrate concern for both operational details and the larger strategic picture. Through the collective support of integrative leadership, an organization will share operational-level details with other supply chain partners. This approach encourages, supports, and facilitates data sharing at the operational level, enabling the achievement of practical operational goals.

Top management emphasizes the significance of being aware of what others are doing to streamline supply chain operations. Internally, regular top management meetings, efficient IT systems, and cross-functional teamwork are considered crucial for facilitating this knowledge exchange. Externally, maintaining close contact and sharing data with manufacturers and distributors, such as participation in trade fairs, are vital aspects. The responsibility for managing the flow of goods from suppliers through the company to customers is not assigned to a single individual but shared among several members of the top management team. Consequently, top management is required to communicate and interact with logistics issues, making logistics an integral part of their agenda during activities like top management meetings and strategy planning (Sandberg and Abrahamsson, 2010).

6. **Ethical and responsible data sharing**

   While there is limited existing literature specifically addressing ethical and responsible data sharing in the context of supply chains, it is crucial to recognize the significance of this topic. Although the Europe Union (EU) GDPR has been implemented, guidelines for governing responsible data sharing, particularly concerning health data, remain underdeveloped (Kalkman et al., 2019). Therefore, it becomes even more essential to address how data sharing can be conducted in an ethical and responsible manner when it involves healthcare and medical supply chains.

   In terms of ethical data sharing, Parker (2015) proposed three perspectives to consider. Firstly, different approaches to data sharing can yield varying benefits and harms. Secondly, ethical considerations may extend beyond the consequences alone, as certain types of data sharing could be deemed wrong for reasons unrelated to its potential scientific benefits. Lastly, establishing professional standards of conduct for individuals and organizations involved in data sharing, whether in data collection, data management, or data sharing itself, is necessary. Such standards ensure that ethical principles are upheld throughout the entire data-sharing process.

   Ethical data-sharing practices foster transparency, which plays a vital role in building trust among stakeholders. When data is shared ethically, stakeholders can observe how the data is being utilized, who has access to it, and for what purposes it is being used (*United Nations World Data Forum,* 2020). This transparency helps establish a sense of trust among all parties involved. Moreover, the literature emphasizes that ethical data sharing contributes to improved decision-making. Access to a broader range of data empowers stakeholders to make more informed decisions, ultimately leading to favourable outcomes for everyone concerned ("Good Practice Principles for Data Ethics in the Public Sector Acknowledgements," 2020).

3.6. Conclusion

In this chapter, I extensively focused on understanding the state-of-the-art literature on almost everything related to data sharing in the supply chain domain. A comprehensive understanding of the outstanding benefits and barriers to data sharing in the supply chain was deemed critical for delving deeper into the research on enhancing data sharing. This has effectively answered the first sub-research question of *What are the benefits and barriers of data sharing in the supply chain?* mentioned in section 1.3. Following this, once the barriers were identified, they were examined to determine their feasibility for mitigation. I have reflected on the literature and proposed a **Barrier Quadrant** thereby addressing the second sub-research question of *What barriers are mitigable and unmitigable by the supply chain organizations?*. Concluding the literature review, a base research framework was presented, which examined potential solutions for mitigable barriers. This comprehensive approach ultimately addressed the third sub-research question of *What combination of infrastructural and institutional instruments could address the mitigable barriers of data sharing in supply chain??*, leading to the development of an integrated input that was presented to the next research phase, i.e., single case study interviews. This instrument type and category along with more specific details can be seen in Figure 3.5

Instrument type	Instrument Category	Instruments
Infrastructural	Emerging technologies	Information and Communication Technology (ICT)
		Blockchain Technology
	Advanced technologies	Artificial Intelligence (AI)
		Machine Learning (ML)
	Data Standardization	Standardization of data formats
		Interoperability between firms
	Data security measures	Encryption
		Access controls
Institutional	Cultural factors: Towards privacy and data sharing	Attitudes of employees
		Personal perspectives
	Trust	Various trust-building techniques
	Legal agreements	Contractual agreements
		Data governance policies
	Learning programs	General education
		Training programs
	Role of Leadership	Leaders in Supply chain firms
		Senior Management in Supply chain firms
	Ethical and responsible data sharing	Role of ethics
		Compliance, auditing and ESG considerations

Figure 3.5: Overview of the instruments formulation from the literature

<div align="right"># 4</div>

Phase II: Single Case study Results

As mentioned in chapter 2, the research methodology employed in this study involved conducting a series of 14 interviews with participants who possess relevant expertise and experience in the field under investigation. These interviews served as a valuable source of data, allowing for the exploration of diverse perspectives on the various factors considered within the research framework. To ensure the accuracy and reliability of the data collected, the transcriptions of these interviews underwent a meticulous cleaning process. This involved removing any extraneous or irrelevant content while preserving the integrity of the participant's responses. The resulting clean transcripts served as the basis for subsequent analysis. The transcripts were then summarized for better understanding and further analysis, as seen in Appendix B. The analysis of the interview data was conducted using an instrument-based approach, wherein each interview was systematically examined to identify key themes and patterns. This comprehensive analysis offers a deep and nuanced understanding of the factors under investigation. By scrutinizing the interviews instrument-wise, specific insights and observations were derived, shedding light on the intricate relationships and dynamics at play.

4.1. Analysis

This section presents a detailed account of the analysis, presenting the findings and interpretations that emerged from the examination of the transcribed interviews. By delving into the specific viewpoints and perspectives expressed by the participants, the section offers an in-depth exploration of the factors under consideration. Through rigorous and systematic analysis, this study strives to provide a comprehensive understanding of the subject matter, drawing upon the rich insights obtained from the interviews conducted. The following instrument-wise analysis can give us an in-depth understanding of the interviewee's perspectives. A few perspectives that seemed distinct are summarized at the end of each instrument category which has then served as input to the validation phase.

4.1.1. Initial Thoughts and Use-Cases on Data Sharing in the Supply Chain Domain

The interviews suggest that data sharing in the supply chain domain can be beneficial for businesses to achieve better collaboration and efficiency. One common theme is that data sharing can help with forecasting and planning, leading to improved production, inventory management, and demand forecasting. In particular, sharing data related to inventory levels, sellout volumes, order patterns, and forecasts, as well as promotional activities, can lead to more efficient supply chain management. Additionally, interviewees suggest that data sharing can be used to address macroeconomic disruptions in the supply chain, such as port delays, port congestions, and factory closures due to events like COVID. By sharing data about these disruptions, companies can mitigate their impact on the supply chain.

The interviews also highlight the importance of maintaining anonymity when discussing company-specific details. Sharing only necessary data such as forecasts, product details, shipping details, and general communication regarding current outlooks is essential. Another important aspect of data sharing is the need for trust and transparency among partners. Trust is key when it comes to data sharing in the supply chain domain. Building strategic partnerships requires a collaborative value proposition where all parties share data transparently to benefit the business and the end customer. It is not just about sharing data; it is also about understanding what the data means and what is behind it.

The interviews also suggest that there is limited data sharing in the supply chain industry. Even if data sharing is possible, it can be difficult to integrate due to the need for various systems and interfaces to be built. However, data sharing is necessary for a global supply chain to function effectively, using industry-wide standards such as GTIN (Global Trade Item Number) or EAN (European Article Number) codes. Without data exchange and a common standard, the supply chain would not be feasible.

Overall, the interviews suggest that data sharing can be beneficial for companies in the supply chain domain, but it requires a collaborative approach with trust and transparency among partners. Sharing only necessary data and adopting industry-wide standards are also essential. While technical issues may arise, the main challenge is building trust with partners on what data can be shared and what can be done with the data.

4.1.2. Benefits and Challenges of Data Sharing in the Supply Chain Domain

All in all, the interviewees highlighted numerous benefits that can be achieved through data sharing, such as improved operational efficiency, better decision-making, cost savings, enhanced collaboration, increased visibility, and improved customer service. On the other hand, they also identified several challenges, including data security and privacy concerns, the need for trust and transparency, technical challenges, confidentiality issues, and the lack of standardized interfaces. A summary of these findings can be seen in Figure 4.1
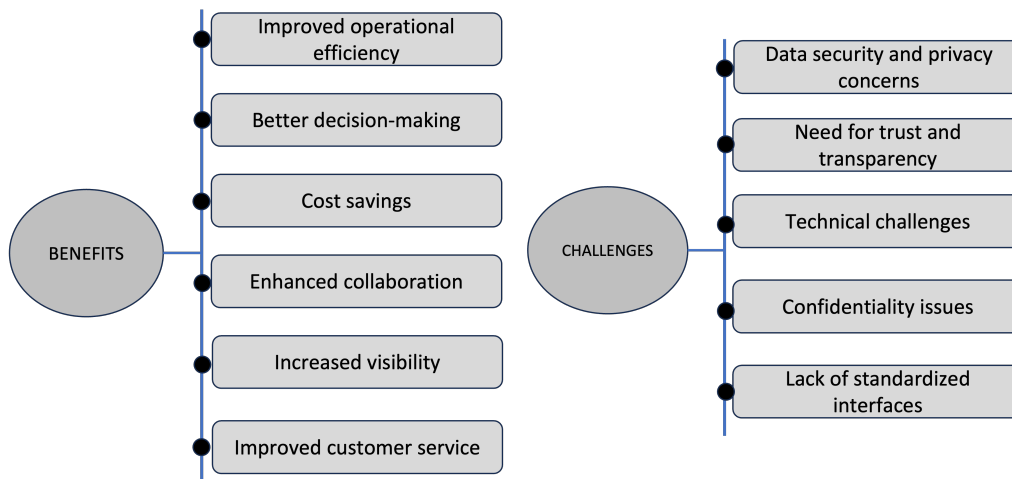
Figure 4.1: Benefits and Challenges of Supply Chain Data Sharing (from interviews)

One of the prominent benefits mentioned by the interviewees is the increased visibility that data sharing brings to the supply chain. Sharing data allows for better planning, resource allocation, and forecasting, leading to efficient resource utilization and reduced inventory costs. It also enables benchmarking against other companies and identifying areas for improvement, thereby fostering continuous improvement in supply chain operations. Additionally, data sharing can improve logistics and support functions within the supply chain, leading to better overall performance and customer satisfaction. Collaboration and knowledge sharing emerged as important benefits of data sharing. By collaborating and sharing data, companies can identify

disruptions, solve problems jointly, and gain insights from other industry players. This collaboration can lead to better decision-making, improved supply chain efficiency, and cost reductions for all parties involved. Furthermore, data sharing can foster a culture of collaboration, transparency, and accountability among supply chain partners, strengthening relationships and leading to mutual benefits.

Despite the perceived benefits, the interviewees also acknowledged various challenges associated with data sharing in the supply chain. Data security and privacy were highlighted as significant concerns, with companies expressing worries about how their data will be used and the potential risks involved in sharing sensitive data. The need for clear guidelines, protocols, and non-disclosure agreements (NDAs) to protect sensitive data and ensure responsible data handling was emphasized. Masking or anonymizing data before sharing was suggested as a potential solution to address data security challenges.

Trust and confidentiality were recurring themes in the challenges identified by the interviewees. Building trust among supply chain partners was deemed essential for successful data sharing, and a clear value proposition for all partners was considered crucial. Striking a balance between sharing data and maintaining confidentiality, as well as avoiding oversharing that could benefit competitors, was highlighted as a challenge. Intellectual property rights, negotiation, and leverage were also mentioned as potential challenges, as full end-to-end visibility can impact negotiation ability and lead to legal and business consequences. Furthermore, technical challenges were another common theme raised by the interviewees. They emphasized the need for a common language, compatible systems, governance, and agreements to enable effective data sharing. The lack of standardized interfaces and the complexity of integrating different systems and platforms were identified as barriers to data sharing in the supply chain. Overcoming these technical challenges requires significant time and effort.

To a large extent, the interviewees recognized the potential benefits of data sharing in the supply chain domain, such as improved operational efficiency, better decision-making, cost savings, enhanced collaboration, and increased visibility. However, they also highlighted several challenges that need to be addressed, including data security and privacy concerns, the need for trust and transparency, technical complexities, and the lack of standardized interfaces. To maximize the benefits and overcome the challenges, it is important for companies to establish clear guidelines, protocols, and agreements, as well as invest in data security measures and build trust-based relationships with supply chain partners.

4.1.3. Infrastructural Instruments

Instrument 1: Emerging technologies like Information and Communication Technology (ICT) and Blockchain

From the provided interviews, it is evident that emerging technologies like ICT and Blockchain have a significant impact on supply chain data sharing. Several perspectives emerged from the interviews.

Interviewees highlighted the benefits of emerging technologies in improving data sharing and visibility across the supply chain. They mentioned that ICT and technologies like RFID enable real-time tracking of products, leading to better decision-making and responsiveness to changes in the environment. For instance, Interviewee 4 stated, *"The more data you have or the more technology you have at your disposal means the quicker you can react to certain things that go on."*

While recognizing the potential of emerging technologies, interviewees also acknowledged the challenges associated with implementation. Interviewee 6 mentioned the need for digital transformation and change management to deploy these technologies effectively. Interviewee 7 emphasized that many companies are still in the early stages of building the necessary foundations to adopt these technologies fully.

Interviewees highlighted the role of blockchain in building trust and facilitating collaboration across supply chain participants. Blockchain's ability to create a trustworthy ledger and enable the use of smart contracts was seen as a means to enhance transparency and ensure data integrity. Interviewee 7 stated, *"The purpose of blockchain is to have something like a trustworthy ledger...that you can reliably check that the data which has been put on there is of high integrity."* Some interviewees expressed concerns regarding the potential risks associated with emerging technologies. Some speakers have raised the issue of data security and the risk of sharing too much or sharing data with the wrong people. Interviewee 13 also mentioned the importance of ensuring traceability and trust in the implementation of technologies like blockchain.

Overall, the interviews reflect a positive sentiment towards the potential of emerging technologies in supply chain data sharing. However, challenges related to implementation, change management, data security, and standardization need to be addressed. The integration of ICT and blockchain has the potential to transform supply chain operations by enabling real-time data sharing, enhancing trust, and facilitating collaborative decision-making. As Interviewee 2 suggested, moving from a linear to a multivariable data-sharing approach can significantly improve supply chain efficiency and responsiveness.

To summarize, some of the distinct perspectives that occurred from this instrument can be seen in Table 4.1

Table 4.1: Distinct perspectives: Instrument 1

Number	Perspectives
1	There are challenges in implementing emerging technologies like Blockchain, but there is potential for a standardized framework
2	The emerging technologies will lead to efficient decision-making that benefits all stakeholders involved
3	The technologies' deployment requires digital transformation, change management, and careful evaluation of their usefulness
4	Blockchain technology can address issues related to property rights and legal aspects of data sharing
5	Blockchain is a buzzword: There are good use cases, but it should not be applied just for the sake of using a popular technology
6	Emerging technologies like ICT and Blockchain can facilitate data sharing and analysis, especially in situations with diverse products
7	The technologies improve traceability and trust among stakeholders
8	The technologies might pose security risks that need to be addressed by enhancing security measures

Instrument 2: Advanced technologies like Artificial Intelligence and Machine learning

According to the interview excerpts, the impact of advanced technologies such as AI and ML on supply chain data sharing is a topic of interest and potential value. The interviewees express various perspectives on the subject, highlighting both the opportunities and challenges associated with leveraging AI and ML in supply chain operations.

One recurring theme is the use of AI and ML in demand forecasting. Interviewee 1 mentions the challenge of accurately predicting demand for customers, where demand signals can spike rapidly. They emphasize the importance of data quality and the need to address potential issues that arise from using multiple data sources. Interviewee 2 extends this idea, suggesting that sharing data and best practices on forecasting methodologies across companies could help optimize supply chain operations and eliminate waste.

Interviewee 6 emphasizes the need for more data in leveraging AI and ML algorithms effectively. They note that while the algorithms are readily available, the lack of sufficient data hinders their application. This highlights the importance of technical mechanisms and relationships for data sharing within the supply chain. Interviewee 9 supports this perspective, stating that as confidence and consent in data sharing grow, AI and ML can play a significant role in creating stronger data models for forecasting and optimization. The potential benefits of AI and ML in supply chain operations are recognized by several interviewees. Interviewee 5 acknowledges that AI and ML can provide concrete and meaningful inputs for planning, surpassing individual capabilities and benefiting multiple organizations. Interviewee 8 also believes that AI and ML are the future and should be invested in for cost savings and bottleneck identification.

However, not all interviewees are convinced about the current impact or feasibility of AI. Interviewee 3 states that they are yet to see positive results, while Interviewee 10 expresses scepticism about the current state of AI and its limitations. Interviewee 13 finds AI and ML interesting and powerful but sees limited application in data sharing, except for automating anonymization processes. Concerns about data sharing and competitive advantage are also mentioned. Interviewee 7 suggests that while sharing AI and ML outcomes for planning and Sales and Operations Planning (S&OP) can benefit counterparts in the supply chain, externally, organizations may hesitate to share sensitive data due to potential competitive disadvantages.

In summary, the interviews reflect a range of opinions on the influence of advanced technologies like AI and ML in supply chain data sharing. While there is recognition of the potential benefits, such as improved forecasting accuracy and optimization, challenges related to data quality, privacy, and competitive advantage remain. The need for technical mechanisms, skilled individuals, and increased confidence in data sharing are highlighted as important factors for maximizing the potential of AI and ML in the supply chain.

To summarize, some of the distinct perspectives that occurred from this instrument can be seen in Table 4.2:

Table 4.2: Distinct perspectives: Instrument 2

Number	Perspectives
1	Advanced technologies like AI and ML have great potential in improving demand forecasting and resource planning
2	Embracing the potential of these technologies is crucial for companies to avoid missed opportunities and losing out to competitors
3	By utilizing these technologies, there will be substantial benefits in supply chain data sharing, leading to improved efficiency and effectiveness across multiple organizations
4	Implementation of these technologies requires a skilled workforce and access to large amounts of data
5	These technologies can optimize overall supply chain processes through collaboration between companies
6	AI is a bunch of nonsense for now. However, Machine learning could help manage unstructured data and improve knowledge management
7	The advanced technologies improve data security by identifying and linking unauthorized content, events, and incidents
8	The technologies are potentially powerful but dangerous, and there is not much assurance about their secure application in supply chain sharing

Instrument 3: Standardization of data formats and Interoperability between firms

The interviews provided valuable insights on the influence of standardization of data formats and interoperability between firms in supply chain data sharing. Interviewees acknowledged the significance of data standardization as a critical factor in facilitating efficient data utilization and interoperability among organizations.

Interviewees emphasized that data standardization plays a fundamental role in enabling effective data sharing and utilization. It ensures that all parties involved in the supply chain speak the same language and have a common understanding of the data. Standardization eliminates miscommunications, discrepancies, and interpretation variations that can arise when data is shared in different formats. One interviewee noted, *"There's no allowance for miscommunications or kind of discrepancies within data that you'd have a like-for-like 100% match."* Another interviewee stated, *"If two companies have a very close standard of data and it's that easy to transfer data, then it's an ideal state."* Interoperability emerged as a key driver for data standardization. Interviewees expressed that standardized data formats would enable seamless data exchange and collaboration across organizations. It would enhance efficiency, speed, and accuracy in supply chain operations and transactions. One interviewee highlighted the benefits, stating, *"Having the same standards definitely influences the efficiency and the speed of the operations and transactions."*

While recognizing the importance of data standardization, interviewees acknowledged the challenges and costs associated with achieving widespread standardization. They acknowledged the complexity of supply chains, with multiple parties and diverse systems, making it challenging to implement comprehensive standardization. One interviewee expressed scepticism, stating, *"Trying to standardize everything is too costly, and you would require a lot of infrastructure... I don't believe data standardization is the way to go."* However, they emphasized the importance of interoperability and modular systems to leverage existing platforms effectively.

Additionally, some interviewees highlighted the connection between data standardization and automation. Standardized data formats facilitate automated processes and reduce the need for manual interventions, enabling the effective utilization of AI and ML technologies. One interviewee explained, "Having standardized data helps with automating because without having the standardization there, you need more manual inputs or manual operations to work with the data." Also, interviewees recognized the importance of data security measures such as encryption and access controls in the context of data sharing. They emphasized the need for secure data exchange while maintaining control over data usage. One interviewee noted, *"Access controls also extremely important... It's about who you let data in, who you let access data and what you let them do with the data afterwards."*

In summary, the interviews emphasized the significance of standardization of data formats and interoperability between firms in supply chain data sharing. Data standardization was recognized as a crucial factor in ensuring efficient data utilization, minimizing discrepancies, and enabling seamless collaboration. While acknowledging challenges and costs, interviewees emphasized the importance of interoperability and the connection between data standardization and automation. They also highlighted the role of security measures in facilitating secure data sharing.

To summarize, some of the distinct perspectives that occurred from this instrument can be seen in Table 4.3:

Table 4.3: Distinct perspectives: Instrument 3

Number	Perspectives
1	A centralized platform and collaboration initiatives enable uniform data sharing (multi-organization-oriented solutions)
2	There will be challenges in the adoption of standardized frameworks by the firms and huge incurring costs
3	Standardizing data formats is crucial for ensuring perfect interoperability between firms and avoiding miscommunications and discrepancies within data
4	Standardization and interoperability is critical for automation, especially with the use of AI or ML, as it reduces the need for manual inputs and operations
5	Standardization and interoperability requires both technical and functional layers to ensure a common understanding and effective communication
6	The use of standardized data formats is essential for achieving interoperability between firms in the supply chain
7	Each company has its own framework for how data should be published and maintained, hence standardization is unlikely

Instrument 4: Data security measures: Encryption and access controls

After analyzing the responses of the 14 interviewees regarding the influence of data security measures, such as encryption and access controls, in supply chain data sharing, it is clear that they are all for data security in supply chain collaborations. The interviewees unanimously agree on the significance of data security measures in protecting sensitive data and ensuring confidentiality. Encryption and access controls are seen as essential for maintaining the integrity of shared data and mitigating the risk of breaches.

Many interviewees highlight the need for compliance with regulations and ethical considerations when implementing data security measures. They emphasize the importance of encrypting personal data to protect privacy and ensure compliance with data protection laws. To support this, interviewee 6 says, *"So definitely if there is personal data you should always encrypt it and then we need to learn how to operate without that data, not without that data encrypted."* While acknowledging the importance of data security, some interviewees expressed concerns about the potential impact of data sharing. They mention the challenges of managing encryption policies and the need to strike a balance between security measures and innovation in leveraging data. Interviewee 6 states, *"So, again, I think in the end it's about the governance you build between what is it that you need to have access on and what is not? It is a key decision for how fast will you go with your supply chain transformation with data."*

Additionally, interviewees recognize the role of encryption and access controls in protecting data during transmission and storage. They mention the need for standardized encryption protocols and emphasize the importance of access controls in preventing unauthorized access and maintaining data integrity. Interviewee 11 emphasizes, *"It's about who you let data in, who you let access data and what you let them do with the data afterwards."* However, several interviewees mention the challenges associated with implementing data security measures. These challenges include key management, complexity, user experience, and potential limitations on data sharing. Interviewee 10 quotes, *"But as I said, encryption is only one of the controls. You would also be looking for totally different controls. You might be thinking about process-related controls or whatever, but when it comes to protecting your data, yeah, you have to scramble it somehow."*

Strong data security measures, including encryption and access controls, are seen as building trust and confidence among stakeholders. They provide assurance that data will be protected from unauthorized access or breaches, leading to increased willingness to share data. To back it up, interviewee 13 says, *"If you have*

proper access controls, you can almost rule out [breaches], which gives provides an insane trust between the parties which enables them to dare to share data. So, data security measures, I think it's one of the most important."

In summary, the interviewees recognize the importance of data security measures, particularly encryption and access controls, in supply chain data sharing. They acknowledge the need to protect sensitive data, comply with regulations, and maintain trust among stakeholders. However, some express concerns about the potential impact of data sharing and the challenges associated with implementing and managing security measures. Striking a balance between security and innovation is seen as crucial for effective supply chain transformation with data.

To summarize, some of the distinct perspectives that occurred from this instrument can be seen in Table 4.4:

Table 4.4: Distinct perspectives: Instrument 4

Number	Perspectives
1	There is a strong need for a governance system to ensure secure data sharing and confidentiality through encryption and access controls
2	Data security measures are essential to mitigate the risk of data privacy and security breaches in the supply chain while ensuring the right level of access without breaching or sharing any sensitive data
3	Data security measures are necessary for compliance and ethics when dealing with personal data
4	Overly strict data security measures can hinder innovation and slow down the supply chain transformation process
5	Data security measures hinder data sharing due to increased difficulty in decryption. Hence, Blockchain should be a priority for secure data sharing
6	Unlike big high-tech firms, smaller companies may face barriers to implementing robust data security measures
7	Confidentiality, integrity, and availability (CIA triad) are important considerations for data security when sharing data in the supply chain
8	Many organizations do not prioritize security until they experience a breach and implementing encryption can be challenging and burdensome
9	Encrypted documents once shared cannot be protected from further manipulation and distribution by authorized parties

Most and least important infrastructural instruments in terms of implementation

During the interview, a crucial question was posed after discussing the various infrastructural instruments and their impact on facilitating supply chain data sharing: *"Among the listed instruments, can you give an order of preference from the most to the least important instruments in terms of their implementation to facilitate supply chain data sharing?"* The question aimed to gauge the respondents' preferences regarding the implementation of these instruments in terms of their importance. The purpose was to assess the overall credibility and usability of these instruments. the responses to this question per interviewee can be seen in Figure 4.2. In this figure, it can be seen that the average ranking column in the table indicates the collective preferences of the 14 interviewees regarding different instruments. It is noteworthy that the ranking values in this column follow a pattern where lower values are associated with higher preference. ***This implies that the least average ranking corresponds to the most preferred instrument among the interviewees, while the highest average ranking indicates the least preferred one.*** This pattern can be attributed to the fact that interviewees, on average, tend to assign lower rankings to instruments they perceive as less valuable or

effective. Conversely, they allocate higher rankings to instruments they consider more beneficial or impactful in the context of emerging technologies. Therefore, we can conclude that the instrument with the least average ranking, as indicated in the table, is the most preferred one among the interviewees. Similarly, the instrument with the highest average ranking is the least favoured among the interviewees. It is noteworthy to see that interviewee 10 did not rank in order of preference, because they believed that all the instruments interact with each other.

The analysis of the responses are depicted visually in Figure 4.3. This revealed that a majority of the interviewees considered the standardization of data formats and interoperability as the most significant instrument for facilitating supply chain data sharing. Following closely behind were data security measures, emphasizing the importance of safeguarding sensitive data. Additionally, emerging technologies such as ICT and Blockchain were identified as influential instruments. On the other hand, advanced technologies like AI and ML were regarded as the least favoured instruments. The interviewees expressed the belief that these advanced technologies are more applicable to forecasting and internal functions rather than facilitating data sharing (refer to Table 4.1.3).

Instrument	Order of Preference														
	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7	Interviewee 8	Interviewee 9	Interviewee 10	Interviewee 11	Interviewee 12	Interviewee 13	Interviewee 14	Average
Emerging technologies like ICT and Blockchain	3	3	2	1	4	2	3	4	2	Null	1	3	3	2	2.5
Advanced technologies like AI and ML	4	4	3	4	3	4	4	2	4	Null	4	1	4	2	3.3
Standardization of data formats and interoperability between firms	1	1	1	2	1	1	1	3	3	Null	2	2	1	1	1.5
Data security measures: Encryption and access controls	2	2	4	3	2	3	2	1	1	Null	3	4	2	1	2.3

Figure 4.2: Preference count in Infrastructural Instruments (from all interviews - least average ranking corresponds to the most preferred instrument among the interviewees, while the highest average ranking indicates the least preferred one)

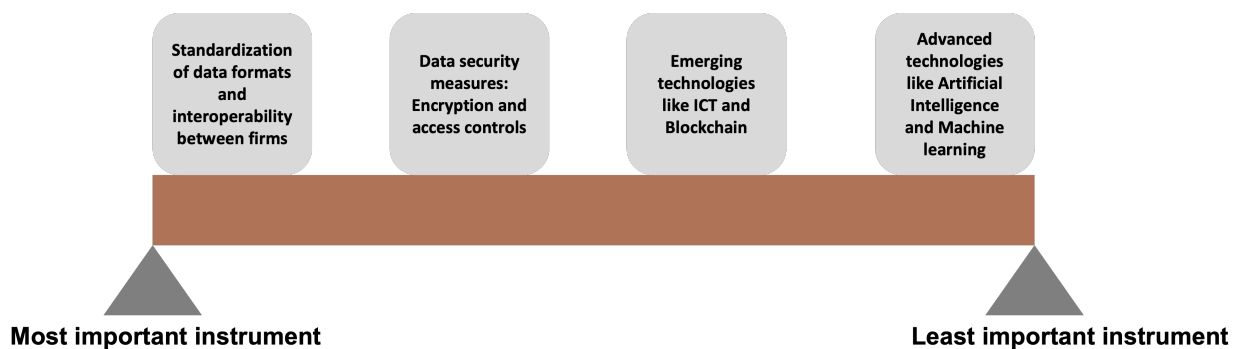**Figure 4.3:** Preference analysis in Infrastructural Instruments

4.1.4. Institutional Instruments

Instrument 5: Cultural factors: attitudes and personal perspective towards data sharing and privacy

Several interviewees emphasized the importance of professionalism and prioritizing the company's interests when it comes to data sharing. They highlighted that personal opinions and perspectives should be secondary

to the overall objectives of the organization. Interviewee 4 stated, *"When you're sharing between companies, it's very important...you need to think on behalf of the company and not specifically on behalf of yourself with your own personal opinions."*

Trust and collaboration emerged as crucial elements for successful data sharing in the supply chain. Interviewees recognized that building trust with partners and stakeholders is essential to ensure the relevance and accuracy of shared data. Interviewee 5 stressed, *"Collaboration is really crucial, and building trust and accountability...if that's not there, I don't think the data that is shared can be properly utilized."*

Participants acknowledged that a culture shift may be required to encourage data sharing in the supply chain. They highlighted the importance of change management processes and clear communication about the benefits of data sharing to overcome resistance and foster a collaborative environment. Interviewee 7 expressed, *"If you clearly mention the benefits...I think it might be feasible, but it will take quite a while before it happens...unless there is a standard set, what they need to share, it will be very vulnerable to the attitude of the people who need to share it."*

While privacy concerns were not extensively discussed by the interviewees, Interviewee 10 raised the issue and highlighted that individuals may become more conscious of privacy only when their personal data is misinterpreted or misused. They stated, *"Most people...are relatively indifferent about security until it hits them...there's always too much security until there's...that not only applies to security, but it applies to basically every compliance domain of which privacy is just one."*

These themes collectively demonstrate the participants' recognition of the importance of data sharing in the supply chain for efficiency and collaboration. While personal perspectives and cultural factors may influence the willingness to share data, there is a consensus that professionalism, trust, and a focus on the company's interests are crucial in fostering a data-sharing culture. Privacy concerns were acknowledged but not extensively discussed by the interviewees.

To summarize, some of the distinct perspectives that occurred from this instrument can be seen in Table 4.5:

Table 4.5: Distinct perspectives: Instrument 5

Number	Perspectives
1	Cultural factors are not a barrier to data sharing as it is widely accepted to enhance supply chain efficiency
2	Supply chain professionals are generally data-oriented and don't see any reason for cultural attitudes to be a hurdle to data sharing
3	Individuals should think on behalf of the company rather than their personal opinions when making decisions related to data sharing
4	Without trust in partners, data cannot be properly utilized, and willingness to collaborate is necessary for positive outcomes
5	A culture shift, internal training, and change management are required to ensure people feel secure about data sharing with clear communication of benefits
6	Individuals' attitudes towards privacy vary and become a concern only when it affects them personally
7	Limited privacy awareness can lead to unintended consequences in online data sharing
8	Data sharing decisions are made by the company, regardless of employee attitudes and perspectives
9	Europe has a privacy-focused culture due to GDPR laws, and individuals have the freedom to voice their concerns about data sharing

Instrument 6: Trust and Trust-building techniques

The analysis of the interview data provided valuable insights into the influence of trust towards data sharing and privacy in the context of supply chain data sharing. Trust was identified as a crucial element in facilitating data sharing in the supply chain. Interviewees emphasized the need for trust to establish and maintain relationships with partners, vendors, and customers. Trust was seen as a foundation for effective collaboration and decision-making based on shared data. Interviewee 7 highlighted, *"If there's no trust in the chain, people won't believe the data that's shared, and then what's the entire point of sharing?"*

Several strategies were discussed for building trust in data-sharing relationships. Interviewee 1 emphasized the importance of reputation and assumed security measures in building trust, stating, *"I would trust a company that is more technological."* Interviewee 3 mentioned the significance of regular contact, follow-through on commitments, and maintaining relationships with customers to foster trust. Transparency and relevance were identified as critical factors in establishing trust. Interviewee 5 highlighted the need for comprehensive and relevant data sharing, ensuring that shared data is accurate and beneficial for all parties involved. Transparent communication about data usage and visualization was seen as a means to increase trust. Interviewee 9 emphasized the importance of clear nondisclosure agreements and legal protections to ensure trust and mitigate risks.

Interviewees stressed the importance of creating value propositions and common goals in data-sharing relationships. Interviewee 6 suggested that building partnerships based on shared goals, such as cost reduction or revenue growth, could contribute to trust. It was emphasized that focusing on the defined purpose of data sharing and avoiding actions that undermine trust, such as using data for claims or audits, are crucial for building trust. Trust was viewed as an element of risk management in data sharing. Interviewee 10 pointed out that trust is based on expectations of behaviour and stable patterns of behaviour. Efforts to reduce risk and ensure effective controls, such as contracts and transparency, were seen as important for maintaining trust in data-sharing relationships.

Overall, the interviews revealed that trust plays a central role in supply chain data sharing. Trust is built over time through transparent communication, adherence to commitments, value creation, and the establishment of common goals. Transparency, relevance, and legal protections were identified as important factors in fostering trust. Trust was viewed as a critical enabler for effective decision-making and collaboration in the supply chain.

To summarize, some of the distinct perspectives that occurred from this instrument can be seen as in Table 4.6:

Table 4.6: Distinct perspectives: Instrument 6

Number	Perspectives
1	Companies with reputation and advanced technology can be trusted for secure data protection measures
2	Collaboration and maintaining relationships via communication are important ways to build trust between companies
3	To build trust, clear guidelines should be established for data usage (transparency) and ensured they are followed by both internal and external parties
4	Trust can be established through written agreements, including NDAs and formal contracts
5	Trustworthiness can be established through pilot projects and subsequently confirmed by the actual performance of long-term projects
6	A balance needs to be struck to ensure that all parties involved benefit (50-50 rule) and that there is no extortion
7	Trust can be built by creating a common goal, avoiding blame, defining a clear partnership strategy

Number	Perspectives
8	Trust is built on predictability and stable patterns of behaviour, supported by effective risk management controls, but cannot be guaranteed by contracts alone
9	Trust is completely based on facts, figures, and practical proofs

Instrument 7: Contractual agreements and data governance policies

One prominent theme that emerged from the interviews is the significance of legal frameworks. Interviewees unanimously recognized the necessity of legal frameworks and contractual agreements in managing data sharing. They emphasized the role of legal teams in ensuring compliance and protecting the interests of the parties involved. This highlights the importance of establishing a formal structure to govern data-sharing activities within the supply chain.

Another key theme that emerged is the role of contractual agreements and data governance policies in building trust. Interviewees highlighted that clear rules and mechanisms outlined in these agreements are instrumental in establishing trust between parties engaged in data sharing. They emphasized that having an NDA or a contractual agreement helps in creating a framework that fosters trust by providing clear guidelines and protection when those rules are not met. This finding suggests that contractual agreements serve not only as legal documents but also as instruments for building trust among supply chain partners.

The sensitivity of the data being shared was identified as a critical factor in determining the necessity and extent of contractual agreements. Interviewees acknowledged that generic data sets could be shared with less stringent contractual agreements, while critical and sensitive data require stronger legal frameworks and stricter controls. This highlights the need for a nuanced approach to data governance, with different levels of contractual agreements based on the nature of the data being shared. However, some interviewees expressed concerns about the neglect or non-enforcement of contractual agreements. They emphasized the importance of verification and enforcement mechanisms to ensure that contractual agreements are effectively implemented. Without proper verification and enforcement, the effectiveness of these agreements may be compromised.

Interviewee 10 provided an interesting perspective on the role of trust at the individual level in data-sharing collaborations. They emphasized that longstanding relationships and trust between individuals play a significant role in successful data sharing, particularly when it comes to strategic and operational data. This suggests that while contractual agreements and data governance policies are crucial, they should be supported by a foundation of trust and strong interpersonal relationships between supply chain partners.

In conclusion, the interviews provided valuable insights into the influence of contractual agreements and data governance policies in supply chain data sharing. The findings underscore the importance of legal frameworks, clear rules, and trust-building mechanisms in facilitating effective data sharing. However, challenges exist in the enforcement of contractual agreements, necessitating the development of robust verification and enforcement mechanisms. The sensitivity of the data being shared and the significance of trust at the individual level were also identified as crucial considerations in data-sharing collaborations. These findings contribute to a deeper understanding of the role and impact of contractual agreements and data governance policies in the context of supply chain data sharing.

To summarize, some of the distinct perspectives that occurred from this instrument can be seen in Table 4.7:

Table 4.7: Distinct perspectives: Instrument 7

Number	Perspectives
1	Legal frameworks designed to manage critical or sensitive data may not be successful in establishing trust
2	Signed data-sharing agreements and contracts can facilitate mutual trust
3	The necessity of these agreements depends on the sensitivity of the data
4	Agreed policies ease supply chain operations by providing clear guidelines
5	Effective data governance policies and contractual agreements involve specialized legal expertise, talent acquisition, and clear communication with all employees
6	The policies alone are insufficient to avoid losses and breaches. Trust and long-standing relationships are crucial for data sharing
7	The agreements and policies must be strictly enforced to prevent parties from disregarding them
8	Data governance policies are primarily a means to avoid legal repercussions rather than a proactive measure to improve data security

Instrument 8: Education and training programs

The interviewees unanimously acknowledged the importance of education in promoting data sharing within the supply chain. One interviewee remarked, *"Maybe from the education part if you were to learn about companies being successful in exchanging data, that would trigger you to think why I'm not doing this with this customer."* The consensus was that education plays a vital role in creating awareness and motivating individuals to exchange data. It was suggested that education could inspire teams and serve as a catalyst for data-sharing initiatives.

The role of training in data sharing was a topic of varying perspectives among the interviewees. Some emphasized its significance, particularly in terms of training employees on what not to share. According to one interviewee, *"I think it's important more on the side of training people what not to share more than what they can share."* However, others argued that training programs should focus more on the cultural aspect and adoption of digital technologies, rather than technical knowledge. One interviewee stated, *"I would focus the education and training programs more on do we have the right mindset across the people and on how to adopt digital."*

The interviews also highlighted the impact of education and training on corporate culture. Several interviewees emphasized that data sharing should be ingrained in the company culture to encourage collaboration and data exchange. As interviewee 5 expressed, *"If companies do not foster this kind of culture within its employees and organization, it will be very hard to have people openly collaborating and sharing data."* Additionally, training programs were identified as valuable tools for change management, enabling employees to understand the benefits, risks, and contractual agreements associated with data sharing.

Practical training and awareness of data governance and policies were recognized as important aspects of education and training programs. Interviewees emphasized the need for specific training tailored to the project and partners involved. Interviewee 9 highlighted the importance of such training, stating, *"Before starting the project, you have to tell everyone that this project involves data sharing with another partner and these are the set of instructions that you have to follow or precautions that you have to take."* Additionally, interviewees stressed the significance of education and training in enhancing data security practices and enabling employees to make informed decisions.

In conclusion, the findings of the interviews demonstrate that education and training programs have a significant influence on supply chain data sharing. Education was found to be instrumental in raising awareness, promoting a culture of collaboration, and inspiring individuals to share data. Training, especially focused on what not to share, data governance, and security, played a crucial role in developing employee skills and knowledge. The cultural aspect, leadership support, and practical training were identified as key factors for maximizing the effectiveness of education and training programs.

To summarize, some of the distinct perspectives that occurred from this instrument can be seen in Table 4.8:

Table 4.8: Distinct perspectives: Instrument 8

Number	Perspectives
1	Motivation through business case studies or success stories of competitors is more effective than education and training programs for sharing data
2	Training may be necessary in the future if a common framework for technology is adopted for data sharing
3	Education and training programs help stakeholders identify which data sets they can share and which they cannot share, particularly with competitors
4	Company culture and change management is crucial for the successful deployment of education and training programs that require open collaboration and data sharing
5	Education and training programs should prioritize cultivating a mindset of digital technology adoption rather than emphasizing technical details
6	They should be tailored to specific needs and be focused on functional-specific training with clear instructions and precautions for specific teams and projects
7	Intrinsic motivation of employees plays a role in encouraging participation
8	Leadership support and buy-in are crucial for the success of these programs

Instrument 9: Role of Leadership and Senior Management

The role of leadership and senior management in supply chain data sharing is a critical factor in promoting a culture of collaboration and data exchange. Many interviewees stressed the importance of leaders setting an example for data-sharing practices. When leaders actively collaborate and partner with external parties, it creates a culture that values data sharing throughout the organization. Interviewee 5 stated, *"I believe in leadership by example. So naturally, if we see that our bosses, our senior management or leadership are actively collaborating or partnering with other parties, especially externally and externally data, that would translate also for people on the lower levels to do the same."*

The role of leaders in driving data-sharing initiatives was highlighted by multiple interviewees. Leaders were seen as responsible for identifying the need for sharing data and initiating collaborations with other companies. Interviewee 4 mentioned, *"The leadership should identify this and then set up some sharing with different companies to try to address those issues and improve that process."* Clear communication from leadership regarding what data can and cannot be shared was seen as crucial. Interviewee 3 emphasized the need for leaders to clearly communicate what can be shared and lead by example, stating, *"Some stuff we need to keep back from customers, not because of the lack of trust, but there's not always necessary to share everything but to share as much as you possibly can lead to a better outcome."*

Interviewees highlighted the importance of leaders motivating and supporting employees to share data. Leaders were expected to demonstrate the benefits of data sharing and create an environment where employees feel confident in sharing their data. Interviewee 9 mentioned, *"Leaders kind of have to constantly say that, yes, this is beneficial for both the companies and we want to share the data in this stream. So that clarity has to come from leadership."* Several interviewees noted the influence of external factors

and collaborations with other organizations. Leaders were seen as driving collaborations with external partners, which encouraged data-sharing practices. Interviewee 2 stated, *"If we start discussing with more organizations on how you're managing your supply chain, we start discussing in terms of how you are able to improve the supply... Then it cascades down in the supply chain that yes, there is an outside-in view as well."*

Overall, the interviews highlighted the crucial role of leadership and senior management in promoting data sharing within the supply chain. Leaders need to set an example, drive initiatives, communicate clearly, motivate employees, and foster external collaborations. By doing so, they can create a culture that values data sharing and enables collaborative efforts among internal and external stakeholders.

To summarize, some of the distinct perspectives that occurred from this instrument can be seen in Table 4.9:

Table 4.9: Distinct perspectives: Instrument 9

Number	Perspectives
1	Leaders play a crucial role in data sharing by making decisions, taking an outside view, and collaborating to maximize benefits
2	Leaders should set an example and acknowledge that some data must be withheld for necessity
3	Strong leadership and value-driven senior management are critical for enabling data sharing and driving digital transformation in the supply chain
4	Senior management should demonstrate a willingness to share data and its benefits, which can influence the rest of the organization
5	Leaders and senior management may not fully understand the implications of criminal organizations in data sharing and may prioritize continuity over security
6	The determination of investment in data sharing and security is based on its significance to the company's overall strategy, which is decided by the leadership

Instrument 10: Ethical and responsible data sharing

Interviewees emphasized the importance of data governance and security in ensuring ethical and responsible data sharing. They highlighted the need for clear frameworks and guidelines to determine the intended use of data and to ensure that it is being followed. There was a recognition that trust is currently placed on the receiving party to use the data in an ethical manner, but there was also a call for stronger mechanisms, such as third-party oversight, to enforce ethical data use. Additionally, GDPR was frequently mentioned as a regulatory framework that guides data-sharing practices. Interviewees mentioned the presence of privacy officers and mandatory GDPR training for employees to ensure compliance. The training programs aimed to educate employees on what data can and cannot be shared and emphasized the responsibility of individuals in maintaining ethical data practices.

The sensitivity of data, particularly in the context of consumer data was acknowledged by several interviewees. They highlighted the importance of not sharing personal or privacy-related data and the need to ensure that individuals cannot be recognized through shared data. The responsibility for protecting sensitive data was seen as a key aspect of ethical and responsible data sharing. Furthermore, interviewees discussed the importance of establishing strong partnerships with trusted organizations that have a good track record in terms of ethics and sustainability. They emphasized the need for contractual agreements to specify data-sharing requirements and to demand responsible data handling from partners. Contractual agreements were seen as a means to enforce ethical practices and protect sensitive data.

Transparency was mentioned as a solution for responsible data sharing. Interviewees suggested that sharing non-sensitive data with transparency could facilitate collaboration and problem-solving. Anonymization of data was also highlighted as an important approach, ensuring that personal data is protected while allowing

data to be shared for analysis and benchmarking. Internal controls and data governance policies were mentioned as mechanisms to ensure ethical and responsible data sharing. Interviewees discussed the importance of data encryption and formatting before data is shared externally. By having accurate data governance policies and following proper data formatting procedures, the process of data sharing can automatically be ethical and responsible.

Responsible data sharing was seen as enabling benchmarking and comparison with external companies, including competitors. Sharing data for benchmarking purposes could help identify areas for improvement and drive better performance across industries. Ethical and responsible data-sharing practices were viewed as essential in facilitating this process.

Overall, the interviews highlighted the importance of data governance, compliance with regulations, transparency, strong partnerships, and responsible practices in ensuring ethical and responsible data sharing in supply chains. While many organizations have mechanisms in place such as training programs, privacy officers, and legal teams, there was recognition that more work can be done to enhance the ethical and responsible use of shared data, especially as data becomes more customer-facing and intertwined with understanding customer needs in supply chain services.

To summarize, some of the distinct perspectives that occurred from this instrument can be seen in Table 4.10:

Table 4.10: Distinct perspectives: Instrument 10

Number	Perspectives
1	The requirement for third-party supervision should be taken into account to guarantee the ethical and responsible usage of data
2	There should be training programs (like GDPR) in place to ensure the responsible use of data
3	Compliance and auditing are needed, and more work is required in the supply chain to prioritize responsible data sharing
4	Ethical and responsible data sharing involves having soft agreements with partners for data sharing
5	Data sharing facilitated by AI or bots, is crucial for enabling faster, ethical and more reliable analytics and avoiding issues with delayed feedback in the supply chain
6	Sharing data that benefits society is crucial, but caution should be exercised to avoid collaborating with organizations that have a questionable track record
7	It is the shared responsibility of the company and its partners to work with established governance layers and Environmental, Social and Governance (ESG) considerations to ensure legal and ethical compliance
8	Ethical and responsible data sharing can be achieved through anonymization and implementing contractual agreements and data governance policies with encryption measures

Most and least important institutional instruments in terms of implementation

In the course of discussing institutional instruments and their impact on supply chain data sharing, a query was presented to the participants, similar to the previous set of instruments. The question was structured as follows: *"Can you provide an order of preference, from most to least important, among the listed instruments in terms of facilitating supply chain data sharing?"*. Similar to the previous set of instruments, the responses to this question per interviewee can be seen in Figure 4.4. In this figure, it can be seen that the average ranking column in the table indicates the collective preferences of the 14 interviewees regarding different instruments. It is noteworthy that the ranking values in this column follow a pattern where lower values are associated with higher preference. ***This implies that the least average ranking corresponds to the most preferred instrument***

among the interviewees, while the highest average ranking indicates the least preferred one. This pattern can be attributed to the fact that interviewees, on average, tend to assign lower rankings to instruments they perceive as less valuable or effective. Conversely, they allocate higher rankings to instruments they consider more beneficial or impactful in the context of emerging technologies. Therefore, we can conclude that the instrument with the least average ranking, as indicated in the table, is the most preferred one among the interviewees. Similarly, the instrument with the highest average ranking is the least favoured among the interviewees. It is noteworthy to see that interviewee 10 did not rank in order of preference, because they believed that all the instruments interact with each other.

The findings from this inquiry are detailed in Figure 4.5. The results revealed that a significant majority of the interviewees regarded the role of leadership and senior management in influencing data-sharing practices as the most important instrument. This was followed by trust, ethical and responsible data sharing, contractual agreements and data governance policies, and finally, cultural factors such as attitudes and personal perspectives of employees towards data sharing and privacy. Conversely, the instrument that was least preferred was education and training programs. This was because the interviewees perceived it as an optional component that did not significantly contribute to the facilitation of supply chain data sharing.

Instrument	Order of Preference														
	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7	Interviewee 8	Interviewee 9	Interviewee 10	Interviewee 11	Interviewee 12	Interviewee 13	Interviewee 14	Average
Cultural factors: attitudes and personal perspective towards data sharing and privacy	5	6	6	6	5	2	5	6	2	Null	3	2	5	2	4.2
Trust and Trust-building techniques	1	2	2	2	3	1	4	5	1	Null	2	3	3	6	2.7
Contractual agreements and data governance policies	2	5	5	3	6	5	3	1	5	Null	4	6	1	1	3.6
Education and training programs	6	3	3	5	2	6	6	2	6	Null	6	5	6	4	4.6
Role of Leadership and Senior Management	3	1	4	1	1	3	1	3	4	Null	1	1	4	3	2.3
Ethical and responsible data sharing	4	4	1	4	4	4	2	4	3	Null	5	4	2	5	3.5

Figure 4.4: Preference count in Institutional Instruments (from all interviews - least average ranking corresponds to the most preferred instrument among the interviewees, while the highest average ranking indicates the least preferred one)
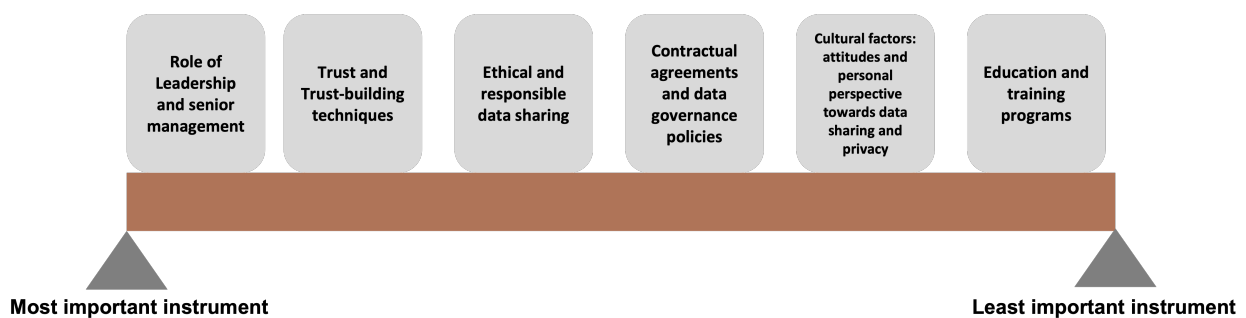

Figure 4.5: Preference Analysis in Institutional Instruments

4.1.5. Future of Data Sharing in the Supply Chain

The analysis of the 14 interviews revealed several common patterns and themes regarding the future of data sharing in the supply chain domain. The following sections summarize the key findings, including the identified benefits and drawbacks of data sharing, the role of technology, the need for standardized frameworks, and the importance of responsible and secure practices, as seen pictorially in Figure 4.6.

- *Integrated Approach and Demand Forecasting:*
  There is a consensus among interviewees that the future of data sharing in the supply chain requires a more integrated approach beyond traditional operational data sharing. The focus should be on demand forecasting and understanding end-consumer behaviour. By linking demand forecasting with data sharing, companies can make accurate decisions and prevent the production of unwanted goods.

- *Benefits of Data Sharing and AI:*
  Interviewees highlighted the benefits of better and faster data sharing combined with artificial intelligence. Companies can enrich their algorithms by leveraging multiple datasets, both internal and external, leading to improved supply chain performance and competitive advantage. Automation and AI enable faster, cheaper, and more reliable decision-making, but there is a concern about potential job losses.

- *Standardized Framework and Data Quality:*
  To facilitate data exchange among companies in a faster, more automated, and more accurate way, interviewees emphasized the need for a common industry framework. This framework should include standardized data structures and ensure data quality. However, despite the shift in the cultural mindset towards collaboration and data sharing, the technological and institutional framework is not yet universally in place, hindering widespread adoption.

- *Technology Adoption and Collaboration:*
  There is uncertainty regarding who will take the first step in implementing data-sharing technologies, which specific technologies will be adopted, who will manage the framework, and what incentives will drive adoption. It is suggested that a cluster of companies, third parties, or institutions may eventually provide the necessary framework for technology adoption in data sharing. Collaboration among various parties, including third parties and organizations, is expected to create industry-specific standards and data mechanisms.

- *Data Security and Responsible Practices:*
  Data security is a significant concern in the future of data sharing. Interviewees highlighted the increasing number of data breaches and hackers as challenges to data sharing. The emergence of many vendors consolidating and sharing data across the supply chain is seen as a positive development, but a common platform requires consensus, solid security measures, and funding. Responsible data-sharing practices are essential to ensure the protection of consumers, individuals, and companies involved.

- *Role of Information Technology:*
  Information technology plays a crucial role in the future of data sharing. Automation, artificial intelligence, and the use of dashboarding tools such as Power BI are expected to enable faster communication, real-time data sharing, and improved decision-making processes. However, the specific technology that will emerge and dominate the future of data sharing remains uncertain.

- *Geopolitical Trends and Communication Barriers:*
  Geopolitical trends pose challenges to data sharing in the supply chain. Companies are hesitant to abandon their proprietary niches, potentially hindering the establishment of interfaces between different parts of the supply chain. Large geographical clusters may start to prioritize self-sufficiency, creating potential communication barriers. Overcoming these barriers and fostering collaboration is crucial for the future of data sharing.

In conclusion, the future of data sharing in the supply chain domain involves an integrated approach focused on demand forecasting, leveraging artificial intelligence, and ensuring standardized frameworks and data quality. Collaboration among various parties, responsible practices, and robust security measures are necessary.

Information technology plays a significant role, but the specific technology and its impact remain uncertain. Overcoming geopolitical trends and communication barriers will be critical for successful data sharing in the supply chain.
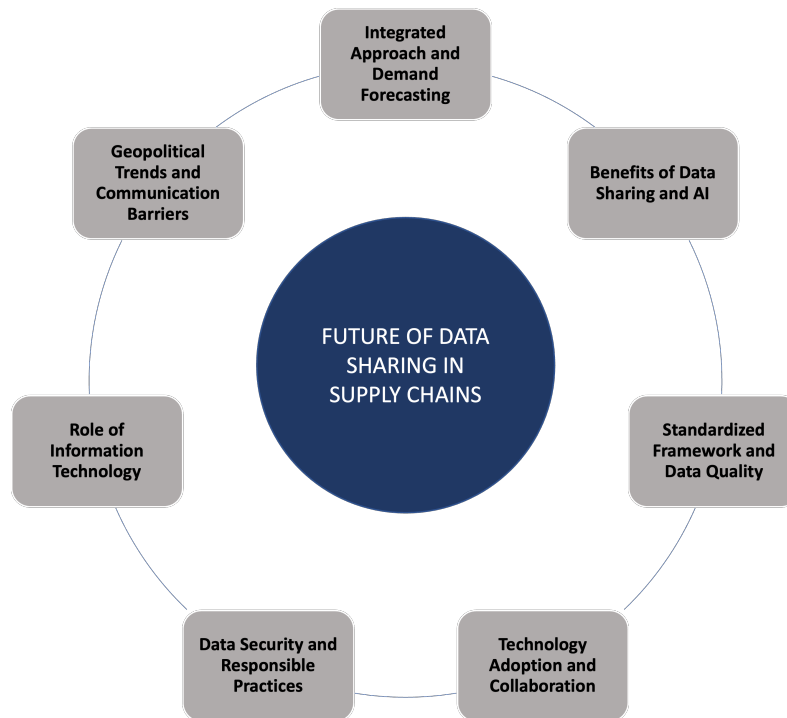
Figure 4.6: Future of Data sharing in Supply Chains

4.2. Conclusion

This chapter effectively addresses the fourth sub-research question: *To what extent can the derived combination of infrastructural and institutional instruments be utilized to overcome the identified barriers?* Through an analysis of transcribed interviews within the supply chain domain, valuable insights have been gained regarding the advantages and obstacles of data sharing. Noteworthy benefits include strengthened collaboration, more accurate forecasting and planning, improved supply chain management, and resilience against macroeconomic disruptions. However, to fully harness these advantages, it is crucial to address challenges such as data security and privacy concerns, the establishment of trust and transparency, handling technical complexities, and the implementation of standardized interfaces.

To maximize the benefits and overcome these challenges, companies should establish clear guidelines, protocols, and agreements, invest in data security measures, and build trust-based relationships with supply chain partners. Emerging technologies like Information and Communication Technology (ICT) and Blockchain have a significant impact on supply chain data sharing, enabling real-time tracking, improved decision-making, enhanced transparency, and trust among participants. However, challenges related to implementation, change management, data security, and standardization need attention. Similarly, advanced technologies like AI and ML offer potential benefits in demand forecasting and optimization. However, concerns about data quality, privacy, and competitive advantage remain. Standardization of data formats and interoperability between firms are crucial for efficient data utilization and seamless collaboration. Balancing security measures like encryption and access controls with innovation is necessary to protect sensitive data and build trust.

The analysis of the interviews also reveals the importance of cultural factors, trust, collaboration, privacy concerns, legal protections, contractual agreements, data governance policies, education, and leadership in promoting data sharing in the supply chain. A culture shift may be required to prioritize the organization's objectives over personal perspectives, and building trust through transparency, relevance, and responsible practices is essential. Education and training programs can create awareness and equip employees with the necessary skills. Leadership and senior management play a crucial role in setting an example and collaborating with external parties. Figure 4.3 and Figure 4.5 in combination can be considered the refined framework after this phase.

Looking ahead, an integrated approach is needed for the future of data sharing in the supply chain. This approach should focus on demand forecasting, leveraging artificial intelligence, ensuring standardized frameworks, and maintaining data quality. Collaboration, responsible practices, and robust security measures are necessary for successful implementation. The specific technology and its impact remain uncertain, but overcoming geopolitical trends and communication barriers will be critical for the widespread adoption of data sharing in the supply chain.

5

Phase III: Validation Results

In the previous chapter 4, a multitude of perspectives emerged regarding the influence of each instrument on data sharing within the supply chain. Now, in this current chapter, these diverse perspectives are carefully consolidated and utilized to develop an interview protocol for Phase III involving the validators (selection criteria mentioned in chapter 2). During this validation phase, the validators were presented with the following question:

To what extent can the distinct perspectives that emerged from the single case study interviews be generalized to similar high-tech firms with complex supply chain intricacies?

To gather their input, the validators were provided with a simple Likert scale, offering options ranging from agree (indicating generalizability of the perspectives), neutral (acknowledging potential generalizability with certain considerations), to disagree (suggesting lack of generalizability). According to Sekaran and Bougie (2016), a Likert scale is a measurement tool that assesses the degree of agreement or disagreement with statements using a three or five-point scale. Analyzing the responses item by item allows for an examination of specific concepts or variables. Alternatively, a total or summated score can be calculated for each respondent by summing the scores across items. This summated approach is commonly employed, and it will also be utilized in the validation phase of this study. It's worth noting that the Likert scale is often referred to as a summated scale.

The objective of this chapter is to provide an in-depth analysis of the responses collected from the interviewers, along with their explanations for selecting a particular rating on the Likert scale. By the conclusion of this chapter, it will be determined which instruments exhibited the highest degree of generalizability and which ones did not fare as well.

5.1. Infrastructural instruments

Instrument 1: Emerging technologies like Information and Communication Technology (ICT), Blockchain

This section of the master thesis report focuses on the responses obtained from interviews with validators regarding the generalizability of different perspectives on emerging technologies, specifically ICT and Blockchain. A summarized analysis of the responses can be seen in Figure 5.1. The validators reached a consensus on the importance of digital transformation and careful evaluation of technology deployment. While acknowledging the challenges associated with implementing these technologies, they also recognized their potential in establishing a standardized framework.

Potential and Challenges of Blockchain Technology: One validator emphasized the genuine potential of blockchain in addressing various aspects such as property rights, legal matters, contracts, transparency, and data sharing, particularly in the supply chain context. They believed that blockchain could significantly reduce data manipulation and stressed the importance of focusing on its utility in supply chain management. However, another validator expressed a more cautious perspective, stating that blockchain has not yet reached a stage where it can effectively handle diverse products. They highlighted the challenges of integrating different forms and formats of data into the blockchain and suggested further examination of specific data product types before incorporating them. Despite this caution, the validator expressed optimism about future feasibility.

Perspectives	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5
There are challenges in implementing it, but there is potential for a standardized framework	Agree	Agree	Agree	Agree	Agree
It will lead to efficient decision-making that benefits all stakeholders involved	Agree	Agree	Neutral	Agree	Neutral
Their deployment requires digital transformation, change management, and careful evaluation of their usefulness	Neutral	Agree	Agree	Agree	Agree
Blockchain technology can address issues related to property rights and legal aspects of data sharing	Neutral	Neutral	Disagree	Agree	Neutral
Blockchain is a buzzword: There are good use cases, but it should not be applied just for the sake of using a popular technology	Agree	Agree	Agree	Disagree	Agree
Emerging technologies like ICT and Blockchain can facilitate data sharing and analysis, especially in situations with diverse products	Neutral	Neutral	Agree	Agree	Agree
The technologies improve traceability and trust among stakeholders	Neutral	Neutral	Neutral	Agree	Neutral
They might pose security risks that need to be addressed by enhancing security measures	Agree	Agree	Agree	Neutral	Agree

Figure 5.1: Validation analysis- Instrument 1

Risk and Security Considerations in Blockchain Technology: Regarding risk, one validator acknowledged that all endeavours carry some level of risk, including the use of blockchain technology. However, they argued that when comparing situations where blockchain is utilized versus situations where it is not, the security risks would generally be lower in the former. They advocated for comparing technology usage scenarios to not using them, specifically addressing the question of security risk. Despite this argument, the validator remained neutral, indicating that the presented viewpoint did not completely convince them.

Balancing Stakeholder Interests and Achieving Universal Benefits in Decision-Making: The validators had mixed responses regarding whether ICT and Blockchain contribute to efficient decision-making that benefits all stakeholders involved. One validator emphasized the importance of finding a delicate balance, noting that advantages for one stakeholder may potentially be detrimental to another. They expressed scepticism about the claim that all stakeholders will benefit and found it overly inclusive. Another validator focused on the supply chain context and highlighted the disparity in benefits between different stakeholders. They raised concerns about information sharing and the reluctance of organizations to share information, which complicates efficient decision-making. Balancing stakeholders' interests and varying advantages poses challenges to achieving universal benefits, especially considering the reluctance to share information in complex supply chains.

Blockchain for Property Rights and Legal Aspects of Data Sharing: The validators' perspectives on the potential of blockchain technology for addressing issues related to property rights and legal aspects of data sharing were also mixed. One validator acknowledged the potential of blockchain, particularly through the use of smart contracts, for enabling data ownership and control. However, they highlighted concerns raised by stakeholders regarding the legal aspects and immutability of the blockchain. The lack of legal grounding and uncertainty surrounding corrections or missing information contributed to a critical and hesitant stance towards adopting blockchain technology for data sharing. Another validator expressed neutrality due to the specificity of the statement, while the final validator disagreed and emphasized concerns about surrendering control over the flow of information when relying on blockchain technology.

Effectiveness of ICT and Blockchain in Enhancing Traceability and Trust: The effectiveness of ICT and Blockchain in improving traceability and trust among stakeholders received varied responses from the validators. Some expressed a neutral stance, acknowledging the potential benefits but noting the lack of concrete use cases or conflicting ideas in the literature. Another validator highlighted the need to consider factors beyond technology, such as organizational processes, to establish trust. Scepticism about the reliability of shared data was also raised, questioning the accuracy, completeness, and integrity of the data, particularly in competitive supply chain situations. Some validators expressed doubts about the trustworthiness and functioning of technology itself, making the claim of technology automatically improving trust questionable.

Instrument 2: Advanced technologies like Artificial Intelligence and Machine learning

This section explores the opinions obtained from interviews with validators regarding the generalizability of advanced technologies like AI and ML in supply chain data sharing. The validators expressed varying perspectives on the topic. Figure 5.2 provides a thorough analysis of the validators' responses. Some validators were sceptical about the benefits of data sharing in the supply chain, while others recognized the potential power and risks associated with AI and ML technologies. Concerns were raised about the secure implementation of these technologies. Although the majority of the validators agreed that these technologies aid in demand forecasting and resource planning, one validator was sceptical because they think that relying solely on algorithms without ensuring excellent data quality manually would not magically solve supply chain problems.

Skilled Workforce and Access to Data in Implementing Emerging Technologies: There was a disagreement among validators about whether a skilled workforce and access to large amounts of data are necessary for implementing these technologies effectively. One group of validators argued that AI and ML technologies are becoming more user-friendly and accessible, diminishing the need for a highly skilled workforce. They suggested that integrating AI into data-sharing platforms could simplify its usage for a wider community. However, another group emphasized the importance of a capable workforce for the effective implementation of these technologies.

Optimizing Supply Chain Collaboration through AI and ML: The topic of optimizing supply chain processes through collaboration between companies elicited mixed responses from validators. Some validators highlighted the need to address the challenges of data sharing before considering the impact of AI and ML. Others expressed scepticism about the suitability of these technologies in optimizing collaboration. Concerns were also raised about the willingness of organizations to share information due to potential conflicts between the benefits of sharing and individual stakeholder interests.

Perspectives	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5
The technologies have great potential in improving demand forecasting and resource planning	Agree	Agree	Agree	Agree	Neutral
Embracing the potential of these technologies is crucial for companies to avoid missed opportunities and losing out to competitors	Agree	Agree	Agree	Agree	Neutral
There will be substantial benefits in supply chain data sharing, leading to improved efficiency and effectiveness across multiple organizations	Agree	Agree	Neutral	Disagree	Disagree
Implementation of these technologies requires a skilled workforce and access to large amounts of data	Agree	Disagree	Disagree	Disagree	Agree
These technologies can optimize overall supply chain processes through collaboration between companies	Agree	Agree	Neutral	Disagree	Neutral
AI is a bunch of nonsense for now. However, Machine learning could help manage unstructured data and improve knowledge management	Neutral	Neutral	Neutral	Disagree	Disagree
They improve data security by identifying and linking unauthorized content, events, and incidents	Neutral	Agree	Neutral	Agree	Disagree
They are potentially powerful but dangerous technologies, and are unsure about their secure application in supply chain sharing	Agree	Agree	Neutral	Disagree	Agree

Figure 5.2: Validation analysis- Instrument 2

Identifying and Linking Unauthorized Content for Data Security: Validators had differing opinions on whether a specific solution improves data security by identifying and linking unauthorized content, events, and incidents. One validator disagreed while another found the statement too vague to form an opinion. A third validator acknowledged some benefits but argued that additional measures are necessary to enhance data security, emphasizing the need for complementary actions alongside machine learning.

Effectiveness of Machine Learning for Unstructured Data and Knowledge Management: Regarding the statement that "AI is a bunch of nonsense for now. However, Machine learning could help manage unstructured data and improve knowledge management," validators expressed diverse views. One validator expressed scepticism about the effectiveness of machine learning in handling unstructured data and knowledge management, citing challenges related to explainability and algorithm limitations. Another validator emphasized the importance of providing specific explanations and clarifying the context to gain a better understanding of AI's implications. There was disagreement about segregating machine learning and AI, with one validator suggesting a more integrated view. Some validators agreed that machine learning could benefit from managing unstructured data, while another validator remained neutral, emphasizing the complexity of the machine learning process and the need for diverse approaches.

Instrument 3: Standardization of data formats and Interoperability between firms

The section presents the perspectives of validators on the generalizability of different perspectives of standardization of data formats and interoperability between firms in supply chain data sharing. Figure 5.3 provides a thorough analysis of the validators' responses. The validators unanimously agreed on the importance of standardization and interoperability for automation, particularly in conjunction with AI or ML, as it reduces

the reliance on manual inputs and operations. They emphasized the need for both technical and functional layers to ensure a common understanding and effective communication.

Data Sharing Challenges and the Centralization vs. Decentralization Debate: The validators noted that having a centralized platform does not guarantee uniform data sharing in the supply chain. Multiple vendors often promote their own platforms, leading to a fragmented landscape. The dominance of a specific platform remains uncertain, and the existence of a platform does not automatically facilitate seamless data sharing. Validators expressed neutral and uncertain stances on the centralization versus decentralization debate, emphasizing the significance of data standardization. One validator highlighted the hierarchical nature of data sharing, where main companies hold significant power, which can lead to smaller businesses being exploited. The International Data Sharing Initiative (IDSI) was mentioned as an example within the European Union framework to address these challenges and achieve interoperability.

Perspectives	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5
A centralized platform and collaboration initiatives enable uniform data sharing (multi-organization-oriented solutions)	Agree	Agree	Disagree	Agree	Neutral
There will be challenges in adoption by the firms and huge incurring costs	Agree	Neutral	Agree	Agree	Neutral
Standardizing data formats is crucial for ensuring perfect interoperability between firms and avoiding miscommunications and discrepancies within data	Agree	Agree	Agree	Agree	Neutral
It is critical for automation, especially with the use of AI or machine learning, as it reduces the need for manual inputs and operations	Agree	Agree	Agree	Agree	Agree
It requires both technical and functional layers to ensure a common understanding and effective communication	Agree	Agree	Agree	Agree	Agree
The use of standardized data formats is essential for achieving interoperability between firms in the supply chain	Agree	Agree	Agree	Agree	Neutral
Each company has its own framework for how data should be published and maintained, hence standardization is unlikely	Neutral	Disagree	Agree	Disagree	Neutral

Figure 5.3: Validation analysis- Instrument 3

Importance of Standardization for Achieving Interoperability and Competitive Advantage: Validators emphasized the importance of standardization beyond data formats, including aspects such as semantics, behaviour, and legal considerations, to achieve true interoperability. Technical interpretability and understanding of the actual meaning behind the data were also highlighted. Common understanding and legal authorization to access and utilize the data were considered crucial. Interoperability frameworks were suggested as a means to address these concerns. In addition, future research suggestions from a validator include considering distinct levels of interoperability, providing greater precision in measurement, and adopting a comprehensive approach to standards covering technical aspects, semantics, usage, and legality. While data sharing is crucial for companies to remain competitive, standardization is seen as necessary for companies to thrive. Adhering to standardized infrastructure allows companies to differentiate themselves and create new value propositions. Validators expressed differing views on the extent and nature of standardization, with some believing in the necessity of comprehensive standards covering various aspects.

Evolution of Information Systems and Standardization: Lastly, validators discussed the evolution of information systems and the potential for companies to maintain their own systems while developing

standardized interfaces to connect with each other. The needs and goals of companies should be considered, and standardization becomes a requirement for collaboration and information sharing.

Instrument 4: Data security measures: Encryption and access controls

This section presents the responses obtained from interviews with validators regarding the generalizability of different perspectives on data security measures, specifically encryption and access controls, in the context of supply chain data sharing. A summarized analysis of the responses can be seen in Figure 5.4. The validators provided valuable insights and perspectives on various aspects related to compliance, ethics, governance, risk management, and the challenges faced by SMEs.

Data Security and Governance in Supply Chain Data Sharing: The validators unanimously agreed that encryption and access control measures are necessary for ensuring compliance and ethics when dealing with personal information in the supply chain. They emphasized the importance of the Confidentiality, Integrity, and Availability (CIA) triad as fundamental considerations for data security. However, one validator suggested expanding the triad to include Safety, particularly for companies with Operational Technology (OT) systems. This perspective highlights the need to consider safety alongside confidentiality, integrity, and availability in data security measures. A validator expressed the belief that even without encryption and access control, a clear governance framework is essential for secure data sharing. This perspective emphasizes the importance of governance in determining authorized individuals and types of data accessibility, regardless of specific security methods.

Data Privacy and Security Risks: The validators discussed the risk of data privacy and security breaches in the supply chain, and one validator challenged the notion that encryption and access control alone ensure absolute prevention of breaches. This validator argued that there may be cases where sharing sensitive information is necessary, suggesting that prevention measures may not always be foolproof.

SMEs' Data Security Challenges and User-Friendly Technologies: The challenges faced by SMEs in implementing strong data security measures were acknowledged by the validators. Limited resources and knowledge were identified as potential barriers for SMEs, emphasizing the need for greater support and training in addressing data security risks. The validators also mentioned the potential of user-friendly technologies like AI to enhance data security in SMEs, highlighting the importance of user interfaces (UI) and their potential benefits.

Data Security vs. Innovation in Supply Chain Transformation: When considering the impact of overly strict data security measures on innovation and the supply chain transformation process, validators presented diverse opinions. While some validators disagreed with the perspective that strict measures hinder innovation, others emphasized the crucial role of security in any information system. Striking a balance between security concerns and facilitating effective information sharing was deemed important.

Concerns about Blockchain for Secure Data Sharing: The validators expressed scepticism about the effectiveness of blockchain as a solution for secure data sharing. Concerns were raised about security issues associated with blockchain, including potential manipulation of the network and limitations of the technology. Some validators highlighted the difference between encryption and blockchain, focusing on privacy and transparency aspects, respectively. The prioritization of security varied among organizations, with larger companies more likely to prioritize security due to regulations and prior experience. SMEs and startups may have different priorities depending on their unique circumstances and risk assessments.

Perspectives	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5
There is a strong need for a governance system to ensure secure data sharing and confidentiality through encryption and access controls	Neutral	Agree	Agree	Agree	Agree
They are essential to mitigate the risk of data privacy and security breaches in the supply chain while ensuring the right level of access without breaching or sharing any sensitive data	Agree	Agree	Neutral	Agree	Agree
They are necessary for compliance and ethics when dealing with personal information	Agree	Agree	Agree	Agree	Agree
Overly strict data security measures can hinder innovation and slow down the supply chain transformation process	Agree	Neutral	Disagree	Disagree	Agree
Data security measures hinder data sharing due to increased difficulty in decryption. Hence, Blockchain should be a priority for secure data sharing	Disagree	Disagree	Disagree	Disagree	Disagree
Unlike big high-tech firms, smaller companies may face barriers to implementing robust data security measures	Agree	Neutral	Neutral	Agree	Agree
Confidentiality, integrity, and availability (CIA triad) are important considerations for data security when sharing data in the supply chain	Agree	Agree	Agree	Agree	Agree
Many organizations do not prioritize security until they experience a breach and implementing encryption can be challenging and burdensome	Agree	Neutral	Neutral	Agree	Neutral
Encrypted documents once shared cannot be protected from further manipulation and distribution by authorized parties	Disagree	Agree	Agree	Neutral	Neutral

Figure 5.4: Validation analysis- Instrument 4

Encryption and Protection of Shared Documents: Regarding the assertion that encrypted documents once shared cannot be protected from further manipulation and distribution by authorized parties, one validator expressed confusion due to limited technical knowledge. Another validator disagreed with the statement, suggesting that encryption should provide sufficient protection against manipulation. However, both validators lacked extensive knowledge in this area, and their perspectives may not be generalized.

5.2. Institutional instruments

Instrument 5: Cultural factors: attitudes and personal perspectives towards data sharing and privacy

In this section, we present the perspectives shared by the validators regarding the generalizability of different cultural factors in relation to attitudes and personal perspectives towards data sharing and privacy in supply chain data sharing. Figure 5.5 shows a brief analysis of the responses. The validators' opinions provide valuable insights into this matter, emphasizing the importance of trust, collaboration, and cultural context in shaping attitudes towards data sharing.

Importance of Trust and Collaboration: All validators unanimously agree on the significance of trust and collaboration in data sharing. They acknowledge that without trust, data cannot be effectively utilized, and positive outcomes are unlikely to be achieved. They emphasize that willingness to collaborate is necessary

to establish a conducive environment for data sharing. The validators also highlight the need for a culture shift, internal training, and change management to ensure individuals feel secure about data sharing. Clear communication of the benefits and implementation of proper training programs within organizations are deemed essential to address concerns and foster a positive attitude towards data sharing.

Influence of Privacy-focused Culture in Europe: The validators acknowledge that Europe has a privacy-focused culture, largely influenced by GDPR laws. They recognize that individuals in Europe have the freedom to voice their concerns about data sharing, which plays a significant role in shaping attitudes and perspectives towards data sharing and privacy.

Disagreement on Limited Data Awareness: One validator disagrees with the perspective that limited data awareness can lead to unintended consequences in online data sharing. They believe that there is already a considerable amount of awareness regarding privacy, especially within organizations. This suggests that individuals are generally conscious of the potential risks associated with data sharing and take appropriate measures to protect their privacy.

Perspectives	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5
Cultural factors are not a barrier to data sharing as it is widely accepted to enhance supply chain efficiency	Neutral	Disagree	Disagree	Disagree	Disagree
Supply chain professionals are generally data-oriented and don't see any reason for cultural attitudes to be a hurdle to data sharing	Neutral	Disagree	Disagree	Disagree	Neutral
Individuals should think on behalf of the company rather than their personal opinions when making decisions related to data sharing	Agree	Agree	Agree	Agree	Agree
Without trust in partners, data cannot be properly utilized, and willingness to collaborate is necessary for positive outcomes	Agree	Agree	Agree	Agree	Agree
A culture shift, internal training, and change management are required to ensure people feel secure about data sharing with clear communication of benefits	Agree	Agree	Agree	Agree	Agree
Individuals' attitudes towards privacy vary and become a concern only when it affects them personally	Agree	Neutral	Disagree	Disagree	Agree
Limited privacy awareness can lead to unintended consequences in online data sharing	Agree	Agree	Disagree	Agree	Agree
Data sharing decisions are made by the company, regardless of employee attitudes and perspectives	Agree	Agree	Agree	Disagree	Disagree
Europe has a privacy-focused culture due to GDPR laws, and individuals have the freedom to voice their concerns about data sharing	Agree	Agree	Agree	Agree	Agree

Figure 5.5: Validation analysis- Instrument 5

Employee Attitudes and Perspectives in Decision-making: The validators express disagreement with the notion that data-sharing decisions are made solely by the company, regardless of employee attitudes and perspectives. They emphasize that a company is composed of individuals, including employees, who make decisions based on their judgment and intuition while aligning their choices with the company's strategy. Considering employee attitudes and perspectives is deemed essential for effective decision-making in data-sharing processes.

Cultural Factors as Barriers to Data Sharing: The responses from the validators unanimously disagree with the statement that cultural factors are not a barrier to data sharing in enhancing supply chain efficiency. Different perspectives shed light on the significant influence of cultural norms and preferences. Personal connections, relational trust, and cultural practices are identified as pivotal in establishing partnerships with suppliers, particularly from an Eastern perspective. Varied acceptance of data sharing across cultures and cultural contexts impacting data-sharing approaches are highlighted. A culture discouraging information sharing in competitive organizational environments is seen as a barrier to data sharing.

Disagreement on Supply Chain Professionals' Data Orientation: The validators present varying perspectives regarding the statement that supply chain professionals are generally data-oriented and don't see any reason for cultural attitudes to be a hurdle to data sharing. One response suggests a disagreement, highlighting that many supply chain professionals still rely on outdated methods and cultural attitudes, particularly related to trust, which poses significant challenges in data sharing. Another validator supports this disagreement, stating that supply chain professionals are influenced by various cultural factors that significantly impact their attitudes towards data sharing. The influence of organizational culture and varying degrees of data orientation based on cultural variations are also emphasized.

Attitudes towards Privacy in Relation to Personal and Business Matters: The validators offer diverse viewpoints on the perspective that individuals' attitudes towards privacy become a concern only when it affects them personally. One response suggests a neutral stance, emphasizing cultural differences and the varying importance of privacy. Another validator disagrees, asserting that privacy concerns extend beyond personal matters and can change based on the actions of companies. The influence of organizations' awareness campaigns on individuals' attitudes in business settings is also highlighted.

Instrument 6: Trust and trust-building

In this section, we examine the perspectives of validators regarding the generalizability of trust in supply chain data sharing. These perspectives include the role of reputable companies with advanced technology, collaboration and relationship-building, clear guidelines for data usage, pilot projects and actual performance, a balanced distribution of benefits, and the importance of predictability and stable behaviour patterns. Each perspective provides unique insights into the complex nature of trust in supply chain data sharing. In Figure 5.6, the responses are analyzed briefly.

Trust in Reputable Companies with Advanced Technology: Validators expressed concerns about the trustworthiness of companies utilizing advanced technologies, highlighting the lack of practical examples to demonstrate their effectiveness in safeguarding data. They emphasized that trust in these companies may require additional efforts such as investments and research to educate potential clients on system functionality and reliability. One validator challenged the significance of trust itself, suggesting that contractual obligations, agreements, and governance structures hold greater importance. This perspective questions the notion that collaboration and relationship-building are the primary drivers of trust in supply chain data sharing.

Clear Guidelines for Data Usage: Validators held opposing views on the establishment of clear guidelines for data usage. While one validator disagreed that guidelines are the initial steps to building trust, emphasizing that trust between companies is typically established first, another validator agreed that clear guidelines are essential but highlighted that trust is often built through factors beyond formal documentation. This divergence indicates the need for further examination of the relationship between clear guidelines and trust in supply chain data sharing.

Perspectives	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5
Companies with reputation and advanced technology can be trusted for secure data protection measures	Neutral	Agree	Agree	Agree	Neutral
Collaboration and maintaining relationships via communication are important ways to build trust between companies	Agree	Agree	Disagree	Agree	Agree
To build trust, clear guidelines should be established for data usage (transparency) and ensured they are followed by both internal and external parties	Agree	Agree	Agree	Disagree	Neutral
Trust can be established through written agreements, including Non- Disclosure Agreements (NDAs) and formal contracts	Agree	Agree	Disagree	Disagree	Agree
Trustworthiness can be established through pilot projects and subsequently confirmed by the actual performance of long-term projects	Agree	Agree	Neutral	Agree	Agree
A balance needs to be struck to ensure that all parties involved benefit (50-50 rule) and that there is no extortion	Agree	Neutral	Agree	Agree	Neutral
Trust can be built by creating a common goal, avoiding blame, defining a clear partnership strategy	Agree	Agree	Disagree	Disagree	Agree
Trust is built on predictability and stable patterns of behaviour, supported by effective risk management controls, but cannot be guaranteed by contracts alone	Agree	Agree	Neutral	Agree	Agree
Trust is completely based on facts, figures, and practical proofs	Disagree	Neutral	Disagree	Neutral	Neutral

Figure 5.6: Validation analysis- Instrument 6

Pilot Projects and Actual Performance: Validators discussed the role of pilot projects in establishing trustworthiness and acknowledged the distinction between trust at an individual level within pilot projects and trust at a corporate level between companies. While trust can be built on a personal level, it may not necessarily align with trust established through pilot projects. This perspective highlights the complexity of trust and suggests that different levels of trust may exist within supply chain data sharing.

Balanced Distribution of Benefits: Validators expressed mixed feelings about the concept of a balanced distribution of benefits, recognizing the challenges associated with maintaining a balance due to power dynamics within supply chains. The dominance of certain players in the supply chain often leads to imbalances, making the 50-50 rule impractical. Validators also raised concerns about power concentration when focal partners demand more data. Initiatives such as dataspaces aim to address these issues and reduce power concentration within a single company.

Importance of Predictability and Stable Behavior: Validators agreed that trust is established through predictability and consistent behaviour. However, opinions differed on the role of risk management in building trust. While one validator expressed uncertainty about the relationship between risk management and trust, others emphasized that contracts alone cannot guarantee trust. They suggested that while contracts ensure cooperation, trust encompasses a deeper level of commitment beyond contractual obligations.

Overall, trust in supply chain data sharing is a multifaceted concept that cannot solely rely on facts, figures, and practical proofs. Validators highlighted the importance of additional factors such as reputation, advanced technology, collaboration, clear guidelines, pilot projects, balanced benefits, predictability, and stable behaviour. Trust is influenced by both tangible and intangible elements and requires careful consideration in

the context of supply chain data sharing.

Instrument 7: Contractual agreements and data governance policies

This section explores the generalizability of perspectives regarding the effectiveness and implications of contractual agreements and data governance policies in facilitating supply chain data sharing. The insights presented are based on interviews conducted with validators, who provided diverse viewpoints on this topic. A summarized analysis of the responses can be seen in Figure 5.7.

Perspectives on Trust and Relationships: One perspective emphasizes that policies alone are insufficient to prevent losses and breaches in supply chain data sharing, highlighting the importance of trust and long-standing relationships. A validator expresses neutrality on this perspective, acknowledging that while policies can include contracts or agreements, trust plays a crucial role in fostering relationships. Another validator finds the concept of trust challenging to understand and apply correctly. One perspective argues that signed data-sharing agreements and contracts can facilitate mutual trust, while another validator disagrees, stating that such agreements are about cooperation rather than trust. Divergent opinions highlight different interpretations of the role that contracts and agreements play in establishing trust among parties involved in supply chain data sharing.

Enforcement of Agreements and Policies: One perspective suggests that strict enforcement is necessary to prevent parties from disregarding agreements, while another validator cautions against excessive formalities that may hinder collaboration and the achievement of shared goals. There is tension between the need for strict enforcement and the desire to maintain a flexible and collaborative environment for effective supply chain operations.

Effectiveness of Legal Frameworks: One perspective raises doubts about the effectiveness of legal frameworks in establishing trust, highlighting GDPR in Europe as an example. A validator maintains a neutral stance, emphasizing that trust depends on how seriously both parties take the legal measure and demonstrate commitment to its principles. While a legal framework is deemed necessary, it is not the sole determining factor in fostering trust. Alignment, common understanding, and adherence to the framework are crucial.

Impact on Supply Chain Operations: One perspective asserts that agreed-upon policies ease operations by providing clear guidelines, while a validator expresses neutrality, pointing out challenges in creating contracts for data usage. Practical challenges hinder the realization of clear guidelines, and there is a need for a decision model in the future to recommend appropriate licenses based on data types.

Necessity of Contractual Agreements and Data Governance Policies: Validators disagree with the notion that the necessity of agreements solely relies on the sensitivity of the data. Non-sensitive data can hold value for organizations, necessitating agreements to control its sharing and usage. Uncertainties surrounding companies' capabilities in the digital age make agreements essential, regardless of sensitivity, to ensure proper data handling.

Legal Measures for Data Security: Opinions vary on whether legal measures primarily serve to avoid legal repercussions rather than proactively improve data security. Validators have neutral and differing positions on the role of legal frameworks, contractual agreements, and governance policies in enhancing data security and establishing trust. Legal measures are seen as reactive in addressing issues, but they are also recognized as proactive measures when accompanied by technological solutions.

Perspectives	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5
Legal frameworks designed to manage critical or sensitive data may not be successful in establishing trust	Neutral	Neutral	Agree	Agree	Agree
Signed data-sharing agreements and contracts can facilitate mutual trust	Agree	Agree	Disagree	Agree	Agree
The necessity of these agreements depends on the sensitivity of the data	Disagree	Disagree	Agree	Agree	Agree
Agreed policies ease supply chain operations by providing clear guidelines	Agree	Neutral	Agree	Agree	Agree
Effective data governance policies and contractual agreements involve specialized legal expertise, talent acquisition, and clear communication with all employees	Agree	Agree	Agree	Agree	Neutral
The policies alone are insufficient to avoid losses and breaches. Trust and long-standing relationships are crucial for data sharing	Neutral	Agree	Disagree	Agree	Agree
The agreements and policies must be strictly enforced to prevent parties from disregarding them	Agree	Agree	Agree	Agree	Disagree
They are primarily a means to avoid legal repercussions rather than a proactive measure to improve data security	Disagree	Neutral	Agree	Agree	Neutral

Figure 5.7: Validation analysis- Instrument 7

Instrument 8: Education and training programs

This section explores various perspectives gathered from interviews with validators in the context of education and training programs for supply chain data sharing. The aim is to understand the generalizability of different approaches and their implications for successful implementation. One unanimous agreement among the validators is the crucial role of leadership support and buy-in for the success of these programs. In Figure 5.8, a concise analysis of the responses can be found.

Company Culture and Change Management: One perspective highlights the significance of company culture and change management in deploying education and training programs that require open collaboration and data sharing. It suggests that these programs can act as a means to realize change within an organization or improve company culture. The validators recognize the vital role of education and training programs in achieving successful change management. However, there is a difference in opinion regarding the role of intrinsic motivation. While one validator believes it is not a key factor and emphasizes the enforcement of training protocols, another validator disagrees and believes intrinsic motivation should be considered.

Tailoring Programs vs. Generality: Another perspective suggests that education and training programs should be tailored to specific needs, while another validator favours a more general approach that can be applied to various situations. This indicates a need to strike a balance between tailoring programs and maintaining generality to cater to diverse requirements.

Mindset of Digital Technology Adoption: The importance of cultivating a mindset of digital technology adoption in education and training programs is highlighted. While one validator acknowledges the need for specialized training, another validator suggests that a broader level of training suffices for general awareness and understanding. Additionally, the challenge of implementing data-sharing infrastructure, particularly for SMEs, is mentioned, emphasizing the need for user-friendly interfaces and education about data ownership.

Perspectives	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5
Legal frameworks designed to manage critical or sensitive data may not be successful in establishing trust	Neutral	Neutral	Agree	Agree	Agree
Signed data-sharing agreements and contracts can facilitate mutual trust	Agree	Agree	Disagree	Agree	Agree
The necessity of these agreements depends on the sensitivity of the data	Disagree	Disagree	Agree	Agree	Agree
Agreed policies ease supply chain operations by providing clear guidelines	Agree	Neutral	Agree	Agree	Agree
Effective data governance policies and contractual agreements involve specialized legal expertise, talent acquisition, and clear communication with all employees	Agree	Agree	Agree	Agree	Neutral
The policies alone are insufficient to avoid losses and breaches. Trust and long-standing relationships are crucial for data sharing	Neutral	Agree	Disagree	Agree	Agree
The agreements and policies must be strictly enforced to prevent parties from disregarding them	Agree	Agree	Agree	Agree	Disagree
They are primarily a means to avoid legal repercussions rather than a proactive measure to improve data security	Disagree	Neutral	Agree	Agree	Neutral

Figure 5.8: Validation analysis- Instrument 8

Motivation through Business Case Studies vs. Education and Training Programs: Validators provide different responses to the question of whether motivation through business case studies or success stories of competitors is more effective than education and training programs for sharing data. One validator disagrees with treating them as separate entities, as education and training programs can incorporate business case studies and success stories. Another validator disagrees with the statement but believes that education and training programs should incorporate real-life cases and success stories. The third validator expresses neutrality and discusses the challenges of education and training within the data-sharing community.

Training in the Future with a Common Framework for Technology: The question of whether training is necessary for the future if a common framework for technology is adopted is addressed. One validator challenges the notion that training should be a future requirement, emphasizing the importance of proactive engagement in training to capitalize on technology's benefits. Another response supports the idea that training is always beneficial without providing extensive reasoning.

Data Sharing Supercentres and Identifying Shareable Data: Validators share their perspectives on data sharing Supercentres and their role in helping stakeholders identify which data sets they can or cannot share, particularly with competitors. One validator disagrees with the idea that training and education should explicitly dictate data-sharing boundaries, emphasizing that companies should have the responsibility to determine their practices. Another validator remains neutral, citing uncertainty about the level of detail to be explored. Similarly, another validator also adopts a neutral position, acknowledging a lack of thorough exploration of the specific activities of data-sharing Supercentres.

Instrument 9: Role of leadership and senior management

In analyzing the responses from the interviewed validators regarding the generalizability of different perspectives on the role of leadership and senior management in supply chain data sharing, several unanimous agreements emerged. The most agreement in terms of generalizability is seen for this instrument as seen in Figure 5.9. Firstly, the validators acknowledged the importance of leaders setting an example and recognizing the neces-

sity of withholding certain information for business purposes. Additionally, they emphasized the criticality of strong leadership and value-driven senior management in driving digital transformation and enabling data sharing in the supply chain. The validators also highlighted the significance of senior management demonstrating a willingness to share data and actively communicating the benefits of data sharing to influence the organization.

Perspectives	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5
Leaders play a crucial role in data sharing by making decisions, taking an outside view, and collaborating to maximize benefits	Agree	Agree	Neutral	Agree	Agree
Leaders should set an example and acknowledge that some data must be withheld for necessity	Agree	Agree	Agree	Agree	Agree
Strong leadership and value-driven senior management are critical for enabling data sharing and driving digital transformation in the supply chain	Agree	Agree	Agree	Agree	Agree
Senior management should demonstrate a willingness to share data and its benefits, which can influence the rest of the organization	Agree	Agree	Agree	Agree	Agree
Leaders and senior management may not fully understand the implications of criminal organizations in data sharing and may prioritize continuity over security	Agree	Neutral	Disagree	Neutral	Agree
The determination of investment in data sharing and security is based on its significance to the company's overall strategy, which is decided by the leadership	Agree	Agree	Agree	Agree	Neutral

Figure 5.9: Validation analysis- Instrument 9

Furthermore, the validators emphasized the crucial role leaders play in data sharing through decision-making, adopting an external perspective, and fostering collaboration to maximize the benefits derived from data sharing. One validator also adds that the role of leadership in determining investment in data sharing and security goes beyond individual decision-making. It involves actively engaging with the team, considering diverse perspectives, and striking a balance between innovation and conservatism. By fostering an environment that encourages open discussions and leveraging the strengths of various perspectives, leaders can make well-informed decisions that support the organization's strategic goals.

The topic of discussion revolves around the understanding and priorities of leaders and senior management regarding the implications of criminal organizations in data sharing. One validator takes a neutral stance, emphasizing that leaders and senior management may not possess the specific data regarding criminal organizations involved in data sharing. The responsibility of assessing potential partners for problematic issues falls more on mid-level managers, as evidenced by the example of the organization IDSI. IDSI maintains a code of conduct and a central registry of members, which enables mid-managers to access information about criminal records related to data sharing. This suggests that the responsibility of understanding and addressing criminal implications in data sharing lies with mid-management or similar roles, rather than senior leadership. One validator, on the other hand, maintains a neutral position regarding leaders' understanding of the consequences of criminal organizations engaging in data sharing. The response does not provide any further elaboration or justification for this stance, leaving room for interpretation. In contrast, another validator firmly disagrees with the statement, suggesting that if leaders prioritize continuity over security in data sharing, it indicates a lack of understanding of the consequences associated with criminal organizations. According to this view, senior management should prioritize security in their role, and failure to do so would render them unsuitable for their

positions.

Instrument 10: Ethical and responsible data sharing

In this section, we analyze the perspectives shared by validators regarding the generalizability of different perspectives on ethical and responsible data sharing in supply chain data sharing. The validators were asked about their opinions on various aspects, including the need for training programs, shared responsibility, compliance and auditing, and the importance of sharing data for the betterment of society. A summarized analysis of the responses can be seen in Figure 5.10.

Perspectives	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5
The requirement for third-party supervision should be taken into account to guarantee the ethical and responsible usage of data	Agree	Neutral	Neutral	Agree	Neutral
There should be training programs (like GDPR) in place to ensure the responsible use of data	Agree	Agree	Agree	Agree	Agree
Compliance and auditing are needed, and more work is required in the supply chain to prioritize responsible data sharing	Agree	Agree	Disagree	Agree	Neutral
Ethical and responsible data sharing involves having soft agreements with partners for data sharing	Agree	Agree	Disagree	Disagree	Neutral
Data sharing facilitated by AI or bots, is crucial for enabling faster, ethical and more reliable analytics and avoiding issues with delayed feedback in the supply chain	Neutral	Agree	Neutral	Neutral	Disagree
Sharing data that benefits society is crucial, but caution should be exercised to avoid collaborating with organizations that have a questionable track record	Agree	Agree	Disagree	Agree	Agree
It is the shared responsibility of the company and its partners to work with established governance layers and ESG considerations to ensure legal and ethical compliance	Agree	Neutral	Neutral	Agree	Agree
Ethical and responsible data sharing can be achieved through anonymization and implementing contractual agreements and data governance policies with encryption measures	Agree	Neutral	Disagree	Disagree	Disagree

Figure 5.10: Validation analysis- Instrument 10

Training Programs and Responsible Use of Data: All validators unanimously agreed that training programs, similar to GDPR, should be implemented to ensure responsible use of data in supply chain data sharing. They recognized the importance of providing education and guidelines to individuals involved in the data-sharing process, promoting ethical and responsible practices.

Shared Responsibility and Compliance: Validators presented contrasting opinions regarding the perspective of shared responsibility and compliance. One validator agreed with shared responsibility but disagreed with the idea of a collective responsibility beyond contractual obligations. They emphasized that each stakeholder should be accountable for their specific role. Another validator acknowledged shared responsibility but remained neutral, noting that larger companies often bear the brunt of the blame and face penalties, leading to cautious behaviour.

Compliance and Auditing: Divergent viewpoints emerged regarding the need for compliance and auditing in the supply chain. One validator expressed uncertainty about the specific level of scrutiny needed for data sharing, seeing it primarily as a business decision. In contrast, another validator disagreed, suggesting that compliance and auditing could be eliminated when collaboration is based on shared benefits.

Data Sharing for the Betterment of Society: Validators had mixed opinions on the importance of data sharing for the betterment of society. One validator expressed uncertainty about its significance due to a lack of understanding.

AI and Bots for Data Sharing: Validators provided varied responses to the statement about the crucial role of AI and bots in enabling faster, ethical, and more reliable analytics in the supply chain. One validator strongly disagreed, expressing a lack of trust in AI bots. Another validator took a neutral stance, highlighting the potential biases in AI. Another validator emphasized the need for more real-world use cases while raising concerns about the ethical implications of AI's use in profiling.

Anonymization and Data Governance for Ethical Data Sharing: Four out of five validators shared their perspectives on the statement regarding ethical data sharing through anonymization and data governance policies. One validator disagreed, emphasizing that contracts and encryption measures alone do not ensure ethical behaviour. Another validator disagreed with relying solely on anonymization, emphasizing the need for strict security protocols. Another validator expressed disagreement, stating that agreements and contracts can be exploited. One validator remained neutral, acknowledging the benefits of anonymization but also highlighting its limitations and risks.

Soft Agreements for Data Sharing: Three validators responded to the statement on soft agreements for data sharing. One validator strongly disagreed, emphasizing the need for documented agreements. Another validator disagreed, asserting that ethical considerations go beyond formal agreements. One validator took a neutral stance, acknowledging the suitability of soft agreements depending on the partners involved.

Third-Party Supervision for Ethical Data Usage: Responses regarding the necessity of third-party supervision were varied. One validator supported third-party oversight but raised concerns about efficiency and scalability. Another validator remained neutral, expressing uncertainty about the necessity of such supervision. Similarly, another validator questioned the need for mandatory governance structures and suggested a mutually agreed-upon approach among stakeholders.

5.3. Analysis

With regard to the first instrument of emerging technologies like ICT and Blockchain, the validators' responses highlighted the potential and challenges of ICT and Blockchain. They acknowledged the importance of digital transformation and careful evaluation of technology deployment. While some validators expressed optimism, others remained cautious. The effectiveness of these technologies in enhancing traceability and trust, as well as their contribution to efficient decision-making, were met with mixed perspectives. The potential for addressing property rights and legal aspects of data sharing was also met with varying opinions. Overall, the responses reflected the complexity of implementing these technologies and emphasized the need for further examination. Secondly, the opinions on the generalizability and effectiveness of AI and ML in supply chain data sharing varied among validators. While most validators agreed that AI and ML were better for demand forecasting and resource planning, there were concerns about their implementation and data security among others. It can be concluded that these technologies' implementation still needed to have many use cases to demonstrate their positive influence on supply chain data sharing.

When it came to data standardization and interoperability, validators stressed the importance of standardization and interoperability in supply chain data sharing. The majority of validators expressed agreement and emphasized the importance of standardization for automation, communication, and achieving true interoperability. They highlighted the need for technical and functional layers, emphasized the significance of data standardization, and discussed the evolution of information systems for collaboration. Next, the instrument under discussion was data security measures (encryption and access controls). Regarding this, the validators emphasized the importance of encryption and access controls for data security in supply chain data sharing. They discussed the risks of breaches, challenges faced by SMEs, and the potential benefits of user-friendly technologies. The only major exception was that blockchain could not be a solution for achieving secure data sharing as proposed by one of the interviewees in Phase II.

The validators' perspectives highlighted the importance of trust, collaboration, and cultural context in shaping attitudes towards data sharing. Considering the majority of validators disagreed with the idea that cultural factors were not a barrier to data sharing and emphasized the significance of trust, collaboration, cultural context, and privacy-focused culture, it suggested that the validators were generally in favour of cultural factors positively influencing supply chain data sharing. However, there were a few dissenting opinions, leading to some variability in the overall level of favorability. Furthermore, the instrument of trust gathered a lot of opinions from the validators. There was a common consensus that trust was a significant factor in any type of collaboration, let alone a supply chain. The validators also believed that trust could not be generally achieved through formal contracts or written agreements and that it was an altogether separate entity. It also could not be guaranteed based on facts, figures, and proofs alone. As the next instrument, we talked about contractual agreements and data governance policies. It appeared that the validators generally had a positive outlook on the influence of contractual agreements and data governance policies on supply chain data sharing, with the majority leaning towards agreement or neutrality on various aspects. These insights highlighted the complexity and ongoing evaluation required in contractual agreements and data governance policies.

With regards to the next instrument of education and training programs influencing SC data sharing among employees and organizations, the validators' opinions indicated a positive inclination towards the potential of education and training programs to positively influence supply chain data sharing, with a recognition of the various factors and considerations that contributed to their success. Then, the instrument of leadership and senior management influence gathered the most positive outlook. The validators overwhelmingly agreed that the role of leadership and senior management had a positive influence on supply chain data sharing. Hence, it indicated a high level of agreement among them, making this instrument the most important and most generalizable. As the last factor, ethical and responsible data sharing had validators' responses reflect a range of opinions, but there was a general recognition of the importance of ethical and responsible data sharing in supply chains, with an emphasis on training, compliance, and the consideration of societal benefit.

5.4. Conclusion

This chapter successfully answers the fifth sub-research question: *To what extent can the derived combination of infrastructural and institutional instruments be generalized to the high-tech supply chains?* The responses gathered from the validators shed light on the positive perceptions of certain infrastructural and institutional arrangements for enhancing data sharing in the supply chain. The validators expressed a strong consensus on the importance of standardization of data formats and interoperability among firms, as well as the implementation of data security measures such as encryption and access controls. Following these instruments, blockchain and ICT garnered interest, followed by advanced technologies like AI and ML.

In terms of institutional arrangements, leadership emerged as the most positively perceived instrument for enhancing supply chain data sharing. This was followed closely by education and training programs, contractual

agreements and data governance policies, and cultural factors, all of which had a similar level of consensus among the validators. Trust was recognized as a key instrument but more of an overarching factor that is needed for both institutional and infrastructural instruments to work, suggesting that further research is needed in this area. Finally, there was some agreement on the importance of ethical and responsible data sharing, although it was not prioritized as highly as the other instruments. Overall, these findings provide valuable insights into the factors that contribute to effective data sharing in the supply chain and highlight areas that require further investigation. The final, refined framework will be discussed in chapter 7 (Figure 7.2 and Figure 7.3) while answering the research questions.

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Research Contribution

Drawing upon the findings from chapter 4 and chapter 5, this chapter aims to develop a strategic deployment plan for infrastructural and institutional instruments. Serving as a roadmap, this plan guides high-tech supply chain companies in implementing these instruments in a hierarchical manner. It is important to note that the effectiveness of this deployment plan could be further examined in future research to validate its practicality. Additionally, from an academic standpoint, the inclusion of risk-related factors, along with trust, technology, privacy, and governance-related barriers is deemed crucial.

6.1. Practical contribution

The primary practical contribution of this research is the proposal of a deployment plan for the identified instruments, going beyond their mere relevance or generalizability. The deployment plan is based on insights gathered from 14 interviews conducted during the case study phase and validation feedback from 5 validators in the validation phase. Through these conversations, a distinction emerged: infrastructural instruments are primarily geared towards enhancing inter-organizational supply chain data sharing, while institutional arrangements focus on fostering a culture of data sharing within the company. Initially, trust was perceived as a component of institutional instruments. However, through the course of the research, it became apparent that trust plays a more overarching role, influencing both infrastructural and institutional instruments. With this understanding, first, the deployment of infrastructural instruments can be sequenced by following the steps illustrated in Figure 6.1.

Based on the collected and analyzed information, *data standardization* emerges as the foremost prerequisite for effective data sharing. While some may argue that achieving standardization is challenging, the interviews revealed that Europe has specific frameworks in place that aim to establish interoperability and ultimate standardization. It is important to note that data standardization does not necessitate a complete overhaul of the companies' existing operations. Rather, it entails standardizing data platforms, formats, and semantics. Once data standardization is achieved, the secure transfer of data becomes a critical consideration. Practices such as encryption and access controls must be implemented to ensure the safe transmission of data among companies. Choosing the appropriate technology for this secure data transfer is equally important. While Blockchain has given mixed responses and requires further use cases for full implementation, advanced ICT tools such as the Internet of Things (IoT) and RFID have proven to be effective representations of technology for data sharing in supply chains. Continued advancements in technology will likely yield even more secure data transfer methods in the future.

Lastly, regarding the implementation of AI and ML for supply chain data sharing, feedback has been varied. These technologies can be employed to automate certain aspects of data-sharing practices and enhance

operational supply chain activities, such as demand forecasting. However, it is unlikely that AI and ML will completely replace the entire data transfer process. Instead, they can complement and augment existing practices.
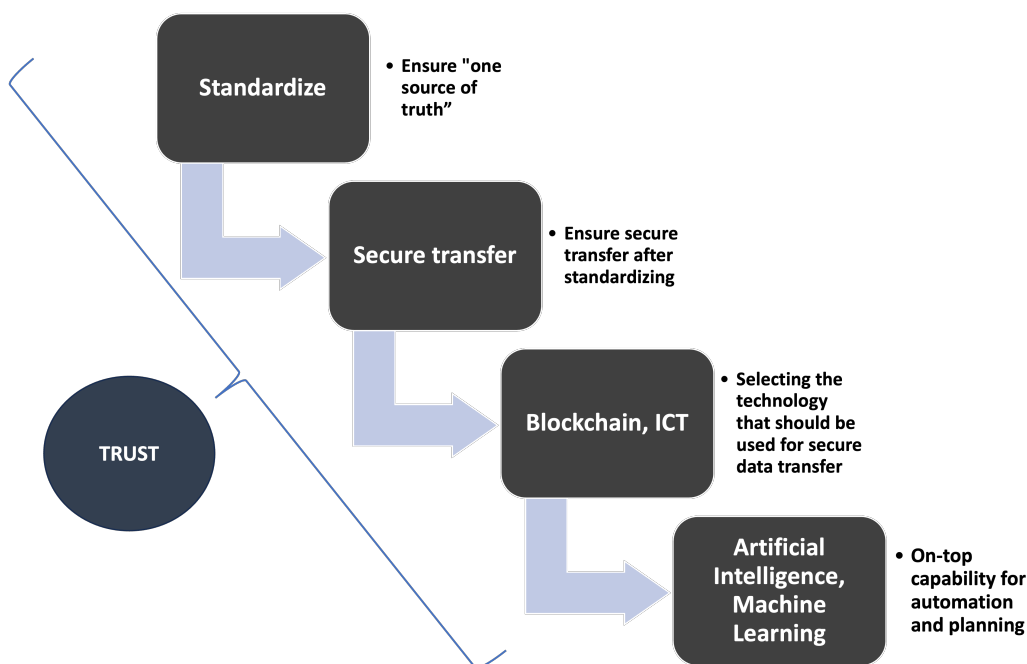

Figure 6.1: Roadmap for Infrastructural instruments' deployment

In the context of deploying institutional instruments, as depicted in Figure 6.2, it becomes evident that firstly cultural factors, specifically the perspectives of employees towards data sharing practices, play a significant role. While it is true that individuals may not have a direct influence on company decisions, participants and validators have emphasized that companies are ultimately comprised of people. Therefore, it becomes crucial for employees to understand the importance, benefits, and potential barriers to SC data sharing. Secondly, the influence of leaders and senior management becomes paramount in fostering a culture of data sharing within the organization. It has been unanimously highlighted that leaders must lead by example and develop a deep understanding of the intricacies involved in data sharing. Their active involvement and commitment to data-sharing practices are instrumental in promoting a data-sharing mindset throughout the company.

The third stage centers around education and training programs. These programs play a vital role in equipping individuals with the knowledge and skills necessary to engage in SC data sharing effectively. Participants in these programs gain a comprehensive understanding of various aspects, such as what should and should not be shared, the appropriate level of data sharing, and, importantly, the methods and techniques for sharing data securely and efficiently. As a next step, it is essential for companies to engage with a dedicated legal team to ensure that data sharing within the supply chain is conducted in accordance with established rules and legal contracts. This ensures that there are clear principles and guidelines governing the sharing of data, with specified repercussions in case of non-compliance. Having a robust legal framework provides a foundation for secure and reliable data-sharing practices.

Lastly, it is the responsibility of the company to ensure that data sharing is carried out ethically and responsibly, adhering to the ethical rules and guidelines established by the partnerships within the supply chain or by relevant governance bodies. This involves considering the privacy and confidentiality of shared data, respecting the rights of stakeholders, and maintaining transparency throughout the data-sharing process.

By addressing these different aspects and deploying the appropriate institutional instruments, companies can foster a culture of trust, enhance leadership involvement, provide education and training, establish legal frameworks, and promote ethical and responsible data-sharing practices. These efforts contribute to the successful implementation of SC data-sharing initiatives and the realization of its associated benefits.
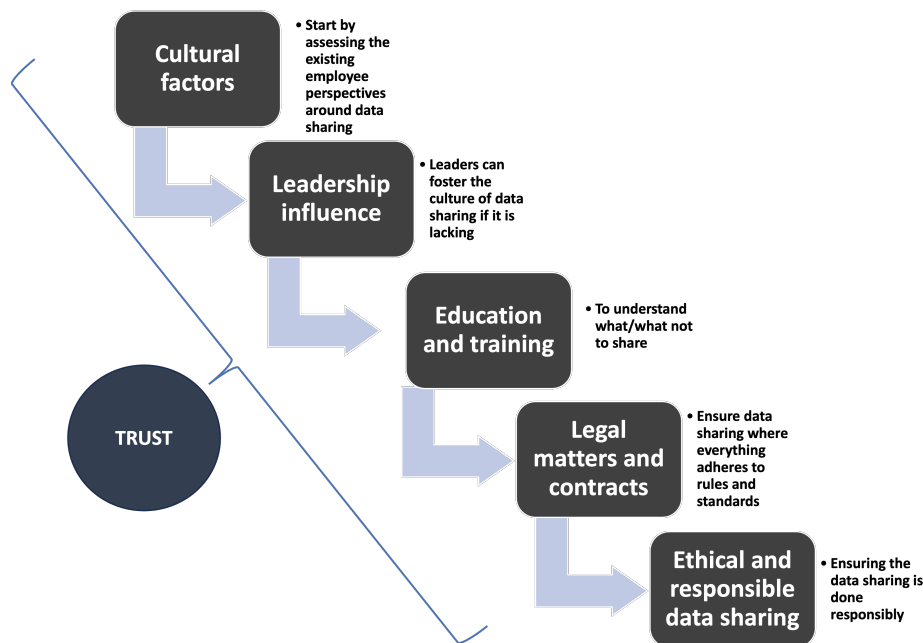

Figure 6.2: Roadmap for Institutional instruments' deployment

6.2. Academic contribution

Perceiving risk as a barrier in relation to other factors

The existing body of literature contains significant research examining the role of risk in SC data sharing. For instance, Colicchia et al. (2019) conducted a study indicating that the primary risk associated with SC data sharing is the intentional or unintentional leakage of information. The literature also emphasizes the complex relationship between risk and trust in the context of data sharing, with trust and interpersonal relationships being widely discussed as important factors in managing risks (Colicchia et al., 2019). In another study by Tran et al. (2016), it is observed that the types of risks vary depending on the level of data sharing. For instance, one-way data sharing presents risks related to integrity, privacy, lack of trust and commitment, spoofing, lost transactions, information leakage and so on. On the other hand, in highly interconnected networks with simultaneous communications among SC partners, risks may arise concerning the denial of services or unauthorized access to data.

These research findings contribute to a more comprehensive understanding of the multifaceted nature of risk in SC data sharing. However, it is my perception that the majority of the existing literature primarily focuses on the immediate or short-term risks associated with SC data sharing, such as leakage of information or denial of services. For a long-term potential solution, it is important to consider risk as a comprehensive concept encompassing all potential barriers in order to understand the root causes and potential solutions. In the literature review conducted for this thesis in chapter 3, a comprehensive analysis was performed to identify the barriers to data sharing in the supply chain (as shown in Figure 3.1). However, based on input from interviewees and validators, it is recognized that considering risk not only in relation to trust or data leakage but also as

a comprehensive concept in relation to the mentioned barriers of this research is important. For instance, exploring various aspects, such as the adoption of AI and ML and the associated risks, the risks associated with data standardization, and the risks related to governance and contractual agreements in data sharing, can contribute to a comprehensive understanding of risk mitigation. This holistic knowledge is crucial because, as emphasized by an interviewee during the single-case study phase, the perception of risk plays a pivotal role in shaping companies' willingness to share their data. By thoroughly examining and addressing these risks, organizations can effectively navigate barriers and foster a more conducive environment for data sharing.

As the research concludes, it becomes evident that including risk-related factors as barriers, in addition, to trust, technology, privacy, and governance-related barriers, is essential (as illustrated in Figure 6.3). By incorporating risk along with other factors, the thesis aims to make a significant academic contribution to the field and also opens the door for further research in enhancing our understanding of the dynamics of risk-oriented data sharing within the supply chains.
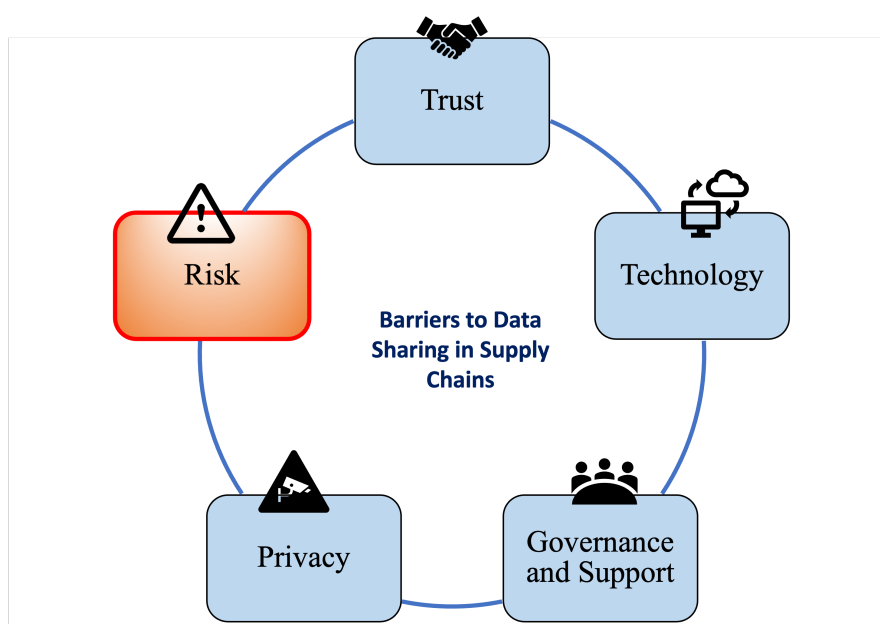

Figure 6.3: Barriers contributing to Supply Chain data sharing

6.3. Conclusion

In conclusion, this chapter presents the research contribution of proposing a deployment plan for infrastructural and institutional instruments in enhancing data sharing in supply chains. The practical contribution includes insights on data standardization, secure data transfer, technology implementation, and fostering a data-sharing culture. From an academic standpoint, the research emphasizes the holistic understanding of risk and its relation to trust, technology, privacy, and governance factors. Overall, the research adds value by providing a structured approach to address data-sharing barriers and contributes to the understanding of data-sharing dynamics in supply chains. Importantly, both the practical and academic contributions presented in this research are based solely on the findings and insights obtained through this study. As such, further research is warranted to validate the effectiveness of the proposed deployment plan and its implications. Future studies can build upon this research to assess its practical applicability and expand the academic understanding of data sharing in supply chains.

7

Discussion and conclusion

The objective of this thesis is to identify a combination of infrastructural and institutional instruments that can enhance data sharing in supply chains while addressing the barriers identified in the existing literature. To achieve this, interviews were conducted and analyzed to gain insights into the implications of these instruments. Additionally, a validation phase involved further interviews to assess the generalizability of these instruments in improving data sharing. The results and validation chapters have already presented the findings comprehensively.

In this chapter, I will interpret and analyze the findings of the study in detail, providing extensive discussions supported by relevant data and evidence. The results will be examined in relation to the research question and objectives, and comparisons will be made with the existing literature to identify similarities and differences. Moreover, I will explore the theoretical and practical implications of the findings, acknowledging the limitations or constraints of the study and considering their impact on the interpretation of the results. Recommendations for future research will also be provided in this section. Finally, the chapter will conclude by summarizing the key points discussed, emphasizing the overall contribution of the study to the field. A concise conclusion will be presented, tying together all the elements of the research and providing a cohesive final statement.

7.1. Answering the research questions

This section undertakes a detailed and systematic exploration of the research questions as mentioned in chapter 1, using the findings of the study as the basis for analysis. The primary objective of this section is to provide succinct and lucid responses to the research questions, illuminating the significant insights and implications gleaned from both the data collection phases of research - the single case study interviews and validation interviews. By meticulously addressing each question, the aim is to contribute to a comprehensive comprehension of the research topic, while offering valuable insights to practitioners, researchers, and stakeholders within the field. Employing an organized and evidence-driven approach, this section unveils the connections, patterns, and interpretations that have emerged from the investigation, thereby fostering the advancement of knowledge and understanding in this particular area of study.

7.1.1. Answering sub-research questions
In this subsection, we focus on the core of the research. We address the sub-research questions that were identified earlier. These sub-questions are essential in understanding the complexities of the research topic and offer valuable insights into specific aspects connected to the main research question.

SQ1: What are the benefits and barriers of data sharing in the supply chain?

This sub-question has been answered as part of the literature review (as seen in chapter 3). This sub-question has explored the benefits and challenges of sharing data across different entities within the supply chain. By gaining insights into the existing advantages and disadvantages, we have enhanced our understanding of why this research was essential in the first place. In practical terms, comprehending the benefits and barriers associated with data sharing has the potential to enhance supply chain efficiency and effectiveness. It enables improved decision-making and coordination among the various stakeholders involved, leading to better outcomes. In summary, the following Figure 3.5 of benefits and barriers were identified as part of the literature review.

Table 7.1: Overview of the benefits and barriers of business data sharing

Benefits	Barriers
Inventory reduction, cost reduction and efficient inventory management	Data Privacy Concerns
Significant reduction or complete elimination of the bullwhip effect	Lack of Trust
Improved resource utilization	Reliability and Cost of Data Technology
Increased productivity, Organizational efficiency and improved services	Capability Challenges
Early problem detection and Quick response	Limited Supply Chain Actor Willingness
Building and strengthening social bonds	Challenges in Obtaining Real-time Data
Better tracing and tracking	Data Misinterpretation and Connectivity Limitations
Earlier time to market	Lack of Standardized Data-Sharing Methodology
Expanded network	Financial and Capability Constraints
Optimized capacity utilization	

SQ2: What barriers are mitigable and unmitigable by the supply chain organizations?

To address this sub-research question, the findings from the literature review shed light on a Barrier quadrant that hinders data sharing, as depicted in Figure 3.1. This Barrier quadrant comprises four key barriers to data sharing which are mitigable if appropriate solutions are utilised in the correct manner. These barriers include Trust, Technology, Privacy and Governance & Support. However, it was observed that barriers related to competition among firms might not be feasible to mitigate for obvious reasons.

The following can be analysed from the literature:

Trust: Trust plays a crucial role in determining whether individuals and organizations are willing to share their data. Factors such as cultural attitudes towards privacy and data sharing, the role of leadership in fostering trust, and the use of trust-building techniques are important instruments that influence trust in data sharing. Additionally, ethical and responsible data-sharing practices contribute to building trust among stakeholders.

Privacy: Privacy concerns can hinder data-sharing initiatives. Cultural factors, such as attitudes towards privacy and data sharing, can influence individuals' willingness to share their data. Implementing robust data security measures and having legal agreements in place that protect the privacy of individuals and organizations are important instruments for addressing privacy concerns. Ethical and responsible data-sharing practices also play a significant role in mitigating privacy-related barriers.

Technology: The rapidly evolving technological landscape presents both opportunities and challenges for data sharing. Emerging technologies like Information and Communication Technology (ICT) and Blockchain offer new possibilities for secure and efficient data sharing. Advanced technologies such as Artificial

Intelligence (AI) and Machine Learning (ML) have the potential to extract valuable insights from shared data. These technologies serve as instruments that can help overcome technological barriers to data sharing.

Governance and support: Establishing effective governance structures and providing adequate support are crucial for facilitating data sharing. Instruments such as data standardization promote interoperability and consistency in data-sharing practices. Learning programs can educate stakeholders about the benefits and best practices of data sharing. Legal agreements ensure compliance with relevant regulations and provide a framework for data-sharing activities. These instruments contribute to overcoming governance-related barriers and provide the necessary support for successful data-sharing initiatives.

SQ3: What combination of infrastructural and institutional instruments could address the mitigable barriers of data sharing in supply chain?

Now that the mitigable barriers have been identified in the previous sub-question, the next step is to focus on understanding the factors that can positively influence data sharing in the supply chain, while trying to mitigate these barriers. To find this combination, an extensive literature review took place to understand what factors could possibly aid in influencing data sharing in the supply chain positively, as seen in chapter 3. These factors have been formulated as a combination of infrastructural and institutional instruments according to the relevancy of the nature of the instrument. A consolidated view of the framework can be seen in Figure 7.1.
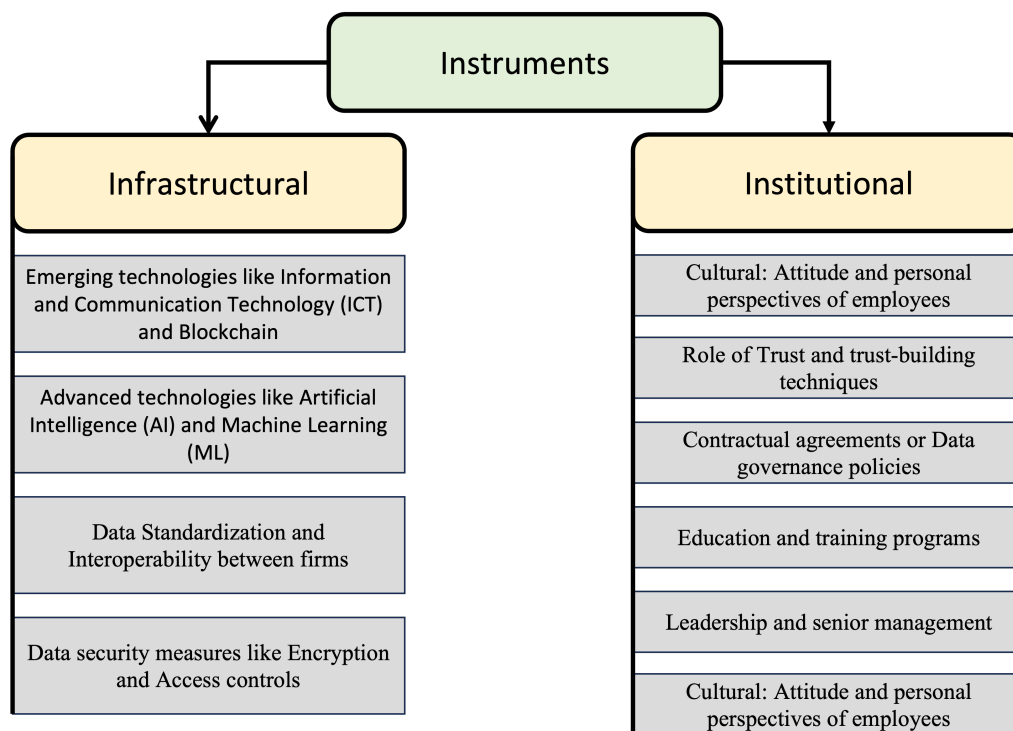

Figure 7.1: Instruments formulation from the literature

SQ4: To what extent can the derived combination of infrastructural and institutional instruments be employed to address the identified mitigable barriers?

To gauge the effectiveness of utilizing institutional and infrastructural instruments in mitigating the barriers to data sharing in supply chains, a comprehensive approach was adopted wherein fourteen in-depth interviews were conducted with a high-tech company's employees, as detailed in chapter 2. The participants were specifically asked about the extent to which these instruments can contribute to overcoming the identified barriers. The insights gathered from these interviews were subjected to a rigorous analysis, as described in chapter 4. This analysis allowed for a thorough examination of the influence of each instrument on data

sharing within the supply chain. Notably, diverse perspectives emerged, shedding light on the distinctive roles and contributions of the institutional and infrastructural instruments.

The findings revealed the significant potential of these instruments to address the barriers to data sharing effectively. Each instrument demonstrated specific attributes and functionalities that can help mitigate the identified barriers. The extent of influence varied for each instrument, highlighting the need for a tailored and nuanced approach when implementing them. In order to provide a comprehensive understanding, chapter 4 offers a concise summary of the utilization of each instrument.

SQ5: To what extent can the derived combination of infrastructural and institutional instruments be generalized to the high-tech supply chains?

To address the generalizability of the findings and perspectives from the results section, a validation phase was conducted. This phase has given new perspectives on the instruments and given room for thinking for some future research as well. It can be seen in section 5.3 of chapter 5, that a thorough analysis of the degree of generalizability of the instruments was seen. In summary, the study's findings indicate that validators expressed positive perceptions of certain infrastructural and institutional arrangements for enhancing data sharing in the supply chain. Standardization of data formats, interoperability, data security measures, leadership, education and training programs, contractual agreements, data governance policies, and cultural factors were considered important. Blockchain, ICT, AI, and ML were identified as valuable technologies. Ethical data sharing also received attention, while trust was seen as an overarching instrument for both infrastructural and institutional instruments. These insights contribute to our understanding of effective data sharing in the supply chain and highlight areas for further research. A quick summary of the generalizability of the infrastructural instruments can be seen in Figure 7.2, and institutional instruments can be seen in Figure 7.3.
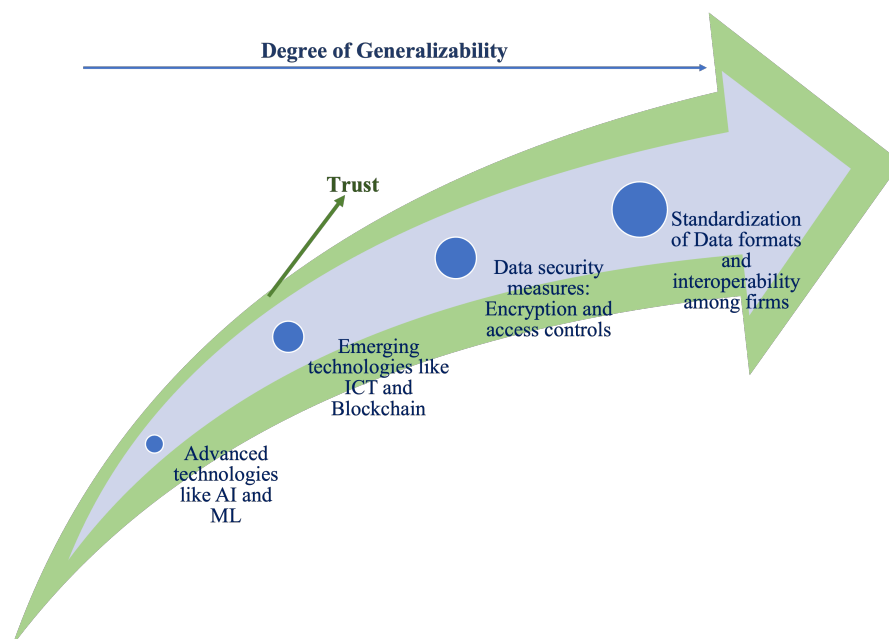

Figure 7.2: Generalizability analysis: Infrastructural instruments (from validation interviews)
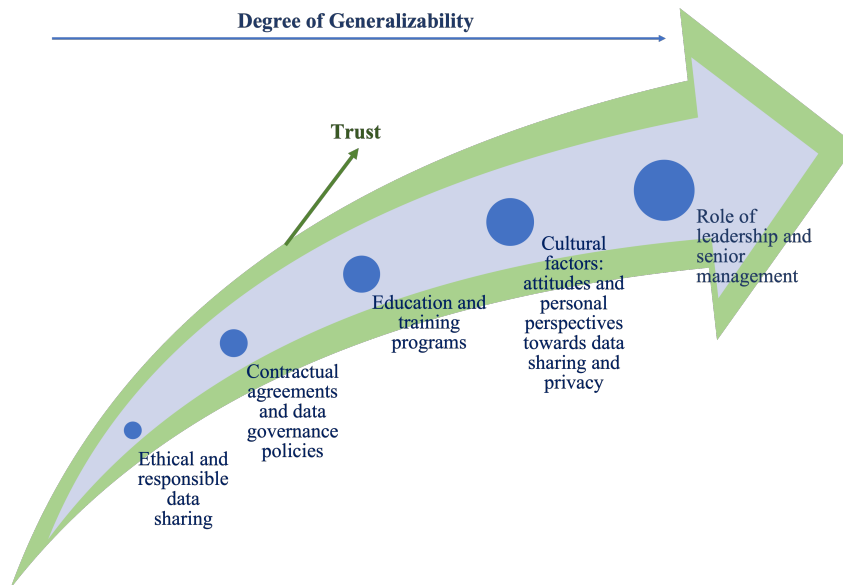
Figure 7.3: Generalizability analysis: Institutional instruments (from validation interviews

The process of answering the sub-research questions ultimately led to the successful resolution of the main research question: ***What combination of infrastructural and institutional instruments enhances data sharing in a supply chain network by addressing the mitigable barriers?*** Each sub-research question was carefully investigated, and their findings played a crucial role in constructing a comprehensive response. Through rigorous analysis and data collection, the researchers identified key infrastructural and institutional instruments that positively impacted data sharing within the supply chain network. By addressing the mitigable barriers, such as data privacy concerns and technological limitations, the identified combination of instruments effectively facilitated data sharing. The research outcomes shed light on the significance of robust infrastructural support, including advanced technologies and reliable communication channels through ICT, along with supportive institutional mechanisms, such as legal protocols and trust-building initiatives. The comprehensive understanding gained from answering the sub-research questions culminated in a definitive answer to the main research question, providing valuable insights for enhancing data sharing in supply chain networks.

7.2. Key takeaway - Unraveling the Complexity of Trust

It was quite evident from the entire research timeline that trust is always needed when we talk about data sharing outside of companies. I have observed that when I talked about trust as an instrument, the majority of the interviewees had placed utmost importance on it as seen in chapter 4. It was perceived as an important prerequisite for all the other instruments to work in place. There was also a bit of a discussion on the relationship between trust and contractual agreements. Contracts, while valuable in ensuring cooperation, cannot guarantee trust in isolation. Although contracts establish obligations and facilitate agreements, trust encompasses something beyond the fulfilment of contractual duties. It could be said with some confidence after the research that contracts hold greater significance than trust, with agreements and governance structures playing pivotal roles in fostering successful partnerships. Trust is a wholesome concept with many more facets and intricacies. The validators' responses on trust were quite interesting and led me to think that this concept was not as easy as I thought while conducting the literature review.

Trust, an intricate concept, presents challenges in understanding and application. Through one of the validator's research, the multifaceted nature of trust was explored, shedding light on various aspects that merit consideration. Establishing trustworthiness can be accomplished through pilot projects, although it is important to recognize that this primarily applies to trust between individuals involved in the pilot, rather

than extending to trust between companies on a corporate level. Furthermore, predictability and consistent behaviour are integral to building trust. When individuals or entities demonstrate reliability over time, trust gradually takes root. It becomes evident that trust is forged upon a foundation of consistency and the ability to meet expectations.

Notably, the relationship between risk management and trust remains complicated. It is a struggle to comprehend the connection and the necessity of risk management in building trust. This is an area that requires further investigation and exploration. It is essential to distinguish between establishing a framework and establishing trust. Trust is not a direct outcome, but rather a entity of creating a framework that enables trust to thrive. This framework establishes an environment conducive to trust, but it is not synonymous with trust itself. It is also noteworthy that trust can still exist even when goals significantly differ, provided that the disparities are acknowledged and considered. Trust extends beyond shared goals, encompassing understanding and empathy. Moreover, trust is intertwined with emotions, affections, and gut feelings. It encompasses an intuitive element and relies on a profound sense of connection between individuals. While rational considerations are important, emotions play a significant role in cultivating trust. It can be understood that trust surpasses contractual obligations and necessitates an emotional and relational foundation.

To summarize, trust is a complex phenomenon encompassing trustworthiness, predictability, emotional connections, and the establishment of a conducive framework. While contracts and agreements are important for cooperation, they cannot fully encapsulate the essence of trust. Understanding and navigating the intricacies of trust remain challenging but continued exploration and analysis can lead to a deeper comprehension of this fundamental human dynamic.

7.3. Navigating the Dilemma of Data Sharing in Supply Chains: Beyond Techno-Optimism

The rapid advancements in technology have spurred techno-optimism, which can be both empowering and deceptive. While data sharing in this technological era undoubtedly holds transformative potential, it is essential to approach its implementation with a critical lens. One of the primary challenges lies in data security and privacy, as discussed previously in chapter 3. As supply chains involve multiple entities sharing sensitive information, there is a legitimate fear of data breaches, cyber-attacks, and unauthorized access. A single weak link in the chain can compromise the entire network, leading to severe consequences for all involved parties. Addressing the valid hesitations and concerns of stakeholders is essential in fostering a collaborative and responsible approach to data sharing. Striking a balance between technological enthusiasm and pragmatic caution will be crucial in realizing the transformative power of data sharing while safeguarding the interests of all supply chain participants. By acknowledging and navigating these complexities, we can build stronger, more resilient, and more efficient supply chains for a prosperous future. Nevertheless, it is essential to recognize that navigating these complexities is not always feasible, and there are instances where certain issues may inherently present wicked characteristics.

Data sharing initiatives in the supply chain domain must be approached with a critical understanding that data is not a flawless reflection of reality. Rather, it is inherently selective and can be prone to limitations and errors. As highlighted by various interviewees in this research (refer Appendix B), the significance of data quality, data relevance, and thoughtful consideration of data sources cannot be understated when advocating for such initiatives. A thorough examination of both successful and unsuccessful cases in real-world scenarios provides a more nuanced insight into the practical implications of data-sharing initiatives. This analysis allows us to comprehend the barriers encountered and the key factors that contribute to their success. By acknowledging these real-life experiences, we gain valuable lessons that can inform and refine future data-sharing endeavours in the supply chain domain.

In the pursuit of optimizing supply chain coordination, it is essential to acknowledge that data sharing's significance can vary significantly across different aspects of the process. Understanding and delving into these nuances can prevent oversimplification and foster a more targeted and context-specific approach to data sharing. In the course of my research, I discovered that interviewees focused on the operational aspects of the supply chain expressed a stronger inclination towards data sharing. For them, data sharing streamlined processes and made operational tasks more efficient. Concerns about data security, contracts, and regulations seemed less pressing in their view, as the benefits of shared data outweighed the potential risks. On the other hand, when engaging with interviewees who held managerial positions and were involved in strategic decision-making, a more cautious attitude towards data sharing emerged. They emphasized that certain circumstances might hinder data sharing, particularly when privacy or security risks are involved. For these stakeholders, safeguarding sensitive information took precedence over operational expediency. In such scenarios, data security measures played a pivotal role in influencing their stance on data sharing. This disparity in perspectives highlights the fact that the spectrum of supply chain data sharing is not uniform. Different stakeholders, depending on their roles and responsibilities within the supply chain, perceive data sharing differently. Operational personnel often prioritize ease of access and efficient processes, while strategic managers emphasize the need to balance data sharing with data protection and regulatory compliance. Therefore, adopting a one-size-fits-all approach to data sharing in supply chains would be inadequate and may overlook critical considerations. A more nuanced and context-aware strategy is required to navigate the complexities of data sharing effectively. This approach involves understanding the unique requirements and concerns of each aspect of the supply chain and tailoring data-sharing initiatives accordingly.

7.4. Addressing the literature

In this section of the report, I aim to reflect back on the literature by comparing it with the research findings to determine if the literature can be confirmed. Moreover, I have highlighted the specific findings from my research (blue) that I believe contribute to the existing literature, as seen in Table 7.2. It is important to acknowledge that despite conducting a thorough literature analysis, there is always a possibility of overlooking certain aspects. Therefore, it is possible that the contributions from my research to the literature may already be present. However, I choose to approach this positively, recognizing that my research has added weight to the existing literature.

Table 7.2: Addressing the literature (All instrument's influence on data sharing in Supply Chains)

Literature findings	Research findings	Confirmation of literature
Implementing ICT and blockchain technology in supply chain management can often overcome trust, transparency, and data-sharing challenges, leading to improved efficiency and optimization of the supply chain ecosystem appears to be supported	Emerging technologies like ICT and Blockchain have a significant impact on supply chain data sharing, with potential benefits in terms of improved visibility, decision-making, trust, and collaboration, but also challenges related to implementation, change management, data security, and standardization	The research findings align with the literature, supporting the notion that ICT and blockchain can address trust, transparency, and data-sharing challenges while presenting implementation and operational hurdles that need to be addressed

Literature findings	Research findings	Confirmation of literature
Advanced technologies like AI and ML have the potential to improve supply chain data sharing and enhance resilience, but challenges related to implementation costs, data standardization, security measures, training, and innovation need to be addressed	The integration of advanced technologies like AI and ML in supply chain operations has the potential to enhance forecasting accuracy, optimize collaboration, and improve data security, but challenges related to data quality, privacy, and the need for a skilled workforce and access to data must be addressed for effective implementation	The research findings confirm the literature findings regarding the potential benefits and challenges (though different sets of challenges emerged) associated with integrating advanced technologies in supply chain operations
Standardized data formats and interoperability in supply chain management enable efficient data exchange, collaboration, and trust-building among organizations, enhancing the potential of emerging technologies and addressing common challenges in supply chain practices	Standardization of data formats and interoperability between firms play a crucial role in facilitating efficient data sharing, enabling collaboration, and leveraging automation technologies in supply chain operations while ensuring data security	The research findings align with the literature, confirming the significance of standardization and interoperability in facilitating efficient data sharing and leveraging automation technologies while ensuring data security
Implementing data security measures like encryption and access controls is crucial for safeguarding digital supply chain data sharing and mitigating risks	Encryption and access controls are recognized as essential measures for data security in supply chain data sharing, contributing to trust, compliance, and stakeholder confidence, while challenges such as SME limitations and balancing security with innovation need to be addressed	While the research findings align with the literature in recognizing the significance of encryption and access controls for data security in supply chain data sharing, they also provide new information and perspectives on the limitations and challenges associated with implementing these measures
Individual factors such as cultural attitudes, employee orientation toward change, power dynamics, justice, organizational identification, trust, locus of control, and satisfaction with HR practices influence data-sharing behaviour in the supply chain	Cultural factors significantly influence attitudes towards data sharing in the supply chain, while privacy concerns may vary based on personal experiences and cultural contexts	Both sources highlight the influence of cultural factors on attitudes towards data sharing in the supply chain. Additionally, the research supports the idea that privacy concerns can vary based on personal experiences and cultural contexts (such as nationalities)

Literature findings	Research findings	Confirmation of literature
Trust plays a crucial role in facilitating supply chain data sharing by promoting cooperation, reducing uncertainty, and mitigating risks and uncertainties	Trust is a crucial element in facilitating data sharing in the supply chain, enabling effective collaboration, decision-making, and value creation, while relying on factors such as reputation, transparent communication, adherence to commitments, clear guidelines, pilot projects, balanced benefits, predictability, and stable behaviour	The research findings align with the literature by emphasizing the importance of trust in enabling effective collaboration, decision-making, and value creation. Additionally, the research identifies various factors as mentioned in the adjacent column
Effective governance structures and data sharing agreements play a crucial role in influencing the willingness of supply chain partners to share data, leading to improved supply chain performance	The effectiveness and implications of contractual agreements and data governance policies in facilitating supply chain data sharing are influenced by trust, enforcement, the effectiveness of legal frameworks, impact on supply chain operations, the necessity of agreements, and the role of legal measures in data security	While aligning with literature, the research findings expand upon the literature by providing a more comprehensive understanding of the various elements (as seen in the adjacent column) that contribute to successful data sharing within the supply chain
Education and training programs play a crucial role in fostering a collaborative environment where individuals understand the value of data sharing and actively contribute to the success of the supply chain	Educational and training programs play a crucial role in promoting data sharing within the supply chain by fostering a collaborative culture, providing practical knowledge on data governance and security, and facilitating change management	The research findings confirm the literature highlighting the role of these programs in fostering a collaborative environment, enhancing individuals' understanding of the value of data sharing, and facilitating change management
Effective senior management, characterized by integrative leadership and a culture of knowledge sharing, significantly influences the sharing of supply chain data both internally and externally, leading to improved supply chain operations and performance	The influence of leadership and senior management on supply chain data sharing is critical in promoting a culture of collaboration and data exchange, as they set an example, drive initiatives, communicate clearly, motivate employees, and foster external collaborations	While confirming the literature, the research findings provide a more detailed understanding of the specific actions and behaviours of leadership and senior management that contribute to promoting data sharing within the supply chain, complementing and enhancing the broader insights provided in the literature

Literature findings	Research findings	Confirmation of literature
Ethical data-sharing practices in general terms positively influence transparency, trust-building, and decision-making among stakeholders	Implementing training programs, establishing shared responsibility and compliance, ensuring data anonymization and governance, and exploring the role of AI with proper oversight can contribute to ethical and responsible data sharing practices in supply chains	While confirming the literature, the research findings specifically suggest various other implementations that need to be considered as seen in the adjacent column

7.5. Limitations and future scope

Limitation: The research primarily focuses on data sharing in SCs but does not explicitly address knowledge sharing. Knowledge sharing involves communicating knowledge or understanding with other people, groups, communities, or organizations (Zheng, 2017). This knowledge may be explicit, which refers to rules and documentation, or tacit, which refers to intuitive and experience-based knowledge. Knowledge sharing makes sure that information within a company is accessible to others (Nazim and Mukherjee, 2016). Nonetheless, the choice to center this thesis solely on data sharing was motivated by the extensive body of literature surrounding the subject and the intention to prevent overly limiting the scope to only structured data sharing. The decision to specifically focus this thesis on data sharing alone was driven by the abundance of literature available on the topic and the desire to avoid narrowing the scope exclusively to knowledge sharing.

Future scope: Expanding on this limitation, it is important to recognize that information and knowledge sharing go beyond the mere exchange of raw data. Information sharing involves the contextualization and interpretation of data, while knowledge sharing encompasses the transfer of expertise, insights, and best practices. Exploring these dimensions would provide a more comprehensive understanding of the dynamics involved in SC collaboration and decision-making processes.

Limitation: During the case study interviews, it was occasionally observed that some interviewees did not fully grasp the significance of certain questions. Consequently, some responses may not have precisely aligned with the intended question. To maintain objectivity and avoid influencing participants' answers, limited information was provided during the interviews. While this limitation exists, it should be noted that the impact is relatively minor, as most of the interviews were conducted in accordance with a semi-structured format and yielded valuable insights. Elaborating on this limitation, it is important to acknowledge the potential impact of misinterpretation or misunderstandings during the interview process. Ambiguity or lack of clarity in questions can result in respondents providing answers that may not fully capture the intended information. However, steps were taken to mitigate this limitation by ensuring a comprehensive understanding of the research objectives and employing a structured interview framework to guide the discussions.

Future scope: Instead of relying solely on a single interview session, future studies can consider employing an iterative interview approach. This involves conducting multiple interview rounds with participants, allowing for the opportunity to clarify any misunderstandings, revisit certain questions, or delve deeper into specific areas of interest. The iterative nature of these interviews promotes a deeper understanding of the research topic and provides a chance to rectify any previous misinterpretations.

Limitation: The research employed a single case study approach with a focus on the European region. Although efforts were made to enhance the generalizability of the findings through a validation phase, there remains a slight limitation in terms of complete generalizability and potential variations across countries. The influence of culture, both at the company and country levels, was observed to play a significant role in the research. Therefore, it can be inferred that the impact of cultural factors on data-sharing practices may vary

to some extent in different geographical contexts.

Future scope: Further expanding on this limitation, it is crucial to acknowledge the potential influence of diverse cultural factors on data-sharing practices. Different countries and regions may have distinct cultural norms, values, and approaches to collaboration, which can affect the willingness and mechanisms for data sharing in SCs. Consequently, while the research findings provide valuable insights into the European context, caution should be exercised when extrapolating these findings to other regions or countries. Future studies could consider conducting comparative analyses across multiple regions to gain a more comprehensive understanding of the influence of cultural factors on data-sharing practices in SCs.

Finally, as mentioned in chapter 6, it is noteworthy that both the practical and academic contributions have solely been generated from this research alone. Hence, it could further be tested for future research to validate its effectiveness. An area that requires extensive further research is the influence of trust on the other instruments. Some of the validators and interviewees emphasized that trust is an independent entity and is often linked to risk. Therefore, future studies could investigate the combined effect of trust and risk to precisely understand how the proposed instruments impact data sharing in the supply chain.

7.6. Conclusion

The research has explored the topic of data sharing in supply chains and identified a combination of infrastructural and institutional instruments that can enhance data sharing while addressing the barriers identified in the existing literature. The literature review revealed numerous benefits associated with data sharing. However, several barriers were also identified, such as data privacy concerns, lack of trust, and technological challenges. These barriers highlight the need for effective instruments that can mitigate risks and facilitate data sharing among supply chain partners. Based on the literature review analysis, a set of instruments was formulated to address the identified barriers. These instruments encompass factors such as trust, privacy, technology, and governance, offering a holistic approach to overcoming the challenges of data sharing. Through a comprehensive research approach involving interviews and validation, valuable insights have been gained regarding the influence and generalizability of the proposed instruments in the literature.

As an academic contribution, it is noteworthy that this research recognizes the importance of perceiving risk as a comprehensive concept. By incorporating risk into the framework alongside other barriers, a more comprehensive understanding of the challenges associated with data sharing was achieved. From a practical standpoint, this research offers a deployment plan for the identified instruments, providing guidance on their implementation. The plan differentiates between infrastructural and institutional instruments, emphasizing the need for both inter-organizational and intra-organizational approaches to data sharing. The roadmap for deploying infrastructural instruments highlights the significance of data standardization, secure data transfer methods, and the potential of advanced technologies. The deployment of institutional instruments emphasizes the establishment of a data-sharing culture within organizations, considering factors like leadership, employee training, legal agreements etc. In conclusion, this study has undertaken a comprehensive and insightful exploration into the implementation of the proposed instruments pertaining to data sharing within high-tech supply chains.

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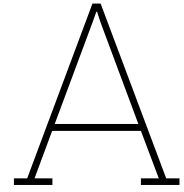
A
Interview Protocol for Phase-II data collection

I. Pre-interview Setup/Communication (2-3 mins)

1. Explanation of the research: Introducing myself and explaining the purpose and scope of the research. Give a brief overview of the research questions and how the interviewee's input will be valuable to the research.

2. Emphasizing confidentiality: Assure the interviewee that their responses will be kept confidential and that any information provided will be used solely for the purpose of the research.

3. Obtain consent: Obtain the interviewee's consent to participate in the interview and to have the interview recorded – The informed consent form shall be sent over a week prior to the interviews.

4. Set expectations: Explain the format of the interview, how long it will take, and any other logistical details.

Starting Notes

Hello, and thank you for taking the time to speak with me today. My name is Rishika, and I am conducting research for my master's thesis on enhancing data sharing in the supply chain domain.

My goal is to gather your opinions and insights on these factors to help inform the development of this framework. If you do not wish to answer any question during the process, you could prompt by saying "Next question". Then, I will skip the question and move on to the next one.

Another important thing to share is that the interview shall be recorded for transcription purposes. But as mentioned in the informed consent that I shared earlier, the recorded video will be destroyed once the transcripts are cleaned up. Also, I shall share the transcripts with you before using if for my research once I finish cleaning it up.

Before we start, I seek your permission to start recording the interview and I hope you can see my screen.

Starts recording

In this interview, I will be asking you questions about the factors related to both the arrangements that could influence data sharing in the supply chain domain. Infrastructural arrangements refer to the technical and governance instruments that could influence data sharing, while institutional arrangements refer to formal and informal agreements and structures.

We will begin with some introductory questions before digging into the factors related to the arrangements.

II. Introduction (5-7 mins)

1. Can you please introduce yourself and talk about your role in the supply chain department at the company?

2. What is the first thing that comes to your mind when I say, "Data sharing between companies in the supply chain domain" - Inclusion of a qualitative research technique- "Projective method": (Word association method) – (To understand their overall perception before digging deep into the interview)

3. Can you give a recent example or describe a use case where you shared data in the supply chain or have worked with data sharing in the supply chain?

4. How important do you think is data sharing to high-tech companies like your company, in the supply chain domain?

5. What do you think are some major benefits of sharing data with other stakeholders in the supply chain?

6. In your opinion, what are some major challenges or barriers that supply chain partners face in promoting data sharing in the company, and how can these challenges be addressed?

Now that we finished our introductory questions, we will begin with the factors related to Infrastructural factors.

III. Infrastructural arrangements (20- 22 mins)

1. How do emerging technologies like advanced Information and Communication Technology (ICT) or Blockchain influence data sharing in a supply chain network?

2. How do you think advanced technologies like Artificial Intelligence or Machine learning influence data sharing in a supply chain?

3. How do you think standardization of data formats and interoperability among firms influences data sharing in a supply chain?

4. How do you think that data security measures like encryption or access controls could impact data sharing?

5. Closing question: In your opinion, among the listed instruments, can you give an order of preference from the most to the least important instruments in terms of their implementation to facilitate supply chain data sharing?

This concludes the section on Infrastructural instruments. We will now begin with the factors related to Institutional arrangements.

IV. Institutional arrangements (20 -22 mins)

1. How do cultural factors of employees, such as attitudes and personal perspectives towards privacy and information sharing, influence data sharing in a supply chain network?

2. How important is trust between supply chain partners for promoting data sharing?

3. Can you provide any examples of how trust has been built between partners to facilitate data sharing?

4. What is your take on contractual agreements or data governance policies that can provide a legal framework for data sharing between companies?

5. To what extent do you think education or training programs for employees can help promote data sharing in the supply chain?

6. How do you think leadership and senior management in institutions play a role in influencing data-sharing practices in the supply chain?

7. How does your organization ensure that data is used ethically and responsibly when shared with other parties in the supply chain?

8. Closing question: In your opinion, among the listed instruments, can you give an order of preference from the most to the least important instruments in terms of their implementation to facilitate supply chain data sharing? This concludes the section on Institutional factors. We will proceed with some last closing questions before concluding this interview.

V. Closing questions (5 mins)

1. How do you see data sharing evolving in the future of the Supply chain?

2. Are there any new initiatives or technologies that the company is exploring to facilitate data sharing between the supply chain collaborations?

3. Finally, do you have any questions for me?

This concludes the interview. Thank you for your time and patience. It was great talking to you, and I gathered some good insights for my research. I shall share the transcripts after the clean-up (which would take around 2-3 weeks) and I will also share my final thesis documentation with you, by the end of my graduation.

B

Anonymized Transcript Summaries

This appendix serves as a summary of the 14 interview transcripts (see from next page). The company information and the personal information of the interviewees are anonymized.

Interviewee 1: Supply Chain Lead

The speaker is the supply chain lead for a personal health product portfolio for the company. The company delivers products to eight markets and plans to launch a ninth in Belgium. The speaker manages the supply chain from demand forecasting to delivery with a team of four people.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:

The speaker is talking about how their company and a large e-commerce retailer exchange data related to supply chain management. The e-commerce retailer primarily shares information such as inventory levels, sellout volumes, order patterns, and forecasts with their company. This information is useful for the speaker's company to better plan their production, adjust inventory levels, and forecast demand. In the past, the speaker's company has also shared information related to inventory levels and forecasts with the e-commerce retailer. This kind of information sharing helps to foster a collaborative approach to forecasting and planning, which can ultimately lead to more efficient supply chain management for both parties.

The speaker also mentions that there is a lot of exchange in terms of promotional activities, such as when they get close to a big event, and they exchange information on when stock will be delivered and when they will be able to deliver it to the e-commerce retailer. They use EDI (Electronic Data Interchange) interfaces for this kind of communication, which helps to ensure that orders are processed quickly and efficiently. Finally, the speaker mentions the possibility of adopting the e-commerce retailer's API (Application Programming Interface) technology in the future. This technology could help to streamline their communication and data sharing even further, but the speaker notes that their company is not yet ready to adopt it.

Importance of data sharing, benefits, and challenges:

Importance:
1. Sharing forecast data between two companies is crucial for planning and maximizing value for customers.
2. Without regular exchange of information, there can be a negative impact on forecast accuracy, inventory, and sales potential.

Benefits:
1. Visibility is important in the operational part to prepare resources efficiently for inbound processes and receiving orders in an automated fashion.
2. Forecasting and stock levels are important for higher customer service and lower inventory cost.
3. These benefits can maximize value for all parties involved.

Challenges:
1. In the past, companies were not transparent about sharing stock and forecasting with customers during commercial negotiations, which was mainly due to concerns about potential effects on the negotiations.
2. However, nowadays, both vendors and retailers are realizing the benefits of exchanging data to make their respective parts of the supply chain more efficient, reduce costs, and increase customer service levels.
3. As more players in the supply chain recognize that it is a shared process, there is potential for greater transparency and collaboration.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	1. The speaker believes that blockchain technology requires multiple players to be on the same page and share information through a common platform, which is not currently the case in their company and their relationship with a partner company. 2. The speaker acknowledges the potential benefits of blockchain technology but is not clear on what these benefits would be compared to the current methods used, which vary in sophistication from Excel files via email to fully automated processes. 3. The speaker sees the potential for a common framework in the use of blockchain technology, which would benefit both their company and retailers by standardizing the way data is shared and eliminating the need to deal with multiple vendors.	3/4
Advanced technologies like Artificial Intelligence and Machine learning	1. The company is using artificial intelligence and machine learning to improve their demand forecasting, especially for their customer, where demand signals can spike quickly. 2. The company has tried using in-house teams for this task but is now exploring external parties with more expertise. 3. The main challenge in using AI models for better prediction is the quality of the data being used, as it can be difficult to map data from different sources and ensure correct formatting and completeness. 4. The company's focus accuracy levels are around 40%, and while they believe that AI is the way forward, they have not yet achieved substantial improvements and only expect a 4-5% incremental improvement.	4/4
Standardization of data formats and interoperability between firms	1. The implementation of a standardized data format is necessary to promote interoperability between companies and enable the sharing of data in a uniform way. This has been successful in the past with EDI. 2. The challenge is finding someone to bring this forward and getting all companies to adopt the technology, while ensuring that the cost is not too high, and the benefits are clear. 3. A standardized data format would be a fundamental step towards a more centralized platform and the use of common data sources or chains, which would benefit artificial intelligence applications like forecasting.	1/4
Data security measures: Encryption and access controls	1. Encryption and access control are important data security measures that should not be overlooked. 2. The speaker is unsure whether the data being shared is secure because of the use of different systems, formats, and the involvement of multiple parties such as retailers, carriers, and warehousing operations.	2/4

	3. The speaker suggests that having a governance system in place to ensure encryption and access control for all shared data would be helpful but acknowledges that the company is not currently there yet.	

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspective towards data sharing and privacy	1. Personal information sharing is not typical in supply chain management as the data shared usually involves goods movement, quantities, and EAN (European Article Number) codes. 2. Cultural factors are not a block in data sharing in supply chain management as compared to past practices in sales perspective where stock and planning information were not shared. 3. The role of customer collaboration has expanded in supply chain management, and sharing data is widely accepted to make supply chains more efficient.	5/6
Trust and how could it be built?	1. The interviewee places trust in companies with advanced technology due to their assumption that these companies have secure data encryption and effective data protection measures in place. 2. The interviewee expresses less concern about sharing data with such companies as they trust that their data will not be leaked or stolen due to the high levels of security, they expect these companies to have. 3. The interviewee notes a lack of transparency in how companies use shared data and expresses a desire for clearer guidance on who has access to the data and how it is used. Trust in these companies is based more on reputation than on specific tools or processes in place, which indicates room for improvement in data handling practices. 4. **Trust-building techniques:** A) Sharing data, particularly in collaborative forecasting, is an important way to build trust between companies. B) Trust is built when both parties take actions based on the shared data, such as ordering in line with forecasted needs or alerting each other to potential stock shortages. C) As companies become more sophisticated, the nature of data sharing may change, with more automated processes and one-way communication. However, trust remains a crucial factor in maintaining effective partnerships.	1/6
Contractual agreements and data governance policies	1. The speaker acknowledges that they are not an expert in data governance and contractual agreements within the supply chain, and thus have limited knowledge in the area. 2. The speaker suggests that there may be a need for more structured approaches to data governance and quality control within the supply chain, including a better understanding of what data is being shared and how it is being used. 3. The speaker suggests that their company may benefit from having someone within their team who is more knowledgeable about data governance and contractual agreements.	2/6
Education and training programs	1. Education and training programs may not be necessary for sharing data, as motivation through business case studies or success stories of competitors may be more effective in triggering action. 2. Learning about successful data exchange between companies may also inspire individuals to consider why they are not doing the same with their own customers. 3. Training programs may become necessary in the future if a common framework for technology, such as blockchain, is adopted for data sharing.	6/6
Role of leadership and senior management	1. The leaders are responsible for deciding what data is shared and what is not shared. Their past experiences with successful data sharing can influence their decision. 2. Leaders should take an outside view to help them be bolder and take data sharing to the next level, as it has the potential to improve forecasting, visibility, and technological advancements. 3. Instead of one-on-one data sharing practices, leaders should collaborate to move the needle forward and maximise the benefits of data sharing.	3/4
Ethical and responsible data sharing	1. Ethical and responsible data sharing involves ensuring that data is used for its intended purpose, and that this purpose is clearly defined and followed. 2. Data governance and security are important considerations in ensuring ethical and responsible data sharing, and companies should have frameworks in place to enforce these principles. 3. Trust is currently placed in the receiving party to use the data in good faith, but third-party oversight may be necessary to ensure ethical and responsible use of the data.	4/6

| | 4. While personal or sensitive data may not be shared in operations, it is still important to consider ethical and responsible data sharing frameworks for both data received, and data shared. | |

1. There is a need for a more integrated way of working in the supply chain beyond traditional operational data sharing, with a focus on demand forecasting and linking it to end consumer behaviour.
2. Better and faster data sharing, coupled with artificial intelligence, can help in making accurate decisions and stopping the production of unwanted goods.
3. A common industry framework is needed, with standardized data structures and data quality, to facilitate data exchange among companies in a faster, more automated, and more accurate way.
4. While the cultural mindset has shifted towards collaboration and data sharing, the technological and institutional framework is not yet in place for all companies to adopt a similar way of working.
5. It is unclear who will take the first step, which technology will be adopted, who will manage the framework, and what incentives will drive adoption. A cluster of companies, third parties, or institutions may eventually provide a framework for technology adoption in data sharing.

New initiatives or technologies that the speaker's company is trying to explore:

1. The speaker's company is exploring the use of their partner company's API to improve their IT landscape, aiming to leverage it for real-time information and seamless flow towards their systems.
2. They plan to use this technology for different programs and consider it their next-level challenge.

Interviewee 2: Head of Global Supply Chain (for a key account)

The speaker holds the position of leading the global supply chain for their company's consumer products, specifically for a key account of one of their customers.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:

The speaker suggests that there should be more information sharing about macroeconomic disruptions in the supply chain, such as port delays, port congestions, and factory closures due to events like COVID. The speaker also believes that better information sharing about these disruptions could help mitigate their impact on the supply chain.

Use case: The speaker was previously a part of a customer logistics share group in the US that included the top 50 companies' supply chain managers. The group shared information regarding challenges they faced, related to key accounts, specific functions within the supply chain, fill rates, on-time performance optimization for transportation, and benchmarking. They brainstormed to find good or best practices, sharing experiences to manage problems better. The group shared information indirectly, which helped them collaborate better and avoid reinventing the wheel.

Importance of data sharing, benefits, and challenges:

Importance:
1. The speaker acknowledges that certain sensitive commercial data cannot be shared but believes that non-critical performance data such as vendor performance, availability checks, and lead times can be shared with other supply chain companies to improve collaboration.
2. Sharing this data can also help minimize the need to reinvent the wheel by learning from solutions that are already available. Overall, the speaker believes that data sharing in supply chain is important but recognizes the need to protect sensitive commercial data.

Benefits:
1. Data sharing allows for benchmarking against other companies and identifying areas for improvement.
2. Collaboration through data sharing helps to identify disruptions and solve problems jointly with other companies. One example is the case study where company A and company B collaborated on emerging supply chain opportunities and worked together to gain insights on working better with a third-party company.

Challenges:
1. Data security is the biggest challenge when sharing data, as there are concerns about how the data will be used.
2. Commercial data points are often sensitive and cannot be shared, making it difficult to segregate the relevant supply chain data from the overall data set.
3. Masking the data before sharing is a potential solution to the challenge of sharing sensitive information.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	1. The speaker believes that emerging technologies such as blockchain and ICT can have a significant impact on how information is shared in the supply chain. 2. They argue that current information sharing in the supply chain is linear and can be improved by making it multivariable. By doing so, multiple stakeholders can analyse the data to make informed decisions together. 3. The speaker gives an example of a semiconductor shortage, which highlights the importance of sharing information quickly and efficiently across the supply chain. 4. The speaker emphasizes the need for better information sharing across the supply chain to enable more efficient decision making. By leveraging emerging technologies, companies can make better decisions that benefit all stakeholders involved.	3/4
Advanced technologies like Artificial Intelligence and Machine learning	1. The speaker believes that advanced technologies like AI and ML can influence data sharing in the supply chain to optimize forecasting and reduce waste.	4/4

	2.	The speaker suggests that companies can use a similar way of working to predict demand better and make the supply chain sustainable across all companies.	
	3.	The interviewee recommends sharing information on how to predict better to save resources not only for the present but also for future generations.	
Standardization of data formats and interoperability between firms	1. The speaker believes that data standardization is a critical factor in using and sharing data, as every company and business may manage data differently. 2. Without standardization, it becomes difficult to use or share the data without manual intervention. 3. Standardization is important not only within organizations but also outside of them to create solutions that are multi-organization oriented. 4. The speaker emphasizes the need for standardization of data formats and interoperability between firms to create solutions that are not limited to a single organization.	1/4
Data security measures: Encryption and access controls	1. Data security is a significant concern for most organizations in the supply chain. 2. Encryption is necessary to secure the data, but there needs to be a central way to bring data points together in a secure way and decouple or mask the data to make it relevant for information purposes only. 3. This plays a critical role in the supply chain, but sharing data directly from one organization to another will require a step in between to ensure data security and confidentiality.	2/4

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspective towards data sharing and privacy	1. The speaker hasn't seen any cultural concerns about sharing data within the supply chain in their experience with multiple forums and people from different cultures. 2. They believe that supply chain professionals are generally data-oriented and don't see any reason for cultural attitudes to be a hurdle for data sharing.	6/6
Trust and how could it be built?	1. Trust is the most important factor when it comes to sharing data. 2. To build trust, it is necessary to provide guardrails for how the data will be received and used, and to ensure that operations are conducted within those parameters. By doing so, trust can be built within the organization or with external parties.	2/6
Contractual agreements and data governance policies	1. The speaker suggests that legal frameworks will be necessary for data governance policies. They recommend a disclosure agreement to determine which data sets are governed by the legal aspect and which are not. 2. Data sets critical to a company's performance or sensitive in nature will need to be managed through a legal framework, but this may impact trust when sharing with other companies or competitors. 3. The speaker believes that contractual agreements will not help build trust to share data, and only generic data sets can be shared.	5/6
Education and training programs	1. The speaker believes that education and training programs to help stakeholders identify which data sets they can share and which they cannot share. 2. The goal is to make people aware of data points that can be shared without concerns about how companies will use it, so that this information can be used to drive improvement in supply chain or decision making.	3/6
Role of leadership and senior management	1. The speaker believes that data sharing practices generally come from senior leadership and management. 2. By discussing supply chain management and seeking opportunities for improvement with other organizations, this mindset can cascade down through the supply chain. 3. The speaker emphasizes the importance of senior leadership in promoting an outside-in view and encouraging data sharing for the benefit of the organization and its stakeholders.	1/6
Ethical and responsible data sharing	1. The speaker's company follows GDPR and has a privacy officer to ensure compliance with data protection rules and guidelines. 2. The speaker's organization handles sensitive information from consumers and must follow strict guidelines to ensure ethical and responsible data management and sharing.	4/6

Future of Data Sharing in the Supply Chain:
1. Companies are relying on artificial intelligence to improve supply chain performance, and data inputs are needed to enrich the algorithms.
2. Organizations can bring together multiple datasets, both internal and external, to enrich algorithms and generate better predictions for the supply chain.
3. The future of the supply chain is predictability, and companies that are better at predicting will gain a competitive advantage.

New initiatives or technologies that the speaker's company is trying to explore:
No information was given in response to the question.

Interviewee 3: Customer Demand Planner (for a key account)

The speaker identifies themselves as a customer demand planner for male grooming and oral health care products at the company. Thoughts

on "Data Sharing in the Supply Chain Domain" and use-case:
In regard to data sharing in the supply chain, it is essential to share necessary information such as forecasts, product details, shipping details, and general communication regarding current outlooks. However, it is important to maintain anonymity when discussing company-specific details.

Use case: The speaker's team shares data related to supply chain performance with their key customer weekly. The data includes two important Key Performance Indicator (KPI) metrics with details on why the supply chain performance is not at 100% and when it is expected to be resolved. Additionally, suggestions for improvement are also shared.

Importance of data sharing, benefits, and challenges:
Importance:
The interviewee emphasized the importance of data sharing in supply chain management. They highlighted that data sharing is crucial for understanding customer needs and providing the necessary support to satisfy those needs. Additionally, data sharing helps to avoid discrepancies and ensure smooth operations.

Benefits:
The interviewee mentioned that data sharing in the supply chain can benefit by ensuring 100% availability and accurate delivery of goods to fulfilment centres.

Challenges:
The interviewee mentioned that confidentiality can be a barrier to data sharing in the supply chain, especially when it comes to peak events. They gave an example of how their customer does not always share the dates of certain key events within their promotional calendar. However, there are usually minimal barriers to data sharing within the supply chain.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	The interviewee mentioned that emerging technologies like ICT or blockchain make it easier for everyone to view and access the same data.	2/4
Advanced technologies like Artificial Intelligence and Machine learning	The interviewee acknowledges the potential benefits of advanced technologies such as AI or ML but has not yet personally witnessed any positive outcomes from their use.	3/4
Standardization of data formats and interoperability between firms	The speaker emphasized the importance of standardizing data formats to ensure interoperability between different firms. They mentioned that it would prevent miscommunications and discrepancies within data, ensuring a 100% match.	1/4
Data security measures: Encryption and access controls	The interviewee believes that encryption and access controls are necessary for data security measures. They mentioned that it is important to keep secure data away from customers and only share it with certain individuals.	4/4

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspective towards data sharing and privacy	The interviewee believes that cultural factors such as attitudes and personal perspectives towards data sharing and privacy can have some influence on team members. However, they also mentioned that as a team, they work closely together, which minimizes the impact of such factors.	6/6
Trust and how could it be built?	The speaker emphasized the importance of trust in business relationships, especially when confidential information is shared. To build trust, it is necessary to establish strong relationships with regular contact and follow-through on commitments. The speaker suggested that this can be achieved by being reliable and providing requested information, which will help build trust with customers. The key is to maintain the relationship with the customer to ensure continued trust.	2/6
Contractual agreements and data governance policies	The speaker believes that contractual agreements and data governance policies are necessary depending on the type of data being shared. For sensitive information suchas pricing or similar things, more agreements are required. However, within their role, they have never had to sign any confidentiality agreements with customers.	5/6
Education and training programs	The interviewee believes that education is important in the context of data sharing with customers. They are unsure about the necessity of training for this purpose, but	3/6

	they do believe that educating others on what is needed and sharing this knowledge with other teams could be necessary.	
Role of leadership and senior management	The interviewee emphasized that leadership and senior management should lead by example and communicate clearly about what can and cannot be shared with customers. While some information may need to be kept back, it is important to share as much as possible to achieve a positive outcome. The decision to withhold information is not due to a lack of trust, but rather based on necessity.	4/6
Ethical and responsible data sharing	The interviewee mentioned that the speaker's company has training programs to ensure ethical and responsible use of data. They also shared that the company is currently sharing data with a third-party company for an AI forecast and ensuring that only relevant information is shared with them.	1/6

Future of Data Sharing in the Supply Chain:

1. The interviewee is focused on making data sharing more automated, especially for their key customer, to ensure smooth flow and reduce manual touchpoints in the process.
2. The interviewee is working with an external AI forecasting team to ensure the seamless flow of data through the supply chain.

New initiatives or technologies that the speaker's company is trying to explore:

The speaker is not aware of it.

Interviewee 4: Fulfillment Manager

The interviewee has been working at the company for almost 2 years as a Fulfillment Manager for an account with a key customer. His role involves overseeing the delivery of goods from a warehouse owned by the company he works for to the customer. Prior to this, he worked in logistics companies for 14 years.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:

The speaker finds the idea of sharing insights and information between companies to be interesting, as it could potentially help both companies and each company individually.

Use case: The speaker mentioned that their company is a vendor of a large online retailer and is aware of other vendors that supply to this retailer. Their company can share their way of working with other non-competitive companies that supply to the retailer to see how the retailer operates and to improve their processes collaboratively. The speaker stated that they can share information on ways to improve the process without causing any negative side effects, such as competition.

Importance of data sharing, benefits, and challenges:

Importance:
1. Data sharing is important in the supply chain, especially for companies that are huge and complex.
2. Each vendor is different, but the speaker's customer is the same for all vendors. This allows companies to see how each other is doing something differently, which can help improve processes.
3. The speaker has personally experienced improvements in their processes thanks to data sharing in the supply chain.

Benefits:
1. Cost saving: Sharing data with other companies in the supply chain can help avoid or reduce costs associated with different aspects of the supply process, such as transportation and penalties from customers.
2. Learning from others: By collaborating and sharing data with other companies, businesses can learn from each other's best practices and experiences to improve their own operations and processes.

Challenges:
1. The challenge of data sharing in the supply chain is to strike a balance between sharing information and maintaining confidentiality.
2. The aim is to share information only with those who require it and to avoid oversharing that could potentially benefit a competitor.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	1. The speaker believes that having access to more information and technology can help a company react more quickly to changes in the supply chain. 2. They emphasized the importance of staying up to date with the latest technology and information to stay ahead of potential competitors. 3. The speaker specifically mentioned that Information and Communication Technology (ICT) is essential for achieving these goals.	1/4
Advanced technologies like Artificial Intelligence and Machine learning	1. The interviewee believes that advanced technologies like AI are influencing data sharing in the supply chain, particularly in the form of chatbots that can mimic human interactions. 2. The interviewee emphasizes the importance of analysing and understanding the potential of these technologies for their company, as failure to do so may result in missed opportunities or losing out to competitors who have embraced them.	4/4
Standardization of data formats and	1. Standardization of data formats is crucial for automation, particularly when using AI or machine learning.	2/4

	2. Without standardized data, more manual inputs or operations are required to work with the data, hindering automation.	
interoperability between firms		
Data security measures: Encryption and access controls	1. Encryption is a key data security measure that needs to be in place to protect sensitive information when it is shared in the supply chain. 2. Access to the encrypted data should be limited to only authorized personnel, and companies need to carefully consider what information is valuable and relevant to share with their partners while avoiding oversharing that could potentially harm their competitive advantage. 3. Overall, it is important to have these security measures in place while still being able to share the necessary information effectively.	3/4

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspective towards data sharing and privacy	1. It is important for individuals to remain professional when sharing data between companies. 2. Personal and cultural perspectives should be kept in the background when sharing data to prioritize the goals and needs of the company. 3. Individuals should think on behalf of the company rather than their personal opinions when making decisions related to data sharing.	6/6
Trust and how could it be built?	1. Trust is important when sharing data with other companies, particularly when there is a risk of that data being shared with competitors. 2. The speaker wants to communicate with other vendors on platforms without involving the platform itself, highlighting the need for confidentiality and trust in these interactions. 3. **Trust-building techniques:** To build trust, the speaker suggests using written agreements, such as emails outlining expectations, and potentially more formal contracts like confidentiality agreements or NDAs.	2/6
Contractual agreements and data governance policies	1. Contractual agreements between companies for data sharing are important, and having them is a good thing, even if they are just a formality in some cases. 2. A written and signed agreement between the parties on how to handle the shared data makes it easier to trust each other.	3/6
Education and training programs	1. Educational training is important in training employees on what to share and what not to share, particularly with competitors. 2. It's crucial to focus on training employees on what not to share, rather than just what they can share. 3. Employees should be educated on these matters before attending any sharing meetings to ensure that they do not share any confidential or sensitive information.	5/6
Role of leadership and senior management	1. The interviewee/speaker suggests that the role of leadership and senior management in data sharing is to identify areas where sharing is needed from a high-level perspective, particularly if there are issues or processes not being performed efficiently within their team. 2. They should then set up data sharing arrangements with different companies to try to address those issues and improve the relevant processes.	1/6
Ethical and responsible data sharing	1. Every employee from the speaker's company receives GDPR training to understand what personal data can and cannot be shared. 2. The company provides mandatory trainings to ensure that ethical and responsible data sharing is covered. 3. The speaker suggests that responsibility and ethics are important in data sharing, and mandatory trainings are in place to ensure that all employees are aware of their responsibilities.	4/6

Future of Data Sharing in the Supply Chain:
1. The speaker has observed the evolution of data sharing in the supply chain, particularly in relation to selling consumer products online through its customer company.
2. As a vendor of the E-Commerce customer, the speaker's company supplies a significant portion of their products to the platform.
3. The online market has grown rapidly, and it is important for vendors to collaborate and help each other evolve at the same pace as online selling platforms.
4. By working together, companies can adapt to changes in the online market and stay relevant in the consumer product industry.

New initiatives or technologies that the speaker's company is trying to explore:
The speaker is not aware of any new initiatives or technologies being explored by their company. However, the speaker's company has started working with an E-Commerce company as a vendor, which has allowed them to share information with other non-competing companies who also supply to that E-Commerce

company. This is a relatively new development for the interviewee's company, as prior to this, they primarily sold products via physical stores and did not have many opportunities for data sharing.

Interviewee 5: Global collaboration manager

The speaker is the customer collaboration manager for the company that works with a key customer. The speaker is responsible for managing the relationship between the two companies. The company has a dedicated supply chain department for the customer, as they are the company's only global customer. The speaker works on multiple supply chain initiatives with the customer company in Europe and collaborates with the global team to discuss strategic initiatives. In smaller markets, the speaker connects with the company's employees who work with the customer company to ensure the customer receives the necessary attention and resources to meet the company's standards.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:
The speaker believes that data sharing, particularly in the area of forecasting, is essential for efficient collaboration between suppliers and customers in the supply chain domain. Without this data, it can be difficult to align and secure goods for customers. Their company has several initiatives where they collaborate with customers and exchange information, which helps them produce enough and confirm orders more efficiently. Although historical data can be used without data sharing, it may not take all factors into account, making collaboration with other partners a good option. Data sharing is crucial for a global supply chain to function effectively. It is necessary not only for planning purposes but also for using industry-wide standards such as GTIN or EAN codes, which are widely used by companies. Without data exchange and a common standard, the supply chain would not be feasible.

Importance of data sharing, benefits, and challenges:
Importance:
1. Data sharing is crucial for a global supply chain to function effectively.
2. It is necessary for planning purposes and using industry-wide standards like GTIN or EAN codes. These codes are widely used by companies.
3. Without data exchange and a common standard, the supply chain would not be feasible.

Benefits:
1. Sharing data can lead to a better understanding of networks and improve decision-making related to supply chain efficiency and performance.
2. It can also have a positive impact on sustainability and foster a culture of collaboration.
3. Collaboration is necessary when sharing data and can lead to transparency, accountability, and stronger relationships.

Challenges:
1. Barriers to data sharing in the supply chain relate primarily to concerns around data privacy and security. Clear guidelines or protocols are needed to protect sensitive information and ensure all stakeholders understand their responsibilities.
2. The need for data privacy and security protocols should be a priority in facilitating data sharing among supply chain partners.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	No information was given in response to the question.	4/4
Advanced technologies like Artificial Intelligence and Machine learning	1. Advanced technologies like Artificial Intelligence and Machine Learning have a significant impact on data sharing in supply chains, particularly in planning. 2. AI systems built on data from multiple organizations can provide better insights and produce more effective plans than any individual in a single company. 3. The benefits of AI and machine learning in supply chain data sharing are substantial and can lead to improved efficiency and effectiveness across multiple organizations.	3/4
Standardization of data formats and interoperability between firms	1. Open standardization of data formats can enhance efficiency and speed of operations and transactions in the supply chain. 2. Interoperability between firms through standardized data formats can positively influence data sharing and communication between companies.	1/4
Data security measures: Encryption and access controls	1. Implementing encryption and access controls can mitigate the risk of data privacy and security breaches. 2. Encryption and access controls enable secure data sharing in the supply chain by ensuring the right level of access without breaching or sharing any sensitive information.	2/4

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspectives towards data sharing and privacy	1. Attitudes and personal perspective towards data sharing and privacy are crucial factors in influencing data sharing in the supply chain. 2. Collaboration, building trust, and accountability are essential to effective data sharing. 3. Without trust in partners, data cannot be properly utilized, and willingness to collaborate is necessary for positive outcomes.	5/6
Trust and how could it be built?	1. Trust is crucial in the supply chain to ensure that partners and providers can deliver on their promises.	3/6

	2. Building trust is especially important at the beginning of collaborations or partnerships, as trustworthiness is only verified later through actual performance. 3. **Trust-building techniques:** To build trust and encourage data sharing in the supply chain, a balance needs to be struck to ensure that all parties involved benefit and there is no extortion. Relevant and accurate data that meets the needs of the other party is crucial, and transparency is key. These three elements (balance, relevancy, and transparency) are essential to building trust in data sharing.	
Contractual agreements and data governance policies	No information was given in response to the question.	6/6
Education and training programs	1. Providing an overall framework and highlighting the importance of data sharing as part of corporate culture can encourage collaboration and exchange of data in education and training programs in the supply chain. 2. It is difficult to achieve open collaboration and data sharing without a company culture that fosters such practices, making it an important aspect to consider.	2/6
Role of leadership and senior management	1. Leadership and senior management can influence data sharing in the supply chain by setting an example for the rest of the company to follow. 2. By actively collaborating and partnering with external parties and sharing external information, they create a culture of appreciation for data sharing and encourage others to work in a similar way.	1/6
Ethical and responsible data sharing	No information was given in response to the question.	4/6

Future of Data Sharing in the Supply Chain:
1. Data sharing in the supply chain will continue to develop with the advent of new technologies and will create global standards for faster communication and decision-making processes.
2. The pandemic has highlighted the importance of data sharing in the supply chain and companies will increasingly shift from manual to automated processes with improved AI technology.
3. The future of data sharing in the supply chain will include global standards, faster communication, faster decision-making processes, and improved AI technology enabling the shift to automated processes.

New initiatives or technologies that the speaker's company is trying to explore:
The speaker is aware of efforts being made to implement AI across the market for planning purposes. However, they cannot provide further details at the moment.

Interviewee 6: Supply Chain Innovation Lead

The speaker works at the company as a supply chain innovation lead. Their job involves analyzing the market to identify the latest capabilities that could be strategically implemented at the firm. They also set up pilot projects to test and learn what can and cannot be implemented and scale up the successful ones. Data plays a significant role in their work, as supply chain issues are often related to information and data flows.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:
The speaker believes that trust is key when it comes to information sharing in the supply chain domain. They do not believe that technical issues are the main problem, but rather it is about building trust with partners on what data can be shared and what can be done with the data.

Use case: The company attempted a blockchain pilot with a logistics partner to address disputes in the supply chain regarding lost materials and identify who is responsible for payment. The goal was to use blockchain technology to increase trust and transparency by sharing transaction data and ensuring that it cannot be modified. However, they found that blockchain was not a good fit for the specific use case and that more time was needed to understand the needs of all partners involved in the supply chain.

The key takeaway is that building strategic partnerships requires a collaborative value proposition where all parties share information transparently to benefit the business and the end customer. Transparency in data sharing is essential, but it's not just about sharing data; it's also about understanding what the data means and what is behind it. Implementing a successful data-sharing solution requires time and effort to understand the needs of all parties involved.

Importance of data sharing, benefits, and challenges:
Importance:
1. Visibility of the supply chain is crucial for the company's performance as they outsource a lot of their manufacturing and need to understand when something will be available to be built and delivered.
2. Without data sharing across partners, it is difficult to properly inform customers, plan production and manage disruption, such as the Covid-19 pandemic and the Suez Canal blockage.
3. Lack of visibility and good information sharing can result in the bullwhip effect, causing inventory shortages and overstocks, which negatively affect both the company and its suppliers.
4. Coils in the magnetic business and E-components are experiencing shortages, which can be addressed by efficient data-sharing mechanisms within the supply chain.
Benefits:
1. Data sharing in the supply chain domain leads to better planning, which results in improved cash flow, inventory management, and product availability.
2. Collaborative information sharing beyond orders and supply capacity can lead to cost reductions for both parties involved, as demonstrated by partnering with third-party logistics providers.
3. In such collaborations, parties usually agree on the 50/50 principle, where both parties get 50% of the benefits.
Challenges:

1. Building trust: A clear value proposition for all partners is needed to achieve a common goal, which requires good management of suppliers and customers. This may involve accepting some level of risk to build the data-sharing mechanism.
2. Technical challenges: A common language is needed for sharing data, as well as compatible systems, governance, and agreements. This can take a lot of time and effort.
3. Partner companies: Partner companies can provide shipment visibility by connecting to public sources such as carrier websites and weather forecast APIs. However, trust is still necessary to onboard people to use these platforms, which is currently a major challenge.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	1. Emerging technologies like ICT and IoT sensors are not yet fully deployed, and only a few big players in the market are using them in their highly competitive operations. Digital transformation is required to deploy these technologies widely. 2. Change management is an essential component of implementing emerging technologies, which involves onboarding people, teaching them the value proposition, and empowering them to cope with the technological changes. 3. Blockchain technology is going beyond connecting systems and is collaborating to connect the business world and the supply chain itself. The use of smart contracts in blockchain platforms creates trust across parties. 4. It's challenging to identify which emerging technology is useful, what is not, and what is just causing the market due to many players in the market. 5. The future of emerging technologies in the supply chain market will be dominated by some parties, focusing on the deployment and onboarding of multiple companies around real-time transportation visibility, blockchain for the supply chain, and integrated planning.	2/4
Advanced technologies like Artificial Intelligence and Machine learning	1. Artificial intelligence and machine learning are driving the need for more data sharing in the supply chain. These technologies offer opportunities for productivity, resilience, and agility in the face of disruptions. 2. They require a lot of data and a skilled workforce to effectively translate them into applications. 3. Simple AI/ML algorithms such as forecasting, safety stock optimization, and lead time predictions are being used in supply chain currently. 4. There is a need to explore their potential further to develop new value propositions for customers, such as chatbots for improved customer experience.	4/4
Standardization of data formats and interoperability between firms	1. The speaker believes that standardizing data formats across firms is too costly and would require a lot of infrastructure and change management. By the time this is achieved, technology may have advanced enough to make it unnecessary. 2. Instead, the speaker believes that interoperability between systems is a better approach, allowing firms to leverage existing platforms and be more agile. 3. The interviewee does not believe in having a single integrated platform but rather allowing innovation to flow and build value propositions.	1/4
Data security measures: Encryption and access controls	1. Data security measures such as encryption and access control are necessary for compliance and ethics when dealing with personal information. 2. However, overly strict data security measures can hinder innovation and slow down the supply chain transformation process. 3. The balance between necessary security measures and flexibility for innovation is crucial in determining how fast a company can progress with their data initiatives. 4. A key decision for companies is to determine what data should have access controls and encryption, and what data can be more flexible for innovation.	3/4

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspective towards data sharing and privacy	1. Many people are becoming more aware of data privacy concerns, but there is still a significant amount of data being shared freely. 2. In the professional world, individuals may be less hesitant to share information about their performance and the processes they are managing. 3. Onboarding the right people who are knowledgeable about changes and willing to adopt them is a crucial factor for successful implementation of data in supply chain.	2/6

Trust and how could it be built?	1. Trust is crucial for data sharing in the supply chain. 2. To build trust, a common goal should be created, which could be related to cost, revenue, or value propositions towards the customer. It's important to avoid blaming each other and focus on the defined goal. 3. A clear strategy should be defined for the partnership, either to build a strategic partnership and trust each other or to use data for cross-checking and audit, which does not build trust. 4. Using data for unintended purposes can negatively affect trust.	1/6
Contractual agreements and data governance policies	1. Contractual agreements and data governance policies are necessary in any relationship to build trust and ensure clear rules and mechanisms to protect parties when rules are not met. 2. Having an NDA or agreed policies makes it easier to operate in the supply chain because parties have clear guidelines to follow.	5/6
Education and training programs	1. Education and training programs can help shift the cultural aspect towards data sharing in the supply chain. 2. The focus of these programs should be on fostering the right mindset and adoption of digital technology, rather than going too deep into the technical details of AI and ML applications. It's important to trigger individuals to have their own spark and get trained by themselves.	6/6
Role of leadership and senior management	1. Leadership and senior management play a crucial role in enabling data sharing in the supply chain. 2. Cultural change starts with leaders who support and promote the values of digital transformation. This is more critical than education and training programs.	3/6
Ethical and responsible data sharing	1. A compliance team focuses on data governance, and any tool or data that goes outside needs to be audited. There are good NDA mechanisms in place for data sharing. 2. The supply chain currently focuses on value and productivity, but more work can be done on responsible data sharing. 3. Data becomes more important when it starts becoming customer-facing and helps in understanding the customer to provide better supply chain services. However, this is not the case yet.	4/6

Future of Data Sharing in the Supply Chain:
1. The future of data sharing in the supply chain will be enabled by companies that focus on the value that data sharing can bring.
2. Some companies focus on real-time transportation visibility and warehouse/distribution space while others focus on building integrated planning tools.
3. New parties will enable data sharing by providing infrastructure, onboarding mechanisms, and industry standards.
4. The collaboration will be enabled by third parties and organizations coming together to create industry-specific standards and data mechanisms.

New initiatives or technologies that the speaker's company is trying to explore:
1. The company is exploring tools for collaborative planning with suppliers. They are considering third-party tools, and also testing planning tools that offer collaborative planning capabilities.
2. They use EDI connections with suppliers and have a traditional approach to onboarding suppliers, including contract agreements.
3. The speaker believes that more needs to be done to build collaborative propositions with suppliers and explore how automation and data can enable this.

Interviewee 7: Supply Chain Deployment Lead

The speaker has been working at the company for over three years. He began as a supply chain trainee and has since held various roles, including program management for inventory tooling, and creating dashboards to mitigate E-component shortages in the personal health business sector. The speaker's latest role involves developing and deploying short-term operational processes for health systems in Western Europe. The interviewee holds a master's degree in supply chain strategy and innovation from an esteemed university in The Netherlands.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:
The speaker believes that there is limited data sharing in the supply chain industry. Even if data sharing is possible, it can be difficult to integrate due to the need for various systems and interfaces to be built. This can take a long time. The speaker believes that there is a lot to gain from data sharing between companies to gain visibility and evidence of end-to-end supply chain data.

Use case: The speaker discusses the possibility of enhancing data sharing with partners in the supply chain, particularly in relation to transportation and carriers. They mention the challenge of integrating publicly available tracking information into their systems and suggest the need for building certain bolts to facilitate this. The speaker also suggests looking upstream towards Tier 2, Tier 3, and Tier 5 suppliers to share information about PO releases and delivery schedules. The speaker's own experience with data sharing has been primarily with carriers to obtain the latest information.

Importance of data sharing, benefits, and challenges:
Importance:
1. Shortages in the supply chain can be traced back to limited traceability and a lack of data sharing among suppliers.
2. Introducing data sharing can increase visibility and predictability, allowing for better planning and commitments to customers.
3. End-to-end visibility through data sharing can help adjust plans based on supplier outlooks.
Benefits:

1. One source of truth: Data sharing in the supply chain can provide a single source of accurate information, reducing the risk of contradictory data due to various filters and perspectives.
2. Increased visibility: Sharing information across the supply chain can improve visibility, leading to better planning and efficiency by enabling stakeholders to have a better understanding of what they can expect and when to expect it.

Challenges:
1. The major challenge in operational data sharing is IDE interfaces. Different IDE systems and platforms have their own interfaces, making it difficult to ensure they connect to the right system.
2. The lack of a common industry standard for IDE interfaces is a barrier to data sharing.
3. Intellectual property rights, negotiation, and leverage can also be a challenge when sharing data, as full end-to-end visibility can impact negotiation ability and lead to potential legal and business consequences.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	1. Many companies are not yet ready to implement emerging technologies like ICT and Blockchain in their supply chain due to lacking foundations. 2. Blockchain technology can address issues related to property rights and legal aspects in data sharing. 3. Other technologies such as RFID can be useful in tracking the location of products and increasing supply chain security. 4. Despite the potential benefits, there are still steps to be taken in the overall setup of companies to effectively utilize these emerging technologies.	3/4
Advanced technologies like Artificial Intelligence and Machine learning	1. Advanced technologies such as AI and ML can be very useful in planning and predictive maintenance, helping to pinpoint bottlenecks within the supply chain. 2. The speaker, however, is not sure if AI/ ML can advance data sharing. 3. While sharing data externally with partners can be a challenge due to competitive requirements, sharing the outcome of AI and ML for planning and S&OP can be very useful for long-term predictability and smoother flow. 4. There can be a competitive advantage in the supply chain, which may make companies hesitant to share data with their partners. Therefore, the value of sharing data externally may not be as clear.	4/4
Standardization of data formats and interoperability between firms	1. Standardization of data formats is a key enabler for data sharing in the supply chain. 2. Without common industry data standards, it will be difficult to achieve a one-to-one match on requested data and ensure data understanding. 3. Standardization is necessary to ensure that all partners involved in the supply chain are speaking the same language and have a similar data understanding.	1/4
Data security measures: Encryption and access controls	1. Data security is crucial in the supply chain as valuable information needs to be protected from breaches, which can lead to severe consequences. 2. Encryption and access controls are essential measures for data protection but can hinder data sharing due to increased difficulty in decryption. 3. Blockchain technology can be a potential enabler for secure data sharing in the supply chain. 4. Secure transfer and storage of data are also critical to prevent unauthorized access, which can lead to severe consequences, including loss of business secrets.	2/4

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspectives towards data sharing and privacy	1. Attitudes and personal perspectives towards data sharing and privacy are crucial factors that influence data sharing in the supply chain. 2. A culture shift is required to ensure that people feel secure about data sharing, and change management will be necessary to achieve this shift. 3. Clear communication of the benefits of data sharing can make it feasible, but it will take time, and individual perspectives will ultimately determine the extent and type of data shared, making it vulnerable to people's attitudes. Standardization may be necessary to overcome this vulnerability.	5/6
Trust and how could it be built?	1. Trust is a very important factor in data sharing in the supply chain. Sharing data without trust is pointless as people won't believe the data being shared, and it will not influence decision-making. 2. Trust is a major enabler for data sharing in the supply chain as decisions are often based on the shared data. 3. **Trust-building techniques:** Standardizing data sharing is crucial to ensure everyone understands the data similarly. Building trust throughout the	4/6

	process of sharing data is important, and commitment from the executive level is necessary to ensure the right data is shared. If there is a breach of trust in the initial phase of setting up a project, it will be difficult to regain trust. It's important for partners in the supply chain to be aligned in their commitment to data sharing.	
Contractual agreements and data governance policies	1. The need for a standard agreement between companies in supply chains regarding data sharing and security is necessary. The establishment of a standard agreement is a key enabler for effective data sharing. 2. Clear requirements from both parties should be stated in supply contractsto ensure proper data sharing.	3/6
Education and training programs	1. Culture and change management are important factors in deploying education and training programs for data sharing in the supply chain. 2. Effective change management should ensure that people understand the benefits and potential risks of the program. 3. Contractual agreements should be in place to address any risks associated with data sharing. Risks should not be hidden but rather clearly stated as part of the change management process.	6/6
Role of leadership and senior management	1. Leadership endorsement is crucial for promoting data sharing in the supply chain. 2. The leaders need to align with partners and demonstrate a willingness to share data and its benefits. 3. The leaders should take a leading role in promoting data sharing, which can influence the rest of the organization to follow with proper change management.	1/6
Ethical and responsible data sharing	1. The company has a soft agreement with its partners for sharing data, which is not very stringent. 2. Ethical considerations are given a high priority, especially when it comes to sensitive data, which are not shared or are anonymized to prevent recognition. 3. Legal obligations are also considered, and the company takes responsibility for ensuring that partners comply with ethical and legal standards through contractual agreements and relationships. 4. Data sharing in the supply chain is influenced by ethical and responsible considerations, as sensitive information can be transmitted through it.	2/6

Future of Data Sharing in the Supply Chain:
1. The speaker expects data sharing in the supply chain to increase.
2. The current challenges to data sharing are related to security and the increasing number of data breaches and hackers.
3. The emergence of many vendors consolidating data and sharing it across the supply chain is a positive development, but a common platform requiresa consensus and solid security and funding.
4. Companies may first establish their own sharing platforms with partners before moving to a common platform in the future.

New initiatives or technologies that the speaker's company is trying to explore:
The speaker mentioned that they have limited knowledge about any new initiatives or technologies that their company is exploring. They stated that they are not very aware of any such developments and, therefore, cannot provide a detailed answer.

Interviewee 8: Fulfilment Manager for a Key account

The speaker works as a fulfilment manager for the company and is responsible for one of their key customers. Their job is to ensure that once a delivery is created in the system, it reaches their customer on time and in the right condition and quality, with no rejections or refusals due to quality issues.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:
The speaker discusses their experience working with their customer company and notes that the customer is very data-driven, often requesting a lot of data in any decision-making process. The speaker acknowledges that the data is the new gold and that the customer's use of data in the supply chain allows for quicker decision-making compared to their own company's process. The speaker believes that their company can also make quick decisions based on data analysis, but their customer company is doing it much faster. They also note that their own company's decision-making process can take too much time.

Use case: The speaker's company is analyzing whether to continue using their current carrier or switch to their customer's Freight. The main bottleneck is their master data, and they are focusing on improving their inbound KPI metric from the customer to ensure their goods can be stored in their system. They discovered that they had a problem with double GTIN codes and wrong EAN codes on their stickers, which caused confusion for both companies. They were able to identify and fix the problem through data analysis and are now changing their labels in all factories worldwide. This achievement was linked to sharing data and using a Pareto set-up to focus on the top leading issues. The problem was ultimately traced back to an issue in their factory.

Importance of data sharing, benefits, and challenges:
Importance:
1. Data sharing is the most important thing for the supply chain's future.
2. Using multiple databases is a problem, and data should be linked together for a unique system.
3. To manage large amounts of data, AI or bots should be used for fast and efficient decision-making.
Benefits:

Data sharing in the supply chain has several advantages, including faster decision-making and reduced manual work. Automation through EDI setup can eliminate the need for working with outdated spreadsheets, improving team efficiency.

Challenges:

The speaker believes that there are no major obstacles to data sharing in the supply chain, as they have an Electronic Data Interchange (EDI) set up with the customer that can be utilized in multiple systems. No specific company names or details were mentioned.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	The speaker is unsure about how emerging technologies such as ICT can influence data sharing in the supply chain. However, they are aware of blockchain technology from a cryptocurrency standpoint but do not know how it can be useful in the context of supply chain management and therefore have not explored it further.	4/4
Advanced technologies like Artificial Intelligence and Machine learning	1. Advanced technologies like Artificial Intelligence and Machine Learning are already being used by companies to analyze data and suggest ways to save costs and address bottlenecks in the supply chain. 2. AI and ML are seen as the future of the industry, and investing in these technologies is essential to stay ahead of the curve.	2/4
Standardization of data formats and interoperability between firms	The speaker agrees that standardization of data formats and interoperability between firms can greatly improve the speed and efficiency of the supply chain. Currently, their processes are fixed and difficult to improvise upon. However, they also suggest that any standardization efforts should allow for some flexibility in the systems.	3/4
Data security measures: Encryption and access controls	The importance of data security measures such as encryption and access controls in data sharing within the supply chain is emphasized. The use of blockchain is mentioned as a highly secure option. Overall, the top priority is maintaining high levels of security.	1/4

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspective towards data sharing and privacy	1. More internal training is needed within companies to determine which data can be shared and where to protect it. 2. Personal attitudes and perspectives towards data sharing and privacy can influence data-sharing practices in the supply chain, and more security measures should be implemented to prevent data breaches. 3. Direct fulfilment projects may pose a challenge to data privacy, particularly when personal addresses are involved. Too many people may have access to sensitive information, which can lead to data breaches.	6/6
Trust and how could it be built?	Trust is an important factor in data sharing in the supply chain. However, it is also necessary to have legal protection in case something goes wrong.	5/6
Contractual agreements and data governance policies	No information was given in response to the question.	1/6
Education and training programs	1. The speaker believes that education and training programs on data sharing should be implemented in companies, whether from external or internal sources. The training should focus on data privacy, particularly in their consumer direct fulfilment project. 2. The speaker suggests conducting refresher training every six months or a year and covering topics such as data usage, benefits, and sharing with both internal and external parties. The speaker considers this a priority for companies.	2/6
Role of leadership and senior management	1. The key customer is a data-driven company and requires data to support any decisions or ideas presented to them. 2. The leadership of the company had a significant influence on this data-driven culture, which is now being adopted by other companies.	3/6
Ethical and responsible data sharing	1. Improved data sharing is necessary to avoid issues with delayed feedback, such as in the case of their customer's current contractual agreement, and to enable faster and more reliable analytics. 2. AI or bots may be required to efficiently analyze and manage the vast amount of data in the supply chain, as manual control via excel sheets may not be sufficient.	4/6

Future of Data Sharing in the Supply Chain:

1. Automation and AI: The interviewee believes that automation and AI will play a significant role in the future of data sharing in supply chain management, potentially leading to job losses but also allowing for faster, cheaper, and more reliable decision-making.

2. Improved data sharing: The interviewee emphasizes the need for improved data sharing, particularly in light of contractual agreements with the customer and the need for immediate feedback on shipments. They suggest that this could be achieved through the use of bots or AI to analyse the data.
3. Human factors: The interviewee expresses trust that there will not be too many human factors involved in the future of data sharing, suggesting a potential shift towards more automated decision-making.
4. Limitations of current setup: The interviewee identifies current issues with the feedback system with their customer, highlighting the need for a better setup that allows for more immediate feedback and prevents problems from happening months later.

New initiatives or technologies that the speaker's company is trying to explore:
The speaker is not involved in any projects related to new initiatives or technologies.

Interviewee 9: Global collaboration manager

The speaker is a global collaboration manager, responsible for monitoring metrics, managing supply chain projects with a prominent e-commerce company, and maintaining supply chain relationships with the same company.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:
Purpose: Data exchange in the supply chain domain serves various purposes, such as joint operations with warehouse providers and improving consumer experience by acting on fill rate and enhancing customer satisfaction. Data sharing should be determined based on the purpose agreed upon between organizations A and B. Once the purpose is defined, relevant datasets can be shortlisted for sharing between the organizations.

Use case: The speaker's team receives weekly data from a prominent e-commerce company, including two major metrics, which are then mapped with their own parameters in the company's system to create a dashboard for actionable insights. The team visualizes the data in their system by mapping it with various parameters such as country, market, value, quality, etc., to facilitate informed actions based on the data.

Importance of data sharing, benefits, and challenges:
Importance:
1. The purpose of data sharing in the supply chain depends on the specific leg of the supply chain and the desired outcome, such as production planning with third-party factories in the speaker's previous role at a previous company.
2. Data sharing is crucial for achieving efficiency in the supply chain, and working closely with partners is necessary to achieve desired outcomes.
3. High-tech companies like the current company the interviewee is working at, emphasize the importance of obtaining and sharing accurate data with the right partners at the right time to optimize supply chain operations. Collaboration with other organizations at various stages of the supply chain is essential.

Benefits:
1. Efficiency: Collaborating with partners, including processors, can lead to better outcomes in solving complex problems, such as linear optimization, by leveraging their expertise and resources.
2. Transparency and trust: Data sharing among partners can foster mutual benefit and trust, but it should be done within the framework of consent, often through non-disclosure agreements (NDAs) to maintain confidentiality.
3. Consent-based collaboration: Efficient collaboration and data sharing should happen with the consent of all parties involved, and maintaining trust through NDAs can facilitate effective collaboration while safeguarding sensitive information.

Challenges:
1. The speaker highlights the drawback of sharing too much data with an external company as it may give them an advantage in negotiations. Careful consideration of the purpose of sharing data is important to prevent potential negative impacts.
2. The speaker suggests that only relevant data sets should be shared, such as fill rate data, and not necessarily manufacturing footprint data, unless required for a specific project, as the partner should be empowered without causing cost leakage.
3. The importance of identifying the purpose of data sharing and finding a balance between empowering the partner and protecting one's own interests is emphasized.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	1. The speaker believes that blockchain is an upcoming technology that has not been fully integrated yet. The speaker sees blockchain as a potential future technology. 2. **Other technologies:** The company currently deals with EDI (Electronic Data Interchange) and API (Application Programming Interface) on a day-to-day basis in their role. The interviewee mentions that EDI and API are well-established mechanisms for data exchange, and they are actively used in their interactions with their customer in the supply chain.	2/4
Advanced technologies like Artificial Intelligence and Machine learning	1. Currently, artificial intelligence (AI) is more focused on improving internal processes within companies, such as optimizing forecasting models in supply chain organizations, rather than facilitating data sharing between organizations. 2. As consent and confidence in data sharing increases, AI has the potential to play a significant role in creating stronger data models through collaborations between organizations, leveraging data sets from multiple sources to optimize supply chain processes.	4/4
Standardization of data formats and interoperability between firms	1. Standardization of data formats and mapping between organizations is a challenge that needs to be addressed, especially with the increasing number of big partners. It is expected that as more companies adopt similar forecasting tools and software, there will be a push for standardization in data exchange formats.	3/4

Arrangement	Response	Rating (order of preference)
	2. The current state of standardization is minimal, but the expectation is that with the involvement of more big players in the industry, there will be a need for data to be exchanged in specific formats, leading to increased standardization for easy information transfer between companies.	
Data security measures: Encryption and access controls	1. The importance of clear consent and data security in preventing data leakage is emphasized, especially for smaller companies with potential infrastructural limitations or data sharing challenges. 2. High-tech companies like the interviewee's company typically use encrypted technologies to minimize the risk of data leakage, while acknowledging that smaller companies may face barriers in implementing robust data security measures.	1/4

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspective towards data sharing and privacy	1. Culture plays a significant role in data sharing, with direction from senior leadership and trust in top managers empowering employees to share data for mutual benefit. 2. Cultural factors such as reluctance to share data with partners, varying levels of trust, and personal perspectives of employees can impact data sharing practices. 3. Factors such as education and familiarity with data sharing practices can influence employees' willingness to share data, and personal perspective is crucial in determining employees' comfort level with data sharing.	2/6
Trust and how could it be built?	1. Trust is crucial in collaborative relationships between organizations and is often built over time through shared purpose and gradual data sharing starting with smaller projects. 2. Transparency in data usage, visualization, and communication helps foster trust in collaborative arrangements between companies, as exemplified by the practice of sharing and explaining data usage between two companies. 3. **Trust-building techniques:** A) Scalability is important in building trust through successful pilot projects and moving on to bigger projects. Trust is also closely tied to working with legal teams and having well-defined nondisclosure agreements to protect data and business interests. B) Clear and comprehensive nondisclosure agreements are crucial in establishing legal power and minimizing concerns about data misuse, as it ensures that both parties have a shared understanding and protection in place for their business interests.	1/6
Contractual agreements and data governance policies	1. Legal team involvement is crucial in contractual agreements with third parties, and large companies with robust legal teams have specialized expertise in areas like IT law or cyber security law. 2. Talent acquisition plays a key role in ensuring that contractual agreements are comprehensive and aligned with data governance principles. 3. Communicating well-summarized policies related to contractual agreements to all employees, including supply chain teams, is important, and the IT and legal teams are responsible for educating employees in this regard.	5/6
Education and training programs	1. Many big companies have their own education platforms with functional-specific training, including IT security, IT systems, data leakage, and data governance. Training programs are available within the interviewee's company with a focus on data governance and data policy. 2. Training for specific teams/projects involving data sharing with partners is important, with clear instructions and precautions tailored to the specific needs of each team. Being specific and targeted in providing training is crucial.	6/6
Role of leadership and senior management	1. Senior management drives employee attitudes towards data sharing, as employees need to be confident that sharing data will not result in penalties. 2. Leadership at all levels, including senior, mid-management, and lower levels, must demonstrate the benefits of data sharing in good relationships between organizations. 3. Clarity on the benefits and permissibility of data sharing needs to come from leadership to create a culture where employees feel empowered to share ideas and data.	4/6
Ethical and responsible data sharing	1. The speaker's company is considered an ethical and sustainable company, and it is important to share data that ultimately benefits society. Care must be taken to avoid partnering with organizations that do not have a good track record.	3/6

2. There are dedicated legal and sustainability teams within the company that monitor human rights and sustainability of suppliers, with mechanisms in place for monitoring. 3. As an employee, it is also important to be ethical in day-to-day work and only share required information. Selecting and monitoring partners is a collective responsibility with teams dedicated to these tasks.	

Future of Data Sharing in the Supply Chain:
1. Artificial intelligence (AI) will be used to build joint data models for improved outcomes in data sharing.
2. Live tracking becoming a trend for companies to have real-time data sharing relevant to their operations.
3. Cleanability and standardization of data as a factor in data sharing trends, ensuring data is usable and modelled in the right way.
4. Shift from push-based to pull-based forecasting game as a trend in data sharing among companies.

New initiatives or technologies that the speaker's company is trying to explore:
1. Many companies in the market, including big high-tech companies, are adopting API technology, and shifting from an EDI mentality to an API mentality.
2. Live tracking of systems with close partners and suppliers may become possible in the future, though currently limited due to being in the consumer goods business. More examples may be obtained from discussions with stakeholders in healthcare and other industries.

Interviewee 10: Head of Enterprise security risk management

The speaker is the head of Enterprise security risk management at the company. Their role involves designing security risk methodology and leading an international implementation team to support the corporate security management framework at the company.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:
The speaker mentions that the first thing that comes to their mind is data ownership and data classification. He prompts that they are important for the topic. Data security is an ongoing challenge for the company, and they have to secure information across all areas, including products, enterprise systems, networks, partners, and customers. The company has a security management framework to educate everyone who needs to protect or secure their data or information. Initially, the framework focuses on protecting assets from an operational view and then ensuring that objectives are achieved from a strategic point of view.
Overall, the company faces the challenge of securing information in various areas and has implemented a security management framework to educate employees and ensure that objectives are met.

Importance of data sharing, benefits, and challenges:
Importance:
1. Data sharing in the supply chain is extremely important. Companies would simply die if there was an absolute stop to information sharing.
2. There is a strong connection between processes and information, and without one, the other will not exist.
3. If information sharing is cut off in a supply chain where collaborating organizations exist, they will likely die.
Benefits:
1. Data sharing in the supply chain requires clear communication and expectations between organizations or entities to ensure consistent behavior.
2. The level of trust between counterparts determines the extent to which data sharing can be beneficial in the supply chain.
3. Making decisions to ensure secure data sharing in the supply chain depends on the level of trust between counterparts.
Challenges:
1. Trusted connections can improve data sharing in the supply chain from a data security perspective.
2. Many challenges exist, including the use of dangerous channels such as open networks, which can compromise confidentiality, integrity, and availability (CIA Triad) of the information.
3. Confidentiality is crucial, as the information must not be tampered with or accessed by unauthorized parties.
4. Without the guarantee of these security measures, the supply chain systems may break down.

Infrastructural arrangements:

Arrangement	Response
Emerging technologies like ICT and Blockchain	1. Blockchain technology is a compact technology that aims to provide a trustworthy ledger between sharing participants for sharing information that can be reliably checked for high integrity. 2. Key management is a major challenge in encryption and blockchain technology tries to solve this issue. 3. Information communication technology (ICT) is a vast field that includes networks, applications, and data. 4. There is a lack of proper solutions for challenges faced in ICT. For example, the integration problem and protocol agreement between systems have not been solved yet. 5. Large companies allow connections between their individual backbone systems, and protecting these connections is crucial. 6. Implementing data sharing through technology, especially ICT, can become a huge problem at the details level.
Advanced technologies like Artificial Intelligence and Machine learning	1. The speaker believes that AI does not currently exist and is a technology of the future. 2. The speaker believes that machine learning is a feasible technology that will have an impact on supply chains. 3. The interviewee believes that machine learning will be useful in managing unstructured data and improving knowledge management in supply chains. 4. The speaker highlights that machine learning faces challenges related to foundational problems in computer science, such as logic and semantics.

	5. The interviewee suggests that mathematicians have previously discussed and partially solved these problems. 6. The interviewee believes that machine learning will provide a platform for better structuring knowledge in supply chains.
Standardization of data formats and interoperability between firms	4. Standardization of data formats is a necessary condition for data sharing in the supply chain from a data security perspective. 5. An interface between two entities is typically built in multiple layers, with the first layer being technical feasibility. 6. The second layer is the functional layer, where semantics oversee the syntactical problems, ensuring both frames have the same understanding of the elements' meaning. 7. For effective communication across supply chains, a common language must be spoken.
Data security measures: Encryption and access controls	8. Confidentiality, integrity, and availability are important considerations for data security when sharing data in the supply chain. 9. Many organizations do not prioritize data security until they experience a security breach. 10. Implementing encryption technology is challenging, particularly in terms of managing and sharing encryption keys. 11. There is a general reluctance to use overly burdensome technology to ensure information security. 12. Encryption is only one of the controls needed to protect information, and process-related controls are also important. 13. Implementing end-to-end encryption for a full channel can be very challenging, which leads to many organizations deciding not to use encryption due to complications.

Institutional arrangements:

Arrangement	Response
Cultural factors: attitudes and personal perspective towards data sharing and privacy	14. Attitudes towards privacy vary among individuals, and most people only become concerned about privacy when it affects them personally. 15. Compliance with privacy and security laws is mandatory for companies that want to conduct business in any market. 16. Many companies comply with privacy and security laws grudgingly, and the cost of compliance is factored into the prices of their products or services. 17. Organizations are guided by principles of law and compliance, which are constantly evolving. 18. Awareness of privacy and security requirements is limited to a small niche within institutions. 19. Sharing personal information online can lead to unintended interpretations and consequences.
Trust and how could it be built?	20. Trust is difficult to define and is considered a weak control from a risk management perspective. 21. Trust is based on the expectation of another entity's behaviour and the ability to predict it. 22. Stable patterns of behaviour lead to higher levels of trust, while random and erratic behaviour decreases trust. 23. In a supply chain, entities will seek to reduce risk by implementing effective and cost-efficient controls, such as contracts, to build trust. 24. However, contracts are not a guarantee of trust.
Contractual agreements and data governance policies	1. Liability is a major driver for having contractual agreements and data governance policies in place for data sharing in the supply chain, from a data security perspective. 2. Contracts (the speaker referred to them as "paper tigers") alone may not be sufficient to avoid losses and breaches, as they are often subject to interpretation and may not hold up in court. 3. Trust and long-standing relationships between individuals in the participating entities are crucial for successful collaboration and information sharing, especially at the strategic level. 4. Operational information can be shared through interfaces, systems, emails, and contracts, but strategic information is typically not written down and relies on trust between individuals. 5. Guaranteeing that participating entities will comply with the agreed-upon rules in their contracts is difficult and cannot be fully guaranteed.
Education and training programs	1. Sharing modern knowledge is important for supply chain processes and must be taught to employees. 2. Education and training programs are critical to ensure that employees follow processes effectively. 3. Intrinsic motivation is also important to encourage employees to seek out and participate in education and training programs. 4. Education and training programs are especially crucial for core processes that impact the delivery of products. 5. Companies must determine the appropriate level of knowledge required for employees to perform their job effectively and ensure they receive the necessary education and training.
Role of leadership and senior management	1. Leadership and senior management can often dictate data sharing agreements in the supply chain. 2. Compliance requirements and training/awareness programs can improve collaboration. 3. Supply chains involve both legitimate and criminal organizations, and senior leadership may not fully understand the implications of this. 4. Companies often only become interested in supply chain security after being hit by a cyber incident.

	5.	Leadership may prioritize maintaining supply chain continuity and avoiding business disruption over addressing potential security risks.
Ethical and responsible data sharing	1.	Legal department is responsible for ensuring compliance with laws related to data sharing in the supply chain.
	2.	Both the speaker's company and its partners are expected to comply with legal and ethical standards related to data sharing.
	3.	The company has governance layers, such as general business principles and internal business systems, in place to ensure responsible data sharing.
	4.	ESG (environmental, social, and governance) considerations are also taken into account in data sharing practices.

Future of Data Sharing in the Supply Chain:

The future of data sharing in the supply chain from a data security perspective is uncertain, but information technology will likely play a significant role. Standards for data sharing are crucial, but the problem of interfacing between systems has not been solved despite attempts. Companies are hesitant to abandon their proprietary niches, and geopolitical trends show that large geographical clusters may start doing things for themselves, creating a potential communication barrier.

Overall, the future of data sharing in the supply chain depends on whether companies are willing to abandon their proprietary niches and embrace standards for data sharing. However, geopolitical trends may make it difficult to build interfaces between different parts of the supply chain due to communication barriers. Information technology will likely play a significant role in the future of data sharing, but it is still uncertain what kind of technology will emerge.

Interviewee 11: Data Security Architect

The speaker is a security architect for the data protection domain within the group security function of the company. The group security function governs the second line of defence, which focuses on risk management objectives ranging from legal and regulatory compliance to broader risk management and may include monitoring, testing, analyzing, and reporting on risk management matters. The speaker's role is to design security for ensuring security systems and services the company throughout its lifecycle, develop security patterns and approaches to new technologies.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:

The discussion is focused on data sharing in the supply chain, specifically third parties sharing data with the company. Privacy is also mentioned as an important consideration, as there needs to be proper management of privacy-related data. Security is emphasized, with established ways of sharing data that are confirmed by security functions. The company has set up proper data classification and access controls, and there is clear documentation of when data is shared and what kind of data is allowed to be shared.

Use case: The speaker is not directly involved in data sharing but observes that their company, frequently shares data with external parties such as contractors and consultants. This is a common occurrence in their day-to-day operations.

Importance of data sharing, benefits, and challenges:

Importance:
1. Data sharing is essential in supply chain operations involving third parties.
2. Proper security measures can accelerate data sharing and protect sensitive information.
3. Security concerns should not be viewed as a hindrance to data sharing, but rather as a necessary component for ensuring secure and efficient operations.

Benefits:
1. Data sharing in the supply chain could improve logistics.
2. Data sharing could enable companies to support each other's protection functions.

Challenges:
1. Trust is a significant barrier to data sharing in the supply chain.
2. Regulations around data privacy and security also contribute to the reluctance to share data.
3. Competition and the fear of losing a negotiation or giving an advantage to competitors also hinder data sharing.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	1. ICT is already well-established and prevalent in data sharing within the supply chain. 2. Tools focused on data sharing are being created, making it easier to unintentionally share too much data or share data with the wrong people. 3. Blockchain is a buzzword. There are good use cases, but it should not be applied just for the sake of using a popular technology	1/4
Advanced technologies like Artificial Intelligence and Machine learning	1. Machine learning and artificial intelligence can enhance security functions in data sharing by detecting and correlating unauthorized content, events and incidents. 2. Advanced technologies such as AI can provide valuable insights for decision-making related to data sharing. 3. The potential benefits of AI in data sharing could lead to increased adoption in the future.	4/4
Standardization of data formats and interoperability between firms	1. Standardization enables interoperability and thus easy data sharing in the supply chain. 2. It also makes detection easier in case of any errors or issues.	2/4

Data security measures: Encryption and access controls	1. Encrypted documents once shared cannot be protected from further manipulation and distribution by authorized parties. 2. Digital Rights Management (DRM) is an encryption technology that prevents the printing or copying of data, providing more control over the shared data. 3. DRM is a potentially good use case for supply chain data sharing as it works well in standardized collaboration environments. 4. Access controls are a crucial part of the DRM solution, determining who can access the data and what they can do with it.	3/4

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspective towards data sharing and privacy	1. Attitudes towards data sharing and privacy can significantly impact data sharing in the supply chain. 2. The culture of sharing everything by default can lead to sharing valuable information that should have been kept confidential. 3. Attitudes towards mistrusting partners or fear of punishment can lead to reluctance to share sensitive information. 4. These attitudes can range from an extreme of freely sharing to an extreme of avoiding sharing altogether.	3/6
Trust and how could it be built?	1. Trust in data sharing in the supply chain can be influenced by having the right contractual agreements and NDAs in place, as well as the right assurance and verification measures. 2. Transparency about security functioning, network functioning, and incident detection can facilitate trust and build it over time.	2/6
Contractual agreements and data governance policies	Contractual agreements and data governance policies are important in influencing data sharing in the supply chain. However, they need to be verified and enforced to prevent parties from ignoring them.	4/6
Education and training programs	Education and training programs can have an impact on data sharing in the supply chain. Leadership support and buy-in is crucial for the success of these programs.	6/6
Role of leadership and senior management	As mentioned in the previous factor, leadership support is crucial and is one of the most important factors at the end.	1/6
Ethical and responsible data sharing	speak would like not to comment	5/6

Future of Data Sharing in the Supply Chain:
The interviewee believes that data sharing in the supply chain will increase in the future. However, they hope that this increase will be responsible and not endanger any party, including consumers, individuals, or companies involved. They emphasize the importance of doing data sharing properly in a responsible manner.

Final thoughts on data sharing in the supply chain from a data security perspective:
The interviewee emphasizes the importance of data security in the supply chain from a management perspective. They state that it is crucial to have solid information security and management practices that are accepted by the business. The tools and technologies that security brings can facilitate success, but without proper support from management, success cannot be achieved. Overall, the interviewee stresses that security is an integral part of making the supply chain successful if done correctly.

Interviewee 12: Customer Demand Planner

The speaker is employed as a customer demand planner for a major account. Their role involves being one of two demand planners responsible for planning two out of the four product categories offered by their company.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:
The speaker's initial thought regarding data sharing in the supply chain domain is collaborative forecast data.
Use case: The company shares weekly data on two of its key performance indicators (KPIs) related to the supply chain with its key customer.

Importance of data sharing, benefits, and challenges:
Importance:
The importance of data sharing in the supply chain domain is highlighted as a crucial factor in meeting KPIs and improving performance. It is noted that this collaborative effort involves the client and can help address any issues that may arise.
Benefits:
The benefits of data sharing in the supply chain domain include improving the customer experience by accessing data for forecasting and improving key performance indicators (KPIs) to meet customer demands. The goal is to fulfil customer orders fully and on time, thus meeting customer expectations and improving the customer experience.
Challenges:

The main barrier to data sharing in the supply chain domain is a structural issue and the challenge of ensuring that shared data is useful for both parties. For example, the customer company uses X codes while the speaker's company uses Y codes. To overcome this, data needs to be translated to ensure it can be used by both parties.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	1. The right information is needed to implement supply chain processes effectively. 2. Emerging technologies like ICT and Blockchain can help with data sharing and analysis, particularly in scenarios with a range of products.	3/4
Advanced technologies like Artificial Intelligence and Machine learning	1. Implementation of AI technology can help improve forecast accuracy in the supply chain. 2. Improved forecasting can assist in ensuring sufficient stock to cover customer orders and positively impact various KPIs. 3. A project is underway with a goal to be achieved this month. The speaker hopes that a pilot can be conducted to test the accuracy of an upcoming AI forecast, which they believe will help improve the PO confirmation rate with an e-commerce platform. This is seen as the top priority by the speaker.	1/4
Standardization of data formats and interoperability between firms	1. Data formats need to be standardized in order to facilitate data sharing in the supply chain. 2. Interoperability between firms is necessary for efficient data sharing, requiring a comprehensive data file with all necessary columns for each party to extract relevant data.	2/4
Data security measures: Encryption and access controls	1. Data sharing in the supply chain depends on the sensitivity of the information being shared. 2. For planning purposes, data related to volumes and quantities are considered non-sensitive and can be shared. 3. Other roles may involve sensitive information such as prices which may have restrictions on sharing.	4/4

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspective towards data sharing and privacy	The importance of employee attitude is highlighted for achieving team goals and KPIs. Working closely as a team is necessary for success.	2/6
Trust and how could it be built?	1. Trust is a crucial factor in data sharing in the supply chain, as it impacts the reliability of collaborative forecasts and planning for inventory levels. 2. Trust needs to be earned through analyzing data, and it can be established through piloting and checking the alignment of orders received with the forecasted data. 3. Double-checking with the customer can also help to ensure the accuracy and reliability of the data, ultimately leading to better project outcomes.	3/6
Contractual agreements and data governance policies	The interviewee stated that they are not knowledgeable about the topic, as they believe it may relate to sales and not planning.	6/6
Education and training programs	The interviewee's company University offers a variety of training programs that can benefit individuals and their tasks. As a manager, some of these programs can be assigned to employees to improve performance. Data sharing in the supply chain can also be influenced by these education and training programs.	5/6
Role of leadership and senior management	1. Leadership and senior management play a crucial role in data sharing in the supply chain. 2. The involvement of managers is essential to ensure that projects move in the right direction. Sometimes, additional steps or involvement may be necessary to advance the project. 3. The availability of information from stakeholders and the willingness to share it is also critical for successful data sharing.	1/6
Ethical and responsible data sharing	1. Transparency is essential when sharing data with the customer for supply chain forecasting. The same file is used for sharing data with the customer as for internal planning. 2. Sensitive information is not shared, but non-sensitive information is shared to enable transparency and improve forecasting accuracy.	4/6

Future of Data Sharing in the Supply Chain:

1. Manual analysis of various variables such as sell-out, stock-in-trade, and warehouse stock is currently done. The focus is on achieving accurate AI forecasting for supply chain planning.
2. AI forecasting is needed for effective planning, especially for large portfolios, to reduce the need for manual work for demand planners.

New initiatives or technologies that the speaker's company is trying to explore:
1. The speaker's company will be involved in a collaborative forecasting project, with their customer providing transparency of their orders for the next 16 weeks within a range of selected SKUs. This is to ensure better forecasting and planning of orders.

Interviewee 13: Security Monitoring Service Delivery Manager

The speaker started as a security level 2 analyst at the company in the Security Operations Center. They were responsible for the operational and data protection of the network. They then became a coordinator for security incidents and ensured they were addressed effectively. They then became a service delivery manager for security monitoring onboarding, facilitating the onboarding of security laws to enhance security operations in the company. The aim is to have a proper security grip on the network by writing alerts on different aspects of security.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:
The speaker mentions that in forensic investigations, third-party specialists in forensics or data recovery may need to be contacted. However, they do not have personal experience with this type of data sharing. The speaker acknowledges that data sharing may also occur in product delivery and healthcare systems, but they do not have specialized information on what data is shared in these contexts.

Importance of data sharing, benefits, and challenges:
Importance:
1. Data sharing among high-tech companies is considered important from a cybersecurity perspective.
2. Information streams are shared between companies, and there are regular meetings with larger companies in the area.
3. Data sharing allows companies to recognize and be warned of cyber threats, allowing for proactive measures to be taken. Proactive cybersecurity measures are beneficial to any company.
Benefits:
1. Proactive handling of data security issues is possible with data sharing.
2. Knowledge sharing through data sharing can help companies position themselves stronger by acquiring more information.
Challenges:
1. The challenge of ensuring secure data sharing is to prevent other parties from accessing information.
2. A collective think tank approach in cyber security is beneficial for all parties involved in data sharing.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	The speaker mentions that ICT is already being used, and blockchain could potentially provide additional traceability and trust in the process.	3/4
Advanced technologies like Artificial Intelligence and Machine learning	1. The speaker believes that artificial intelligence and machine learning are powerful but potentially dangerous technologies, like money. 2. The interviewee is unsure how these technologies can be applied to data sharing in the supply chain from a data security perspective, apart from possibly automating the anonymization of certain data.	4/4
Standardization of data formats and interoperability between firms	1. The use of a uniform set of data standardization is crucial for enhancing interoperability between different companies sharing data in the supply chain. 2. This will not only improve the ease of sharing but also ensure that the data is interpreted in a consistent manner. 3. Without data standardization, interpretations of the data may differ, making it difficult for companies to share data. Ensuring standardization is also important from a data security perspective.	1/4
Data security measures: Encryption and access controls	1. Encryption is necessary for secure data sharing in the supply chain, but it can create challenges for user experience. 2. Making encryption more accessible and easier to use can facilitate secure data sharing, increasing trust between parties and reducing the risk of interception by third parties. 3. Access controls are also important to protect data from unauthorized access and can provide a high level of trust between parties in data sharing. 4. Data security measures, including encryption and access controls, are crucial for ensuring the integrity and confidentiality of shared data in the supply chain.	2/4

Institutional arrangements:

Arrangement	Response	Rating (order of preference)
Cultural factors: attitudes and personal perspective towards data sharing and privacy	1. Companies tend to share cybersecurity-related, incident-related, and technical reports with other parties. 2. The attitude and personal perspective of employees can influence data sharing if it includes their personal data, and they may try to fight it through workers' councils.	5/6

	3. From a business and strategy perspective, culture may not have a significant impact on data sharing decisions, except for individuals in the team or boardroom who are less willing to share certain data. 4. Ultimately, the decision to share data rests with the company, and if they decide to share it, they will do so.	
Trust and how could it be built?	1. Trust is crucial in data sharing in the supply chain from a data security perspective. Open and transparent communication is key to establishing trust between the parties involved. 2. Directional sharing, where both parties share information, is an effective way to build trust. 3. Unidirectional sharing, where one party only provides information, can create an offset between the parties and may lead to a lack of trust.	3/6
Contractual agreements and data governance policies	The speaker believes that contractual agreements and data governance policies are crucial for data sharing in the supply chain from a data security perspective. However, they personally view these measures as more of a legal requirement to avoid legal consequences rather than a proactive step to enhance data security.	1/6
Education and training programs	1. Decision-makers see the benefits of data sharing in the supply chain. 2. End-users should be informed about contractual agreements and data governance policies to ease their concerns. 3. Anonymizing certain employee data can make people more willing to share data. 4. Education programs are not necessary, but awareness about data sharing can help.	6/6
Role of leadership and senior management	1. The primary goal of senior management is to optimize, improve, make things leaner, and reduce risk in the supply chain. 2. Senior management is the driver in setting up data-sharing processes, and there is not expected to be a lot of pushbacks from this level regarding data sharing from a data security perspective.	4/6
Ethical and responsible data sharing	1. Anonymization is a method used for ethical and responsible data sharing in the supply chain from a data security perspective. Nondisclosure agreements can be made to protect sensitive data. 2. Working with well-established third parties that are best in their field with handling specific types of data can ensure responsible data sharing. 3. Contractual agreements and data governance policies play a crucial role in ensuring responsible data sharing, and data is formatted in a way that it is encrypted before going over the line.	2/6

Future of Data Sharing in the Supply Chain:
1. There has been an increase in data sharing in the cyber security area in the last five years.
2. The speaker expects/hopes that data sharing will occur more frequently between certain branches of business, such as the healthcare and financial sectors.
3. The speaker believes that data sharing can provide great advantages, such as minimizing losses, and risks, improving profits, and creating more efficient ways of working.
4. The speaker hopes that data sharing will quickly increase and greatly expand.

Final thoughts on Data Sharing in the Supply Chain from a data security perspective:
From a data security perspective, the speaker discusses data sharing in the supply chain. They note that sharing data on a need-to-know basis is common practice, but due to their company's infrastructure in a supplier's company, sharing data could have mutual benefits. Nonetheless, many firms use a zero-trust model for the cloud to reduce security risks. The speaker highlights the importance of bidirectional data sharing and cites an example involving a major supplier in the industry.Currently, the speaker's company shares data with the supplier company, but the supplier company does not reciprocate. This situation affects both parties negatively, and the speaker believes that if they could receive information back from the supplier company on how certain things work, it would encourage collaboration. The lack of bidirectional data sharing results in a vendor-customer relationship where the speaker's company has to accept changes without explanation, leading to a decline in service quality.

Interviewee 14: Supply Chain Project Manager (Integrated Supply Chain- Early Professional)

The speaker is an early professional working for a company in the supply chain domain. They are part of a program that allows them to rotate through three different programs within the supply chain. The first program they worked in was focused on supply chain strategy and innovation. The goal of this program was to make it easier to communicate the supply chain strategy from the executive level to the integrated supply chain level and across different subsets of the supply chain such as manufacturing and procurement.

Thoughts on "Data Sharing in the Supply Chain Domain" and use-case:
The speaker believes that no company can operate alone and that partnerships with downstream and procurement partners are necessary. Data sharing is crucial to ensure that planning for customers' demands and supply is harmonized. The speaker acknowledges the importance of validating and ensuring error-free data when sharing with external companies or departments. The company shares data with 3PLs and 4PLs to supply products to customers downstream or in global markets.

Use case: The company provides electric trucks for transportation and wanted to assess which shipping lanes could be introduced for their electric trucks. They needed to know the range and charging capabilities of the electric trucks, so the focus was on introducing short-distance, high-frequency lanes from the warehouse

to the factory. To determine if this was feasible, the company extracted data from their freight analytics and sustainability dashboards to see how many kilometers they drive on those routes and the weight they carry. The company signed an NDA with the electric truck provider before sharing internal data to assess the possibility of implementing these lanes and the potential savings in terms of operations and carbon emissions.

Data sharing was critical to the project, as the electric truck provider needed internal data to assess the feasibility of the proposed lanes and the potential savings. The company signed an NDA before sharing the internal data, which included information from their freight analytics and sustainability dashboards. The focus was on short-distance, high-frequency lanes between the warehouse and the factory, and the project was a long-term initiative. The data was analyzed to determine if the proposed lanes were feasible and to assess potential savings in terms of operations and carbon emissions.

Importance of data sharing, benefits, and challenges:

Importance:
1. Data sharing is crucial for businesses to operate efficiently in the supply chain.
2. Collaboration with various companies and software is necessary to facilitate data sharing.
3. Raw materials for manufacturing products are sourced externally, highlighting the importance of data sharing with suppliers.

Benefits:
1. Helps in growing the business by building trust and framing long-term contracts with partners, leading to a win-win situation.
2. Makes the operations leaner and faster by increasing visibility of what's happening around and identifying areas of improvement.
3. Facilitates continuous improvement by having brainstorming sessions with partners to explore possibilities of making operations better, faster, and more efficient.

Challenges:
1. Data validation is a challenge when sharing raw data with other companies or stakeholders. This includes enabling document data standards to provide stakeholders with only the relevant information they need, such as shipping companies needing to understand insurance documents or trade compliance.
2. Manual work and paperwork can result in incorrect data organization, leading to potential errors in data sharing.
3. Standardization of data across different parts of the business is an ongoing challenge, as there are different standards in place across the company.

Infrastructural arrangements:

Arrangement	Response	Rating (order of preference)
Emerging technologies like ICT and Blockchain	1. Emerging technologies like ICT and Blockchain can provide a more secureway of framing contracts and structures in the supply chain. 2. Implementing these technologies requires a lot of change management and internal technological setup, which may pose challenges. 3. Data sharing through these technologies make data more vulnerable to attacks, which requires security teams to look for ways to enhance security.	2/4 same as factor #2)
Advanced technologies like Artificial Intelligenceand Machine learning	1. The company partners with a major technological company to ensure secure channels for sharing emails and assess internal and external threats using machine learning algorithms. 2. Machine learning algorithms are used to detect and move spam emails to another location, allowing employees to focus on their work without distraction. 3. AI and machine learning help in forecasting customer demand and supply chain trends, providing better planning for raw material procurement and sales fluctuations. 4. Data visualization and dashboards provide insights into the company's performance and help in monitoring trends within the supply chain. 5. The use of AI and machine learning allows for more accurate assessments of sales trends and material requirements, particularly during holiday periods such as Christmas.	2/4 same as factor #1)
Standardization of data formats and interoperability between firms	1. It is unlikely that there will be a meaningful standardization of data sharing in the supply chain due to varying standards and security frameworks. 2. Different stakeholders within the supply chain, such as shipping, transportation, and warehousing companies, have certain standards for data sharing. 3. Each company has its own framework for how data should be published and maintained, including content, versions, and other factors. 4. Interoperability is made easier when partnering with other companies in the supply chain.	1/4 (same as factor #4)
Data security measures: Encryption and access controls	1. The speaker's company has a large number of employees, but only specific people who require access to certain data are given access. 2. Access control is implemented to maintain the stakeholder list and prevent unauthorized access. 3. Emails are only sent to people involved in the project and not to everyone. 4. Teams folders are encrypted, and access is controlled by administrators to ensure data security in data sharing and accessing.	1/4 (same as factor #3)

Institutional arrangements:

Arrangement	Response	Rating (order of preference)

Cultural factors: attitudes and personal perspectives towards data sharing and privacy	1. Europe's GDPR laws provide a framework that emphasizes individual ownership of personal data, resulting in a culture of privacy. 2. There is a general attitude of respect for privacy in the workplace, with employees hesitant to share information without explicit permission. 3. Despite this attitude, individuals are free to voice their concerns about data sharing and have their opinions respected.	2/6
Trust and how could it be built?	1. Trust is crucial in the supply chain as it involves handing over operations to another party and trusting them with various tasks. 2. Smart business judgment and decision-making are essential in addition to trust to minimize risks, and strategizing whom to trust is also significant. 3. **Trust-building techniques:** Value proposition is the foundation for building trust among different stakeholders in the supply chain. Trust is built through practical proofs such as smaller-scale projects, pilots, testimoniesfrom other companies, and feedback from the market. Personal recommendations alone are not enough. Trust must be based on facts and figures.	6/6 (Trust comes if everything else is set-up correctly)
Contractual agreements and data governance policies	1. Mergers and acquisitions occur frequently in the company's supply chain to aid growth. 2. Contracts and data governance policies are crucial to protect both parties involved from any misuse of shared information. 3. Setting boundaries through these policies ensures legal compliance and protection of people and data.	1/6
Education and training programs	1. There are education and training programs available on data security and basic employee training across the company. 2. The programs may not always be communicated effectively to make them interesting for employees. 3. The training covers topics such as identifying trustworthy vendors and suppliers and making good decisions on a personal level. 4. Formal training is considered helpful for these topics.	4/6
Role of leadership and senior management	1. Leadership and senior management play a critical role in data sharing and security decisions in the company. 2. Continuous improvement is necessary to keep up with emerging vulnerabilities and risks. 3. Investment in data sharing and security is determined by leadership, based on the importance of the aspect to the company's overall strategy. 4. Data sharing is especially important in the supply chain, where collaboration among internal and external parties is crucial.	3/6
Ethical and responsible data sharing	1. The company generates its own data and does not copy it from anyone, which is considered ethical. 2. The company conducts benchmarking with external companies, including competitors, to improve its operations. 3. Ethical and responsible data sharing allows third-party companies to gather data for comparison across different industries, such as healthcare and supply chain. The company adheres to ethics and standards for data sharing in its business unit.	5/6

Future of Data Sharing in the Supply Chain:
1. Data is considered to be a valuable resource and its importance is increasing day by day.
2. The use of dashboarding tools such as Power BI enables stakeholders to quickly access and interpret data, leading to faster decision-making.
3. Data sharing is essential for identifying current and future priorities, allowing for a focus on fewer, larger, and better goals.

New initiatives or technologies that the speaker's company is trying to explore:No information was given in response to the question.