Kaunas University of Technology

School of Economics and Business

Improving Supply Chain Performance by Means of Information Sharing: The Case of a Logistics Service Company

Master's Final Degree Project

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Kaunas, 2023

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Study field and area (study field group): Business, Business and Public Management.

Keywords: supply chain, information sharing.

Kaunas, 2023. 70 pages.

Summary

Cooling demand and discussions about the recession highly impacted the logistics sector in the United States. Smaller transportation companies that built their business on the spot market suffer, as rates offered by the spot market do not completely cover operating expenses and recognize that now is a perfect time for changes in their supply chain management and that is where information sharing benefits take place.

Information sharing is a crucial part of both internal and external collaboration. Internally, without proper information sharing, companies might incur miscommunication and planning issues, whereas externally, information sharing problems can cause even more issues, for example, disrupted coordination, increased costs, or even decreased service quality that further disrupts collaboration in the supply chain.

The purpose of this thesis is to provide guidelines for the logistics company for potential supply chain performance improvement by means of information sharing. The key problematic aspects of information sharing in the case company are identified and with the use of literature research, a theoretical model for supply chain performance is proposed. The research was conducted using semi-structured interviews and document analysis, where interviews were held with two top-level management and three middle-level management employees, and customer contracts were analyzed.

The research results suggest that there is space for improvement of information sharing both internal and external. To solve the existing problems and encourage information sharing, the following were suggested:

1. Establish data security protocols to prevent possible data leaks, which could incur increased unnecessary costs.
2. Establish standardized data formats with supply chain partners for increased information sharing capabilities together with potential data integration possibilities.
3. Build trust with smaller supply chain partners with the use of the CPFR model.
4. Revise customer contracts to increase information sharing.
5. Establish an internal strategy to prevent barriers of cultural differences with international supply chain partners.

Solving the above-mentioned problems should lead the company to improved supply chain performance, which could be expressed through increased supply chain visibility, improved collaboration, increased agility, and customer satisfaction.

The whole project consists of 70 pages and includes 12 figures and 14 tables. The project includes introductions, 4 main chapters, conclusions, and a list of references.

Dobilas Robertas. Tiekimo grandinės tobulinimas skatinant dalinimąsi informacija: logistikos paslaugų įmonės atvejo analizė. Magistro baigiamasis projektas / vadovas doc. dr. Egidijus Rybakovas; Kauno technologijos universitetas, Ekonomikos ir verslo fakultetas.

Studijų kryptis ir sritis (studijų krypčių grupė): Verslas, Verslas ir viešoji vadyba.

Reikšminiai žodžiai: tiekimo grandinė, informacijos dalinimasis.

Kaunas, 2023. 70 p.

Santrauka

Sumažėjęs poreikis ir diskusijos apie recesiją labai paveikė Jungtinių Amerikos Valstijų logistikos sektorių. Mažesnės transporto įmonės, kurios savo verslą rėmė ant laikinųjų sandorių rinkos smarkiai nukentėjo, nes laikinųjų sandorių rinkos tarifai nepadengia veiklos sąnaudų ir pripažįsta, kad dabar yra puikus metas tiekimo grandinės valdymo pokyčiams ir čia svarbią vietą užima informacijos dalinimosi nauda.

Informacijos dalinimasis yra kritiškai svarbus tiek vidiniam tiek išoriniam bendradarbiavimui. Be tinkamo informacijos dalinimosi įmonės viduje, įmonės gali patirti nesusikalbėjimo ar planavimo problemas, o informacijos dalinimosi problemos įmonės išorėje gali sukelti dar didesnes problemas, tokias kaip, sutrikdyta koordinacija, padidėję kaštai arba sumažėjusi paslaugų kokybė kuri toliau žaloja bendradarbiavimą tiekimo grandinėje.

Šio baigiamojo darbo tikslas yra pateikti gaires, kuriomis vadovaudamasi logistikos kompanija turėtų galimybe patobulinti tiekimo grandinę naudodamasi informacijos dalinimusi. Pagrindiniai informacijos dalinimosi probleminiai aspektai atvejo įmonėje identifikuoti ir naudojantis literatūros tyrimu sukurtas teorinis modelis tiekimo grandinės tobulinimui. Tyrimui naudota pusiau struktūrizuotas interviu metodas ir dokumentų analizė, kur interviu buvo atlikti su dviem aukščiausio valdymo lygio ir trimis vidurinio valdymo lygio darbuotojais, taip pat išanalizuoti kontraktai su klientais.

Tyrimo rezultatai rodo, kad tiek vidinis tiek išorinis informacijos dalinimasis gali būti tobulinamas. Kad išspręsti egzistuojančias problemas ir paskatinti informacijos dalinimąsi, buvo pasiūlyta:

1. Sukurti duomenų apsaugos protokolus, kad išvengti galimo duomenų nutekėjimo, kuris gali padidinti nereikalingas išlaidas.
2. Kartu su tiekimo grandinės partneriais nustatyti standartizuotus duomenų formatus, kad paskatinti dalinimąsi informacija ir potencialią duomenų integraciją.
3. Siekti sukurti mažesnių tiekimo grandinės partnerių pasitikėjimą, naudojantis CPFR modeliu.
4. Patikslinti kontraktus su klientais, kad paskatinti informacijos dalinimąsi.
5. Sukurti vidinę strategiją, kad išvengti kultūrinių skirtumų barjerų su tarptautiniais tiekimo grandinės partneriais.

Išsprendus aukščiau paminėtas problemas, įmonė turėtų galimybę patobulinti tiekimo grandinę, kuri gali būti apibūdinta tiekimo grandinės matomumu, geresniu bendradarbiavimu, didesniu judrumu ir klientų pasitenkinimu.

Visą projekto apimtį sudaro 70 puslapių, randami 12 paveikslėlių ir 14 lentelių. Projektą sudaro įvadas, 4 pagrindiniai skyriai, išvados ir literatūros sąrašas.

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Introduction

Relevance of the topic. Collaboration in the supply chain is important to achieve trust, increased efficiencies, and overall performance of all supply chain members. To achieve this, participants must share information that is accurate and correct. However, it was observed that supply chain members are willing to distort, provide inaccurate or not share information with other members at all.

There are clear examples of increased supply chain performance by means of information sharing, where companies achieved decreased forecast error margins, decreased lead times, and increased inventory turnovers. The more reliable and accurate information is shared between supply chain partners, the better results can be achieved.

Therefore, it is necessary to implement and apply models that ensure and encourage information sharing between supply chain members. This would have a positive impact on the whole supply chain performance.

Research Problem. Information sharing between supply chain members might be distorted and asymmetrical. Companies are frightened to share information due to the potential loss of competitive advantage. It is necessary to share information between supply chain partners to increase supply chain efficiency, decrease forecasting and planning error margins, cut costs, and increase overall profitability.

The object of the research – the means and processes of information sharing in the logistics company.

The aim – to provide recommendations for the logistics company to improve supply chain performance using information sharing systems and models.

Research tasks:

1. To reveal the problem of information sharing impact on the case company's supply chain performance.
2. To find a theoretical solution for supply chain performance improvement by means of information sharing.
3. To evaluate factors that limit or encourage information sharing between the logistics company and other participating members in the supply chain.
4. To develop guidelines and recommendations on information sharing barriers prevention and methods how to encourage information sharing.

Research methods:

1. The analysis of the scientific literature was used to ascertain the increase in supply chain performance by means of information sharing, barriers, and benefits while implementing various models.
2. Qualitative data analysis using semi-structured expert interviews with 25 planned questions and document analysis performed on customer contracts.

1. Problems caused by inefficient information sharing in supply chain

The supply chain is evolving since the day it was first time mentioned, at the beginning of the 20th century, as a term, but recent times showed that the supply chain is still easily affected by political (instability, regulations, wars, or conflicts), environmental (emissions, pollution), economic (labor shortage, inflation, and recession) challenges. Parties involved in the supply chain are always looking for added value, to redeem harm from disruptions of the supply chain, as well as adding additional value to its customers or partners.

Various researchers define information as a key to success. When taking the supply chain into consideration, information asymmetry, lack of sharing or distortion prevents the effectiveness of the supply chain. The model of material, financial, and information flow (Figure 1.), presented by Voluntary Interindustry Commerce Standards (VICS) back in 2002, is still relevant nowadays. The information must flow both upstream and downstream, so all supply chain partners would be able to plan and forecast their production schedules and inventory levels.

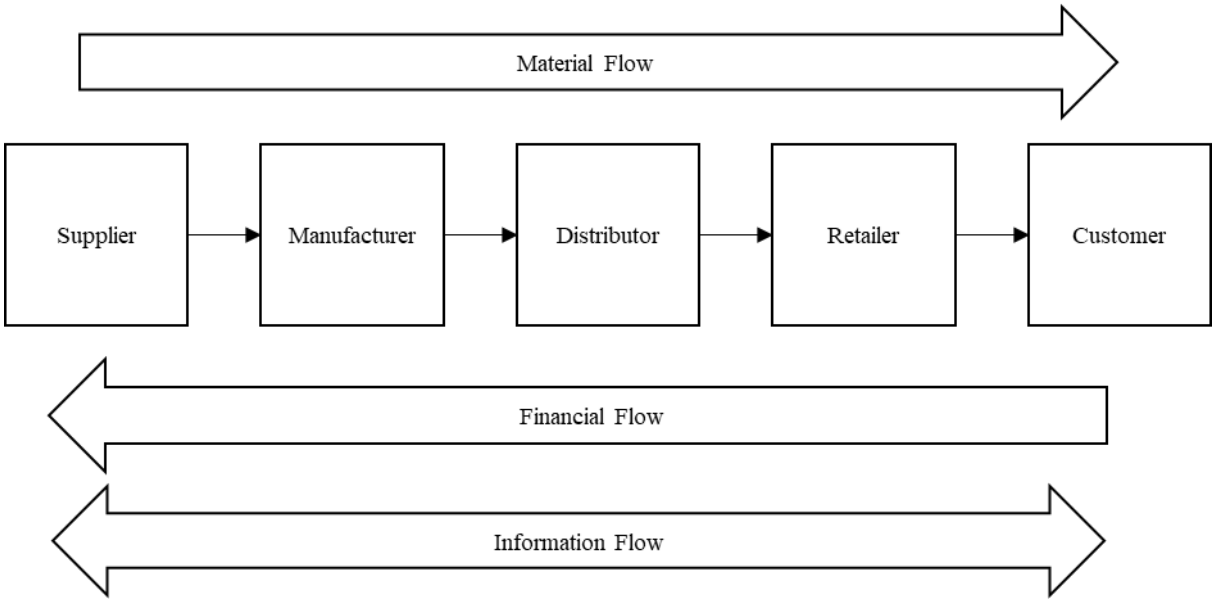

Figure 1. Information, material and financial flows (by VICS, 2002).

Researchers also highlight the importance of information flow as this is the reason for the complexity increase of the supply chain (Madenas, Tiwari, Christopher, Woodward, 2014). Lack of information can lead to a phenomenon called the bullwhip effect. This phenomenon is described as the amplification of demand variation on production and ordering quantities in supply chains (Lee, Padmanabhan, Whang, 1997), or simpler, how small fluctuations at the retail level can cause progressively large fluctuations in demand.

Firms do not want to provide all possible information and want to keep and maintain some information to guard against channel partners' opportunistic behaviors but confirm that they are willing to share information with partners in the supply chain (Kim, Umanath, Kim, Ahrens, Kim, 2012). Information flow between supply chain partners creates added value for all parties. Information that is kept and maintained by the firm could be assigned to internal information flow, while the information which is shared with partners to external information flow.

Performance improvement of information sharing as well as collaboration between supply chain partners is non-arguable. Analysis of eight collaborative contracts provided by McKinsey, a global management consulting firm, shows that collaboration between supply chain partners results in a 15-20 percent improvement in cost and scheduled performance (Figure 2.)

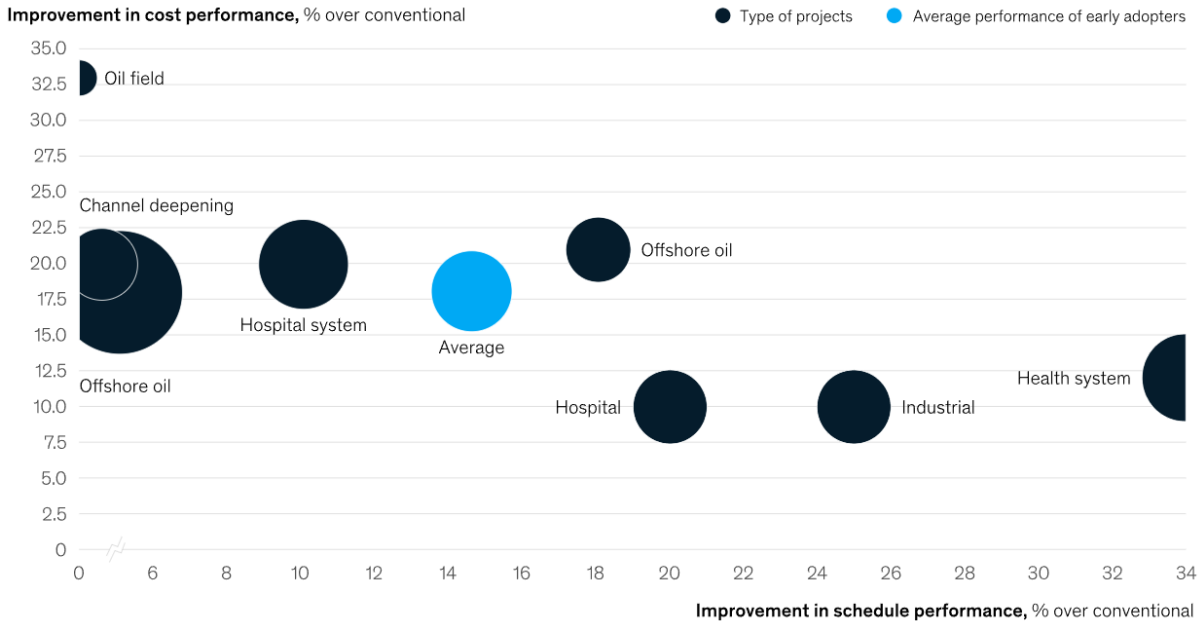

Figure 2. Early adopters of collaborative contracts are seeing improvements in performance (McKinsey, 2020)

1.1. Limitations of information sharing researches

There are still some gaps in the literature that need to be addressed. One area that requires further research is the impact of information sharing on supply chain risk management for logistics companies. While some studies have examined the impact of information sharing on supply chain risk, there is still a need for more research on how different types of information sharing strategies can enhance supply chain resilience in the face of unexpected disruptions.

Another area that requires further research is the role of technology in facilitating information sharing in logistics companies. While many studies have examined the impact of specific technologies on information sharing, there is still a need for more research on the design and implementation of information systems that support effective information sharing in logistics companies.

In addition, there is a need for more research on the factors that influence information sharing in logistics companies. While some studies have examined the role of organizational culture, power dynamics, and incentives, more research is needed to understand how these factors interact with each other and with other factors such as industry characteristics and government policies.

Lastly, more research is needed on the impact of information sharing on logistics companies' supply chain coordination and collaboration. Although some studies have examined the impact of information sharing on supply chain coordination, there is still a need for more research on how logistics companies can use information sharing to improve collaboration with suppliers, customers, and other logistics partners.

In conclusion, while the current state of research on information sharing in supply chain management for logistics companies is relatively well-developed, there are still some important gaps in the literature that need to be addressed:

- Potential risks of information sharing for logistics companies.
- Information sharing technologies implementation for logistics companies.
- Factors influencing information sharing in logistics companies as well as with their supply chain partners.
- Specific areas that require information sharing for supply chain performance improvement.

By addressing these gaps, researchers can help to advance our understanding of the complex dynamics of information sharing in logistics companies and identify new opportunities for improving supply chain performance and resilience.

1.2. The impact on supply chain performance of information sharing in case company

The logistics industry is an integral part of the global economy and plays a crucial role in the delivery of goods and services. However, logistics companies face several challenges, including the effective management of their supply chain, coordination with multiple stakeholders, and information sharing. This thesis will focus on the issue of information sharing in logistics companies, which is essential for improving supply chain performance.

This case logistics company belongs to a corporation, which has different revenue sources such as truck and semi-trailer service, brokerage, transportation (case) company, factoring, and lease companies. While all operations are in the United States, the corporate has offices in three continents – North America (USA), South America (Colombia), and Europe (Lithuania).

All top-level management together with around 50% of middle-level management work in the USA office. They are responsible for all strategic and part of tactical decisions made. Colombia's office was opened only 2 years ago and 90% of employees working here are load planners for the case company, while the rest benefits other corporate companies. Lithuania's office is more diversified. Accounting and finance departments that benefit the whole corporate are located here, together with the rest of middle-level management, load planners, dispatchers, quality control team, and breakdown specialists.

Overall company's top-level management experience in the logistics sector is around 12 years, but within this company fluctuates between 2 to 4 years, even though the company has been working for more than 20 years. Employee turnover in the case company is very high and based on around 60% of all middle-level management being fired due to not reaching set goals by top-level management. During the COVID-19 pandemic, corporate was enrolled in the "Payroll Protection Program (PPP) created by the government to help smaller businesses to survive". During the pandemic, the spot market of domestic loads was extremely high, offering high rates for carriers, but the current situation for transportation is extremely bad and companies are looking for potential ways to cover their losses through other revenue sources.

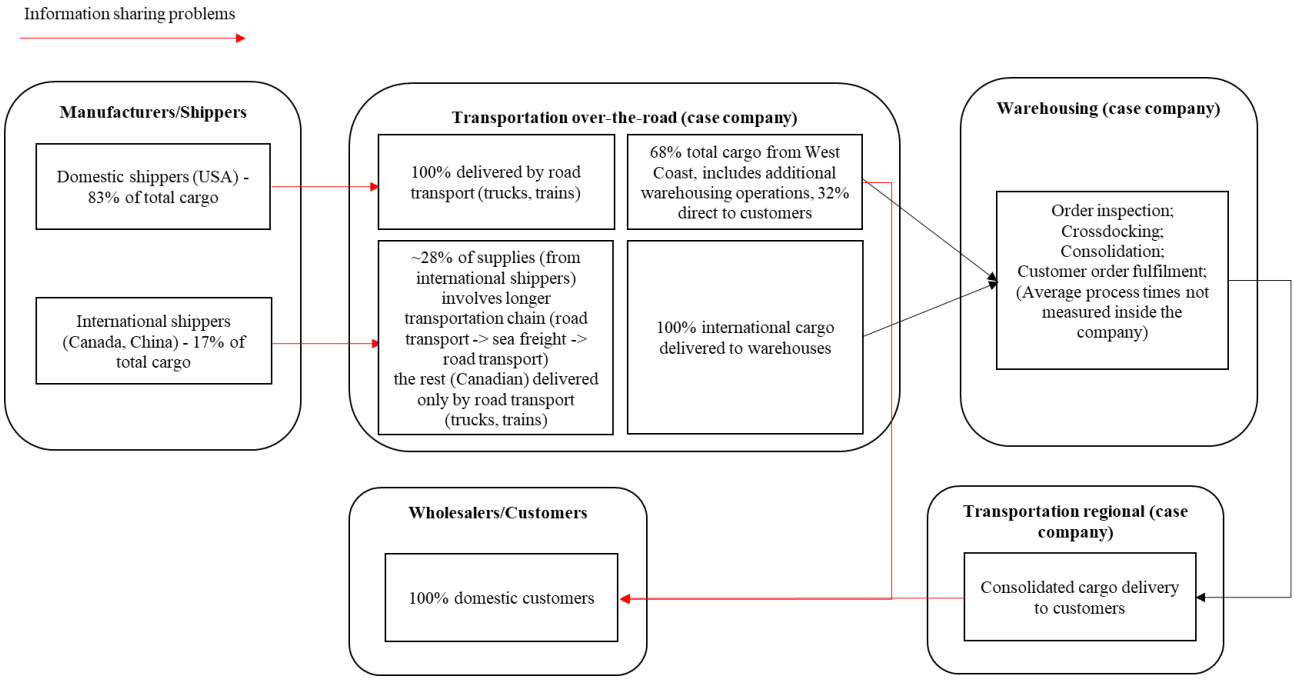

Figure 3. Case company's simplified supply chain (prepared by author)

Logistics companies face several challenges in managing the supply chain efficiently. One of the most significant challenges is inventory management, where they must ensure that they have sufficient inventory to meet customer demand without carrying excess inventory that can tie up capital and increase storage costs. This challenge requires the adoption of sophisticated inventory management systems and demand forecasting techniques to optimize inventory levels and avoid stockouts.

Another challenge faced by logistics companies is transportation management, which involves managing the movement of goods through various modes of transportation. This challenge involves dealing with delays, accidents, and unforeseen events that can disrupt the supply chain. Logistics companies must have contingency plans in place to mitigate these disruptions and ensure timely delivery of goods.

Communication and coordination are also critical challenges in logistics management. Logistics companies must maintain effective communication and coordination between different parties involved in the supply chain, including manufacturers, suppliers, carriers, and customers. This challenge requires the adoption of advanced communication technologies and collaborative tools to enhance visibility and transparency across the supply chain.

Technology and infrastructure are also crucial challenges in logistics management. Logistics companies require reliable technology and infrastructure to manage their operations efficiently, including transportation management systems, warehouse management systems, and other software and hardware tools. The adoption of new technologies such as automation, the Internet of Things, and artificial intelligence is also necessary to streamline logistics operations and enhance efficiency.

Finally, environmental concerns are emerging as a critical challenge in logistics management. Logistics companies must consider environmental factors such as carbon emissions, waste reduction, and sustainable sourcing to meet the growing demand for eco-friendly logistics practices. This challenge requires the adoption of green logistics practices, the use of renewable energy sources, and

the implementation of sustainability management systems to reduce the environmental impact of logistics operations.

Effective information sharing among stakeholders in the supply chain can help address the challenges faced by logistics companies. Improved communication and collaboration can enhance inventory management, transportation management, and regulatory compliance. Technology and infrastructure can be optimized through the sharing of data and insights, and environmental concerns can be addressed through the adoption of sustainable practices. By sharing information and working together, stakeholders in the supply chain can improve overall supply chain efficiency and reduce costs, ultimately leading to increased customer satisfaction and profitability.

Considering the case of an American-based logistics company, the company suffers from all the abovementioned challenges. For example, a company's miscommunication with shippers and customers usually cause overstocked inventory or transportation to be poorly planned due to detention/layover occurring due to delays from shippers or customers sides.

Forecasting and planning are also critical elements in the success of any supply chain. However, without proper information sharing between supply chain partners, it can be extremely challenging to accurately forecast and plan. Each partner within the supply chain has access to specific information that can impact production and delivery schedules, inventory levels, and product quality. When this information is not shared, it can lead to misaligned expectations, unexpected disruptions, and ultimately, a breakdown in the supply chain. Therefore, effective communication and collaboration between supply chain partners is crucial to ensure that all parties have the necessary information to make informed decisions and keep the supply chain running smoothly. The case company uses only historical sales data for forecasting. The company forecasts its sales once a year, which disrupts the accuracy of the whole comparison of actual and forecasted data. As per Figure 4, it is seen that the company's actual mileage never reached the forecast. 2021 forecast was based on the year 2020. In the year 2022 forecast, the company forecasted again based on the previous year with the planned increase in their truck count. Unfortunately, the transportation market suffered a crash and the actual revenue/mile rate started to drop significantly as well as it was practically impossible to receive trucks from dealers as the demand was higher than the supply.

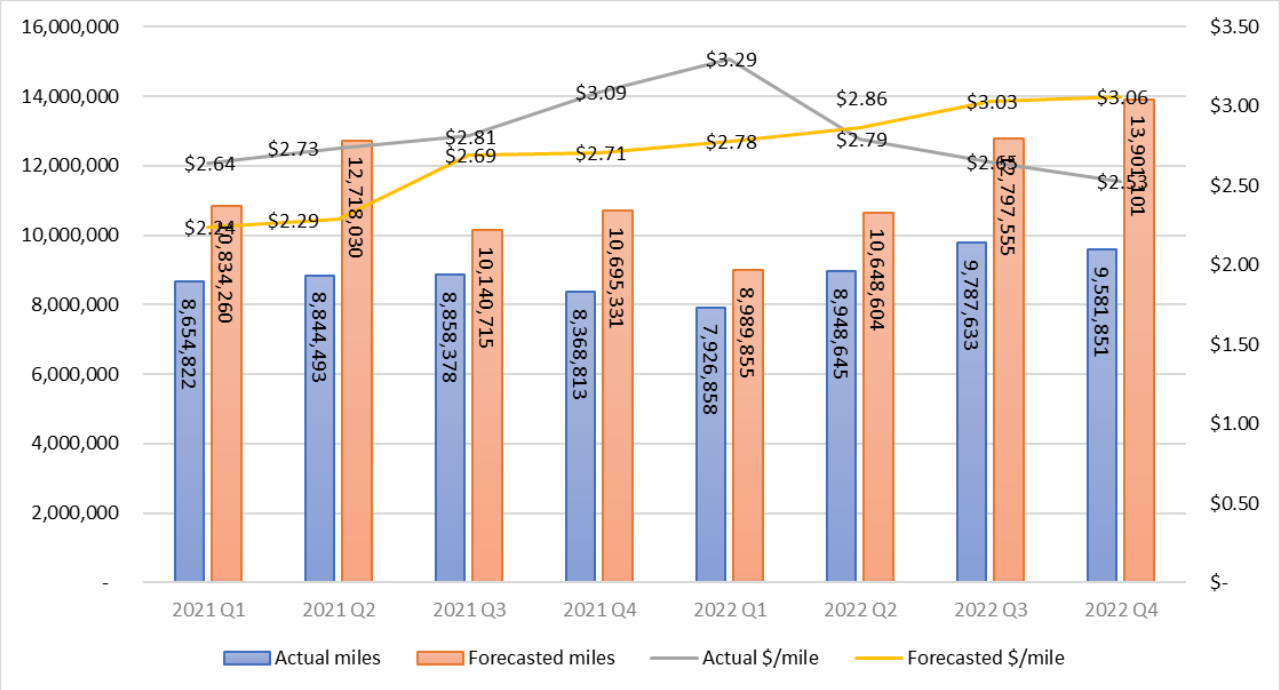

Figure 4. Case company actual and forecasted mileage driven and revenue per mile generated (prepared by author)

As per Figure 5, planned sales in 2021 were not that far from actual (11% lower than planned sales), but due to the facts mentioned above, 2022 actual sales were 32% lower than forecasted. Due to only using the previous year's actual data for forecasting, it is hard to make decisions, which is why economic conditions, market, and customer data must be considered. Economic conditions, such as interest rates, inflation, and unemployment, can have a significant impact on a company's financial performance. By monitoring these factors, companies can anticipate changes in demand, adjust pricing strategies, and make informed decisions about resource allocation. Market trends, such as changes in consumer behavior, emerging technologies, and new competitors, can all impact a company's ability to succeed in its industry. By staying abreast of market trends, companies can identify new opportunities, adapt their strategies, and position themselves for success. Understanding customer needs, preferences, and behaviors is critical for companies to create products and services that meet their customers' needs. By collecting and analyzing customer data, companies can make informed decisions about product development, marketing, and customer service.

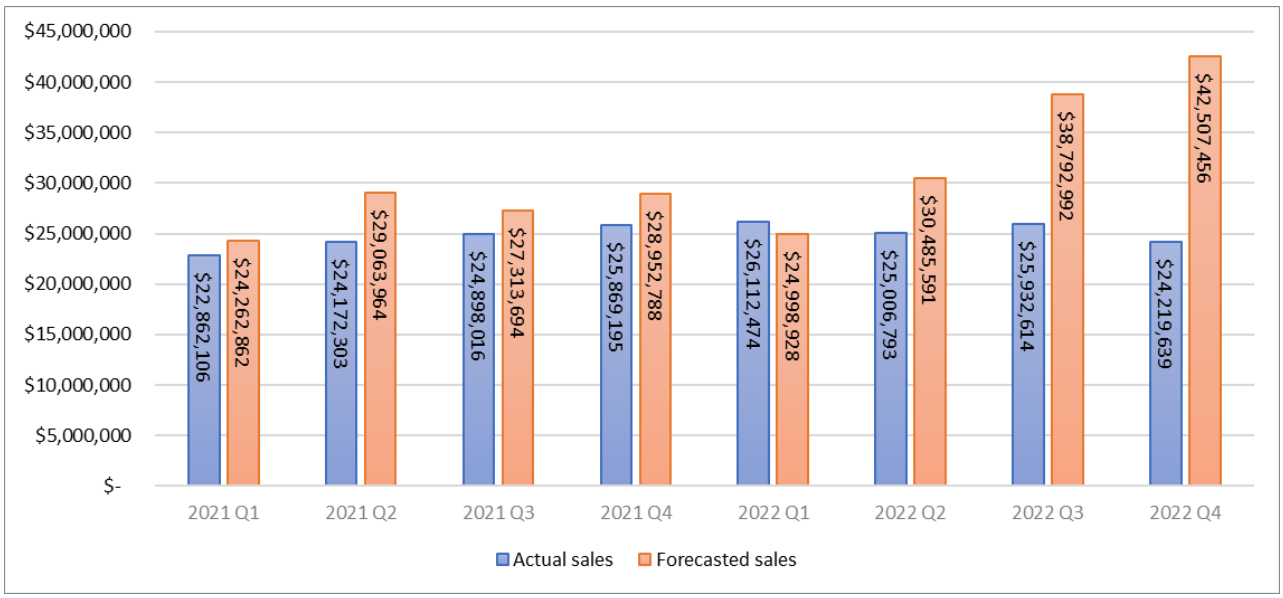

Figure 5. Case company actual and forecasted revenues (prepared by author)

The analysis of the company's current forecasting methodology, using the graphs provided can be proved that the current methodology used is not suitable for this company or even this market as the forecast at any given moment is not close to actual sales. It is known that forecast and actual data in most cases will not be equal, due to various occurrences, such as market crashes or the COVID outbreak mentioned above, but the company must challenge itself to increase forecasting accuracy so other processes could be efficiently planned. Summarizing the above charts, the case company must implement information sharing with their supply chain partners, to have a better visibility of the supply chain and be more concise when planning and forecasting.

In any partnership, information sharing is critical for successful collaboration, but several factors can hinder the process. These factors include a lack of trust between partners, concerns about competitiveness, legal and regulatory constraints, fear of losing control, cost, data security, and lack of standardization. A lack of trust can lead to communication breakdowns and difficulties in collaborating effectively, while competitive concerns may prevent partners from sharing confidential information. Legal and regulatory issues could also prohibit the sharing of certain types of information, and partners may be reluctant to share data due to fears of losing control over their operations or intellectual property. Additionally, cost considerations and concerns about data security could further complicate the sharing of sensitive information, while a lack of standardization could hinder the effectiveness of shared data. Addressing these factors will be essential for successful partnerships that require effective information sharing.

In conclusion, the following main aspects need to be further examined in the case company:

- Inventory management improvement by means of information sharing.
- Technological capabilities for information sharing to increase transportation management.
- Information symmetry and upstream/downstream information sharing for forecasting needs.
- Potential collaboration capabilities between shippers/customers and the case company.

Scientific literature suggests that Collaborative Planning, Forecasting and Replenishment and Enterprise Resource Planning systems can be used to overcome these barriers and enhance information sharing between supply chain partners. Implementation of both systems is costly, time-

consuming, and planning required, but the benefits that companies redeem after implementation are noticeable from financial and business relations perspectives.

2. Theoretical approaches for supply chain performance increase by means of information sharing

Using scientific literature, increase of supply chain efficiency by means of information sharing concepts will be presented and be used later to provide methodological solutions for further research of the case of logistics company.

2.1. Systematic selection of current literature

For literature research, the broadest keyword "supply chain" was selected. Scopus database resulted in 400,935 documents with keyword" "supply chain. To narrow results and get the results needed for research, document type restrictions were added. Document types set to – books, articles. Scopus database resulted in 266,859 documents regarding above mentioned restrictions. To get the most recent results, but at the same time to be able to compare literature by release date, another restriction was added for Scopus database search – published year 2010 and earlier. This one more time narrowed the search results to 236,960. Another restriction added to Scopus database search – "value of sharing information". With all these restrictions added, Scopus database resulted in 31 documents.

The same method is used for ScienceDirect database. ScienceDirect database resulted in 671,122 documents for keyword "supply chain". Restrictions were set to document types of books and articles, which narrowed documents count to 552,724. Year restrictions added for documents to be not older than 2010, which resulted in 552,724 documents. And the last restriction with the keyword "value of information sharing" added resulted in 217 documents.

All references were exported from Scopus and ScienceDirect using Mendeley references tool. To manage all articles and books that were found in Scopus and ScienceDirect databases, EndNote tool were used. Once all articles and books were stored into EndNote library, 10 duplicates were found. Once duplicates were removed, 238 articles and books were left for investigation.

During the first screening, 131 articles and books were rejected. Researcher rejected most of the articles and books since article or book contained keywords "supply chain" and "value of information sharing", but research was not related to one or another keyword.

Literature was assigned to various categories using additional keywords. These categories were used to systematically organize literature.

During the literature screening, additional four categories were created – emphasized category, emphasized model.

Once model and system were selected for research, additional literature required to continue research was searched using KTU e-library, by using "CPFR" and "ERP" keywords. This was useful as literature from various databases were provided in this e-library.

2.2. Information sharing benefits

Table 1 contains articles that all highlight the importance of sharing information in supply chain management. They also provide models and methods for improving collaboration, coordination and efficiency. Schoenmeyr T. and Graves S. (2014) propose a multi-echelon coordination model that can improve collaboration while reducing costs. Panahifar et al. (2010) suggest that the adoption of the Collaborative Planning, Forecasting, and Replenishment model (CPFR) enhances collaboration and

demand forecasting. James B. Sodhi M. and Chopra S. (2014) highlight the importance of information sharing for reducing supply chain risk. Cheung et. al. (2012) proposes to explore the effect of connectivity and willingness-to-share information on collaboration.

Other authors have proposed coordination models that could improve cost reduction, order-processing efficiency, production lead-time reduction, inventory management and profitability. Pishchulov and colleagues (2022) propose an information-asymmetrical coordination model to improve cost reduction. Martin et al. (2010) propose adopting the Enterprise Resource Planning model (ERP) to improve order processing efficiency. Tang et al. (2012) propose a two-level model of supply chain coordination to improve coordination and increase profit. Klein et al (2020) suggest simulations of multi-echelon, supply chains with shared information on demand to improve inventory management.

Other authors stress the importance of integration, long-term relationships, and information quality. Muller et al. (2020) suggest using incentive to improve information quality. Chatti et al. (2021) propose the adoption of ERP model to improve information integration. Kubde et al. (2010) suggest using CPFR model to improve information quality. Prajogo, D., and Olhager J. (2012) highlight the importance of long-term relationships in supply chain management.

Lastly, some authors have suggested specific models to improve the overall performance of the supply chain, profitability, and retailer/supplier collaboration. Huang et al. (2015) present an analytical model for determining the optimal level of information sharing. Venegas, B. and Ventura J. (2018) suggest a two-tier supply chain coordination model that includes price-sensitive demand in order to improve profitability. Guan et al. (2020), propose simulations with shared information on demand to improve retailer demand management and inventory management. Fu (2016) suggests adopting the CPFR to improve retailer-supplier cooperation. Lastly, Nakashima and Sornmanapong (2013) present a case of a semiconductor maker to show how sharing information can improve supply chain designs and reduce costs.

Table 1. Information sharing categorized benefits and models used in the literature (prepared by author)

Emphasis Category	Emphasized Models	Authors
Collaboration Improvement and Cost Reduction	A coordination model for multi-echelon supply chain.	Schoenmeyr, T., Graves, S. (2018)
Collaboration Improvement and Demand Forecasting	CPFR Model	Panahifar, F., Heavy, C., Byrne, P., Fazlollahtabar, H. (2015)
Collaboration Improvement and Risk Reduction	Not specified	Chopra, S., Sodhi, M. (2014)
Connectivity and Willingness Improvement	A model for exploring the effects of connectivity and willingness to share information	Du, T., Lai, V., Cheung, W., Cui, X. (2012)
Coordination Improvement and Cost Reduction	A coordination model with asymmetric information	Pishchulov, G., Richter, K. & Golesorkhi. (2022)
Coordination Improvement and Order Processing Efficiency	ERP Model	Martin, K., Herwih, W. (2019)
Coordination Improvement and Profit Increase	Two-level supply chain coordination model	Sodhi, M.S., Son, B.-G. and Tang, C.S. (2012)
Cost Reduction and Inventory Management Improvement	A simulation model of a multi-echelon supply chain with shared demand information	Klein. R., Koch, S., Stenhardt, C., Strauss, A. (2020)
Incentives for Information Quality and Order Lead Time Reduction	Not specified	Müller, J., Veile, J., Voigt, K. (2020)
Information Integration Improvement	ERP Model	Chatti, H., Radouche, T., Asfoura, E. (2021)

Emphasis Category	Emphasized Models	Authors
Information Quality Improvement	CPFR Model	Kubde, R., Bansod, S. (2010)
Long-Term Relationship Improvement	Not specified	Prajogo, D., Olhager, J. (2012)
Optimal Degree of Information Sharing	An analytical model for determining the optimal degree of information sharing	Huang, Y., Li, M., Ho, J. (2015)
Profitability Improvement	Two-echelon supply chain coordination model with price-sensitive demand	Venegas, B., Ventura, J. (2018)
Retailer Demand and Inventory Management Improvement	A simulation model of a supply chain with shared demand information	Guan, Z., Zhang, X., Zhou, M., Dari, Y. (2020)
Retailer-Supplier Collaboration Improvement	CPFR Model	Fu, H. (2016)
Supply Chain Design and Cost Improvement	Case study of a semiconductor manufacturer	Nakashima, K., Sornmanapong, T. (2013)

The articles listed above cover a wide range of topics relating to improving supply chain performance. These include collaboration, coordination and risk reduction. Each article presents a unique approach or model to address specific aspects of improvement in supply chain.

These articles are a valuable source of information and guidance for a master's thesis on improving supply chain performance in a logistics company through information sharing. The ERP model proposed by Martin K., Herwih W. (2019), Chatti H., Radouche T. and Asfoura E. (2021) could be a useful tool for analyzing order processing efficiency in the supply chain of the logistics service company. The CPFR model, proposed by Panahifar F., Heavy C. Byrne P. Fazlollahtabar H. (2015) Kubde R. Bansod S. (2010) and Fu H. (2016), is useful for exploring how collaboration and forecasting of demand between the logistics service provider and its supply chain partners can improve overall supply chain performance.

2.3. Role of information in supply chain management and decision-making

In today's competitive global market, supply chain management has become a crucial business function. SCM is the integration and coordination between various activities, such as production, procurement, transportation and warehousing, to achieve optimal performance. Many authors have highlighted the importance of sharing information in SCM. This allows supply chain partners to better coordinate their activities and reduce lead times. It also improves the performance of the entire supply chain. Azadegan et al. (2020), for example, outlined the benefits and challenges associated with information sharing within SCM. Muller et. al. (2020) also highlighted the benefits of information quality in SCM and the reduction of order lead times. Others have stressed the use of enterprise resource planning (ERP), collaborative planning, forecasting and replenishment (CPFR), and collaborative planning for SCM. Nakashima and Sornmanapong (2013) discussed the implementation of the CPFR model within a semiconductor supply network, while Handoko et al. (2015) examined the impact ERP systems have on SCM performance. SCM models and information sharing remain a key area of research. Further investigation is needed to determine the most effective strategies for improving supply chain performance.

In recent years, the importance of information sharing in supply chain management has been highlighted. Azadegan (2020) states that information sharing within supply chains can have many benefits, including improving overall performance. Cho, D. & Young, H. (2013) suggest that the sharing of demand information between suppliers and retailers results in better retailer demand management and inventory management. ERP and CPFR have also been suggested as effective ways to share information within supply chains.

MacCarthy et al. (2016) states that supply chain management is not constant and always evolving due to new technologies that improve efficiency and sets a lifecycle for supply chain. In the past 20 years, supply chains have overcome various changes. Koberg and Annachiara (2018) argues that supply chains become more global, where they are composed of different organizations dispersed across multiple tiers, more sustainable, where supply chain become more accountable for environment and more digitalized. Queiroz et al. (2019) states that digitalization has become a tool for companies to make their products or services more consistent, agile and effective.

One of the most important parts of supply chain management is decision making, and information here plays an important role. Supply chain decisions can be divided into three levels (Figure 6.): **strategic**, **tactical** and **operational**.

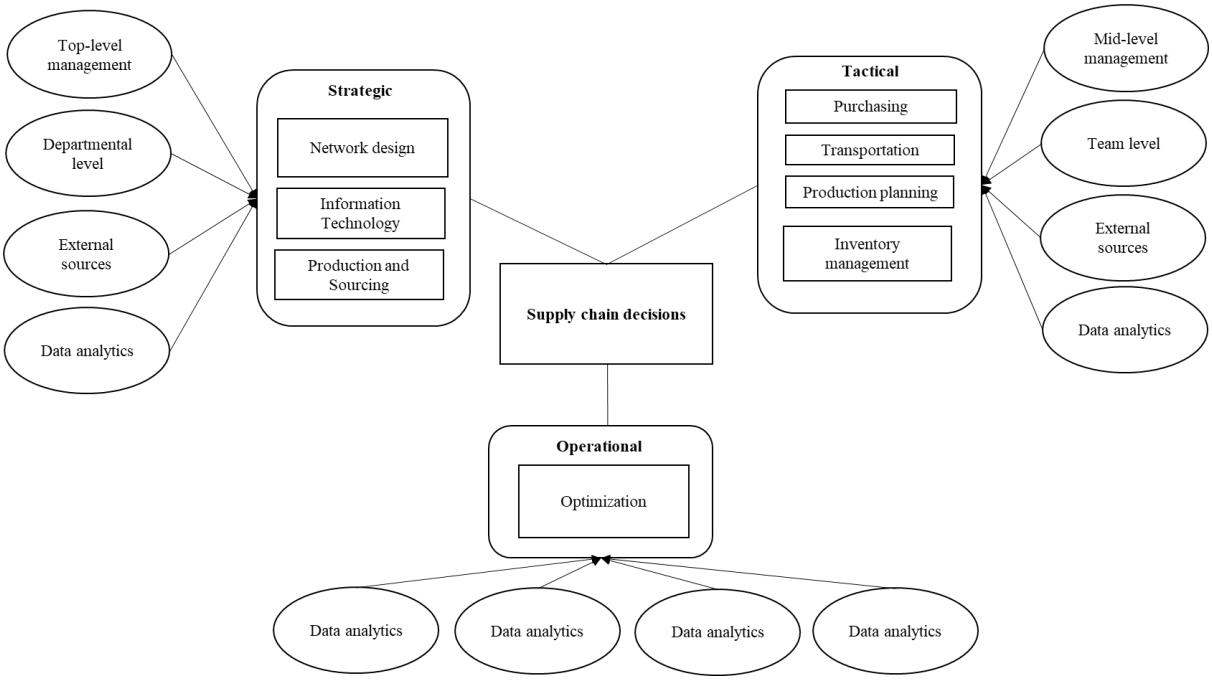

Figure 6. Supply chain decisions. Compiled by author. Source: (Sharan et al, 2021)

Strategic decisions are long-term, used to design the structure of the supply chain, resource allocation and processes taken in each stage (Sharan et al., 2021). Strategic decisions are divided into three categories: network design, information technology and production and sourcing. Network design – this type of decisions is mostly triggered by changing market conditions (Melo et al., 2008). Network design decisions are costly and time consuming since companies are looking for location/relocation of their facilities to improve their inventory and transportation costs. At this stage, information and data gathering together with analysis become a crucial step, for accurate decisions to be made. Information and data gathering should be performed at multiple levels such as country and market to accurately evaluate the potential gains (losses) of the particular location. Production and sourcing – decisions made for production flows and materials allocation. For example, global sourcing might be more suitable for various companies, as offshore suppliers provide lower prices, but at the same time, lead times will be significantly higher, but without additional information gathered, there are no possible ways for the company to decide, materials must be produced in-house or provided by suppliers (Pan et al., 2021). Information Technology – lately, with digitalization being more attractive to companies, information technology has received even more attention. With WEB 3.0, artificial intelligence, Enterprise Resource Planning software, companies have access to potential customers'

data, that allows them to make more accurate decisions. On the other hand, information technology tools are costly, so companies must analyze which is the best fit for their operations to prevent waste expenditure.

Tactical decisions are medium-term and used to plan supply chain activities. With proper information, companies can improve overall supply chain performance and meet market conditions (Sharan et al., 2021). At this decision level, it is important not only gather information but also to share it with supply chain partners, to gain an overall supply chain competitive advantage. Tactical decisions can be divided into various categories, but authors emphasize the four main categories: purchasing, production planning, transportation and inventory management. Tactical decisions have a significant impact on the overall supply chain performance, including cost, delivery time, quality, and customer satisfaction. To make informed tactical decisions, it is necessary to have timely and accurate information on demand, inventory levels, lead times, and supplier performance. Information sharing and gathering play a vital role in supporting tactical decisions in supply chain management. Through information sharing, organizations can reduce uncertainties, improve coordination, and enhance visibility across the supply chain network. For example, sharing demand forecasts and inventory levels can help suppliers plan their production schedules and reduce stockouts. Sharing transportation schedules and delivery status can help reduce transportation costs and improve delivery performance. In addition, gathering information on supplier performance can help organizations evaluate their suppliers and negotiate better terms and conditions.

Operational decisions are short-term and are used for daily operations. The problem with operational decisions is that they are often overlooked as strategic and tactical decisions are considered more valuable. Yet, to achieve overall quality, operational decisions must be taken into consideration. Operational decisions require internal information sharing between departments, as well as external information sharing with suppliers and customers, to keep the whole chain satisfied.

Understanding the different decision levels and their importance can help organizations make informed decisions that improve supply chain performance and ultimately lead to improved customer satisfaction and increased profitability. Failure to recognize the importance of each decision level or neglecting operational decisions can lead to inefficiencies, increased costs, and poor customer experiences. Therefore, it is essential to have a comprehensive understanding of supply chain decision-making to achieve optimal supply chain performance.

In conclusion, effective information sharing is critical for successful supply chain management. It enables organizations to make informed decisions at all decision levels, improve supply chain performance, and ultimately enhance customer satisfaction. Organizations that prioritize information sharing are better equipped to address challenges and opportunities in today's dynamic business environment.

2.4. Barriers of information sharing and gathering

Information sharing between supply chain partners cannot be implemented overnight and requires thoughtful decisions by management, long discussions with partners, choosing who is trustworthy to collaborate with and technology. Even if management decides to collaborate with their supply chain partners and share information, various issues might arise during this process. Possible information sharing barriers:

1. Lack of trust - partners may be hesitant to share sensitive information if they do not trust their partners enough. This may be due to previous negative experiences or concerns about the other party's reliability or intentions. The lack of trust can also lead to a communication breakdown and difficulties in collaborating effectively. For successful supply chain integration and effective supply chain planning, trust among partners is required (Zainah et al., 2014).
2. Competitive concerns – partners may be worried that sharing information could give their competitors an advantage. This could include pricing strategies, product designs, or other confidential information that could be used to gain a competitive edge. As a result, some partners may be reluctant to share information or may only share selective data that they deem safe. Supply chain members are afraid of potential information leakage to unauthorized parties that may cause the loss of competitive advantage (Colicchia et al., 2019).
3. Fear of losing control - partners may be concerned that sharing information could lead to a loss of control over their operations or intellectual property. This may be particularly true for companies that have invested significant resources in developing proprietary technology or processes. As a result, some partners may be reluctant to share information or may require strict controls over how their data is used.
4. Data security - the fear of data breaches and hacking of sensitive information may lead to reluctance in sharing information. This concern is particularly relevant given the increasing frequency and severity of cyber-attacks in recent years. Partners may be hesitant to share information if they do not trust their partners' cybersecurity measures or if they do not have confidence in their own data security systems. Partners need to use the same security standards and protection policies, to ensure each other's data security (Colicchia et al., 2019).
5. Lack of standardization - partners in the supply chain usually use different systems or have different processes for managing information and it can be difficult to exchange data between systems (Huppenbauer, 2015). This could include differences in file formats, data structures, or naming conventions. If partners do not have a shared understanding of how to organize and present data, it may be challenging to collaborate effectively or to make meaningful insights from the shared information.

In research aimed at improving supply chain performance through information sharing, it is important to identify and understand the barriers that prevent effective information sharing. Once these barriers are identified, it is necessary to study previous research models to understand how they have addressed these barriers in the past. By studying previous models, researchers can identify best practices and potential limitations, and develop new strategies for improving information sharing and supply chain performance.

2.5. Previously studied models/systems and their takeaways

When researching the improvement of supply chain performance by means of information sharing, it is essential to discuss previously studied models for several reasons.

Firstly, discussing previously studied models provides a solid foundation for the research study. By examining previous research, researchers can identify the current state of knowledge and understand the research gaps. This information enables them to develop a research design that builds on the previous research, fills research gaps, and contributes to the field's advancement. Therefore, studying

previously studied models is crucial to ensure that the research study builds on existing knowledge and makes a meaningful contribution.

Secondly, previously studied models can be used as a benchmark for evaluating the effectiveness of the proposed model. Comparing the proposed model with previous models allows researchers to identify strengths, weaknesses, and differences between the models. This information enables researchers to assess the improvement in performance that the proposed model provides, and whether the proposed model is better suited to the research context.

Thirdly, studying previously studied models can help researchers identify the factors that contribute to the success or failure of information sharing initiatives in supply chains. Researchers can examine the different models' features and analyze how they contribute to successful information sharing in the supply chain. This analysis can provide insights into the factors that are critical for successful information sharing initiatives in supply chains, such as trust, collaboration, communication, and technology.

Fourthly, previous studies can provide valuable insights into the practical implementation of information sharing initiatives in supply chains. Researchers can examine the challenges faced by previous studies in implementing information sharing initiatives and the strategies used to overcome these challenges. This information can be used to develop practical recommendations for implementing information sharing initiatives in supply chains.

In conclusion, discussing previously studied models is critical when researching the improvement of supply chain performance by means of information sharing. It provides a solid foundation for the research study, enables the proposed model to be evaluated against previous models, identifies factors that contribute to the success or failure of information sharing initiatives, and provides insights into the practical implementation of information sharing initiatives.

In this section one model and one system will be discussed – Collaborative Planning, Forecasting and Replenishment (CPFR) and Enterprise Resource Planning (ERP). Evolution, benefits, barriers and possible overcome will be presented using scientific research.

CPFR and ERP are two essential components of modern supply chain management. According to Zhang (2022) CPFR is a collaborative business practice that involves joint forecasting, planning, and execution between trading partners to meet consumer demand while minimizing inventory and costs. ERP, on the other hand, is an enterprise-wide software system that integrates all aspects of a company's operations, including manufacturing, finance, and human resources (Jacobs & Chase, 2011).

Both CPFR and ERP systems play a crucial role in supply chain management and decision-making at all levels, including strategic, tactical, and operational. At the strategic level, supply chain managers use ERP to analyze historical data, plan production schedules, and forecast demand where CPFR is used to align the strategic goals of trading partners, develop joint business plans, and establish performance metrics (Reimers & Kai, 2014).

At the tactical level, both CPFR and ERP are used to optimize inventory levels, manage supplier relationships, and improve customer service. CPFR enables partners to collaborate on demand planning, forecasting, and inventory management, while ERP allows companies to automate their supply chain processes and manage inventory levels in real-time (Wang et al., 2016).

At the operational level, CPFR helps companies to manage the flow of goods and information between partners, while ERP streamlines operations, improves quality control, and reduces lead times (Jacobs & Chase, 2011). Both CPFR and ERP are critical for decision-making at the operational level, enabling companies to respond quickly to changes in demand, optimize production schedules, and minimize waste.

In summary, CPFR and ERP are both essential components of modern supply chain management, and they are used to support decision-making at all levels of the organization, from strategic planning to operational execution (Zhang, 2012; Jacobs & Chase, 2011; Wang et al, 2016).

2.5.1. Collaborative planning, Forecasting and Replenishment (CPFR)

CPFR evolved from Efficient Customer Response (ECR) concept. ECR introduced back in the mid 1900s for a potential search of new solutions for cooperation between trade partners (Zvirgzdina & Linina, 2015). Seifert (2003), in his book describes CPFR as consideration of trust and improvement of data shared between trade partners. Attaran (2007) describes CPFR as non-dependent on technology, but more scalable if technology is involved, while Panahifar & Heavy (2014) present CPFR as an innovation tool which leverages the internet and Electronic Data Interchange (EDI) in order to improve customer service on behalf of reduced inventories and expenses.

The main purpose of CPFR is to improve relationship between supply chain members through joint planning process, while sharing risks and information, benefits and revenue as well as costs and synchronized forecasts (Hollmann et al., 2014). Shu et al. (2010) add that CPFR helps produce goods efficiently, manage the replenishment of stocks and improves the overall performance of supply chain. Walmart's case confirms usefulness of CPFR initiative. Walmart and Proctor & Gamble (P&G) jointly forecasted sales since 1995. P&G received full and reliable information from Walmart, as P&G were linked to Walmart system electronically and P&G was able to replenish Walmart stocks in perfect timing. Later, other huge chains, e.g., Henkel, Kraft, Unilever joined this CPFR initiative and became strong business partners with Walmart.

To ensure CPFR success, information shared between supply chain partners must be accurate. Büyüközkan & Vardaloğlu (2012) in their research concludes, that improved quality of information provides effective decision making. Ayadi et al. (2013) state that information sharing process improvement is directly correlated with partner trust. Panahifar et al. (2017) performed research on supply chain collaboration and firm's performance. Results of this research show that trust, information readiness and information security positively influenced collaboration between trading partners.

2.5.1.1. CPFR model evolution

The CPFR model has evolved over time as businesses have sought to improve their supply chain management practices. One key aspect of the evolution of the CPFR model has been the increasing use of technology to facilitate the sharing of information and the development of collaborative replenishment plans. This has included the use of electronic data interchange (EDI) systems and more recently, the use of cloud-based collaboration platforms.

Table 2. CPFR model evolution (prepared by author).

Era	Stage of Evolution	Description	Information Sharing
Early 1990s	Early CPFR	The focus was on improving forecasting accuracy and coordinating the replenishment of products between trading partners.	Information was shared manually through paper-based reports and documents, or through the use of limited electronic systems such as Electronic Data Interchange (EDI).
Late 1990s to early 2000s	Advanced CPFR	The focus shifted to more comprehensive collaboration, including the sharing of data and the use of technology to facilitate communication and collaboration.	Information was shared electronically through the use of advanced technologies such as EDI and web-based platforms. Advanced CPFR enabled trading partners to exchange information in real-time and plan production and distribution more effectively.
Early 2000s to late 2010s	Next-generation CPFR	Advanced analytics and machine learning were integrated into the CPFR process, enabling companies to use data-driven insights to make better informed decisions and improve supply chain performance.	Information was shared electronically through the use of advanced analytics and machine learning, as well as through the integration of various business functions and departments. Next-generation CPFR enabled organizations to gain a more comprehensive and predictive view of their operations, leading to improved decision-making and supply chain efficiency.
Late 2010s to present	CPFR 2.0	The current state of CPFR combines the collaborative and data-driven approach of previous versions with the use of new technologies to create a more transparent and efficient supply chain.	Information is shared electronically through the use of new technologies such as blockchain and the Internet of Things (IoT), as well as through the integration of various business functions and departments. CPFR 2.0 enables organizations to gain a more comprehensive and real-time view of their operations, leading to improved collaboration and responsiveness.

In summary, CPFR is a supply chain management strategy that has evolved through four stages: Early CPFR, Advanced CPFR, Next-generation CPFR, and CPFR 2.0. Over the years, CPFR has developed from basic data sharing to advanced analytics and artificial intelligence, which has enabled more proactive supply chain management, better customer service, and increased efficiency. The latest stage, CPFR 2.0, emphasizes the importance of real-time data sharing, advanced forecasting methods, and automated decision-making. Overall, CPFR has proven to be a valuable tool for enhancing collaboration between suppliers and retailers and improving supply chain efficiency.

2.5.1.2. General barriers of CPFR model implementation

CPFR model also have barriers, that makes this model to be evaluated before integration. Panahifar et al. (2014) analyzed potential CPFR barriers and identified 45 barriers that interferes implementation. 13 of these barriers were concluded to be the most significant, and 4 of them are directly related to information sharing:

1. Difficulties with information sharing process. The main difficulties in information sharing process mentioned in literature are information distortion, asymmetry and technological barriers.
    a. Yan et al. (2015) propose that distorted information became useless or might benefit partner who shares distorted information more. Information distortion completely disrupts CPFR model, because planning, forecasting and replenishment under information distortion no longer benefits all supply chain partners.
    b. Information asymmetry, in other words, known as information failure. This definition indicates that information shared by one supply chain member is not symmetrical to information shared by another supply chain member or one member is more informed

than the other. Researchers, such as Tong et al. (2015), are trying to prove that information asymmetry might be effective of performance of supply chain on special occasions, but there is no empirical evidence that information asymmetry could be beneficial to CPFR model, as this model requires precise and trusted information. Information asymmetry might appear in cases where information is shared only upstream or only downstream. In that case, CPFR will not be fulfilled as information will be distributed unevenly.

   c. Technological barriers do not usually interfere bigger supply chain members. In the example of Walmart and P&G integration of CPFR model, there were no serious barriers for such big companies, due to more advanced IT and their capabilities to overcome technological barriers. Small and medium enterprises (SMEs) and smaller supply chains are more likely to experience technological barriers when implementing CPFR model. Mahmud et al, 2021, lists inadequate finance, lack of skilled personnel and incompatible technology as the main technological barriers to SMEs.

2. Fear of losing competitive information. Competitive information is required for accuracy in collaborative forecasting, but this is one of the main barriers, because supply chain members consider whether the information will not result in lost competitive advantage. When considering CPFR implementation, collaborating companies must be trusted between each other. Panahifar et al. (2014) emphasizes that most of the barriers including fear of losing competitive information will not be incurred if the correct partner is selected.
3. Difficulties with real time coordination of information exchange. Min Yu et al. (2010) conclude that effectiveness is not achievable if there is no real-time information sharing and collaborative management between involved partners.
4. Lack of commitment to share information. Commitment is an essential factor for long-term relationship. Diem Le et al. (2021) emphasize that commitment between partners in supply chain must be strengthened and developed further and must be considered as priority factor.

In order to realise CPFR benefits and increase efficiency of the supply chain, all discussed barriers must be overcome. Technological barriers are usually easily overcome by using information technologies that ensure information security and prevents sensitive information leakage, when everything else is mostly the trust between companies factor.

In the case of retailer and supplier collaboration, companies fear the most for loss of competitive information. It is a common belief that sharing sales data between retailer and supplier might affect their relationship, because one might benefit more than another. The purpose of the CPFR model is to increase performance for all supply chain partners, so sensitive data sharing and building common goals are the key factors to overcome this barrier.

2.5.1.3. Benefits of CPFR within information sharing

Benefits of implementing CPFR may include improved forecasting accuracy, reduced inventory costs, increased efficiency, improved customer satisfaction, and enhanced collaboration. Detailed benefits:

1. Improved accuracy: By sharing data and information in real time, organizations can improve the accuracy of their forecasting and planning. This can help to reduce the risk of overstocking

or understocking and enable organizations to align their operations more effectively with demand (Büyüközkan et al., 2013).

2. Enhanced visibility: CPFR enables organizations to gain a more comprehensive and integrated view of their operations, as well as those of their trading partners. This can help to improve visibility and transparency across the supply chain, enabling organizations to better understand and anticipate changes in demand and market conditions (Kalamapur et al., 2013).
3. Greater collaboration: By sharing information and data with trading partners, organizations can improve collaboration and communication across the supply chain. This can help to optimize the flow of goods and information and enable organizations to respond more effectively to changes in demand (Demiray et al., 2017).
4. Increased efficiency: By sharing data and information in real time, organizations can streamline their operations and make better-informed decisions. This can help to reduce lead times, reduce costs, and increase efficiency across the supply chain (Demiray et al., 2017).
5. Enhanced responsiveness: With access to real time information and data, organizations can be more responsive to changes in demand and market conditions. This can enable organizations to adjust their operations and respond more effectively to changing customer needs and preferences. Additionally, by sharing data and information in real-time, organizations can improve their ability to detect and respond to potential issues or disruptions within the supply chain. This can help to mitigate risk and increase the overall resilience of the supply chain. According to Chen et al. (2017), enhanced supply chain visibility can lead to better coordination among supply chain partners and improved responsiveness to changes in demand.

CPFR adoption is a possible method to increase supply chain efficiency when discussing supplier and retailer collaboration. Accuracy is one of the key factors for both suppliers and retailers to increase their long-term forecasting, both in sales and inventory levels, while sharing information in real-time makes this even more efficient in short-term planning.

2.5.1.4. How to encourage information sharing when implementing/post implementation CPFR model?

The primary built CPFR model by VICS had 9 steps, that must be passed to implement CPFR. Over time, authors discussed that some of these steps might be non-material depending on specific supply chains.

CPFR model implementation within information sharing barriers will be presented below using VICS 9-step guide.

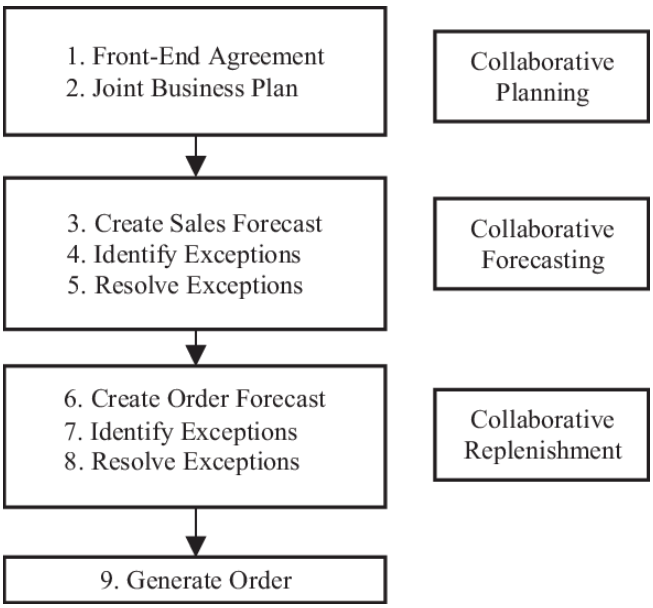

Figure 7. CPFR Process Model (VICS, 2002).

Collaborative planning – the section contains two steps – collaborative agreement and joint business plan. For collaborative agreements, supply chain partners decide the scope of the relationship and responsibilities. Joint business plan – a second step that requires outlining strategies between supply chain members. 8th & Walton (2022) defines a joint business plan as a collaborative process of short- and long-term objectives, financial goals, and growth of companies.

Table 3. Collaborative planning barriers (prepared by author).

Barriers	**Overcome**
Lack of trust	Ghosh et al. (2008) using case studies found that trust is critical for CPFR implementation. It is worth mentioning, that trust in the CPFR model builds over time, but to overcome this lack in the first step, communication between supply chain partners must be transparent and demonstration of commitment to mutual benefit must be shown.
Misalignment of goals	Cristea et al. (2018) mention that firms that implement CPFR must clearly specify their goals, otherwise, this can be determined as a failure of a project. Shared goals must be deeply examined, all parties must state how they perceive these goals and plan how those goals might be achieved.
Cultural differences	To overcome cultural differences, it is suggested to use common language and terminology between supply chain partners to prevent miscommunication. Supply chain partners should provide each other with training and support.
Different business objectives	Different business objectives barrier is quite similar to the misalignment of goals. Supply chain members must openly communicate their objectives and work together to find solutions that meet the needs of all parties.
Data security concerns	Businesses may be hesitant to share sensitive information about their sales or inventory levels due to concerns about data security. There are various ways to overcome this barrier, for example, secure communication channels, access controls, secure storage, or secure collaboration platforms.
Technological challenges	All parties must be familiar with the technologies being used in the CPFR process. Companies might also use third-party technology providers, which provide assist with implementation and management.

Collaborative forecast – this section requires loads of data to be shared between supply chain partners implementing the CPFR model. Partners, who built collaborative agreements and joint business plans, already discussed their goals and objectives prepares a plan on demand for a product or service.

Table 4. Collaborative forecast barriers (prepared by author).

Barriers	Overcome
Inaccurate data	Inaccurate data can occur in two ways – errors in data entry or data distortion. The latter is rarely occurred in the CPFR model, as companies are willing to achieve commonly built goals. For data to be accurate, companies must be responsible for data validation processes and regularly review data, so this data could be used for accurate sales forecasts.
Lack of expertise	Lack of expertise is a problem for the company's staff. This problem can be overcome if one of collaborating partners has a more skilled staff and shares the knowledge with the other partner.
Differing perspectives	Suppliers and retailers might have different perspectives on the expected demand for products or services. This barrier is commonly overcome by using data to support decisions made on sales forecasts.

Collaborative replenishment – is an approach that involves close collaboration between trading partners to manage the flow of goods and optimize inventory levels. In a collaborative replenishment system, trading partners share data on sales trends, customer demand, and inventory levels in real time. Panahifar et al. (2014) states that there is a tight relationship between collaborative forecasting and collaborative replenishment, as better visibility of sales and orders forecast helps to better plan replenishment.

Table 5. Collaborative replenishment barriers (prepared by author).

Barriers	Overcome
Technological barriers	Technological barriers are the most common for collaborative replenishment to be effective. In the case mentioned earlier, Walmart and P&G used IT systems to easily overcome these barriers and get real-time data about inventory levels.
Changing demand	As customer demand constantly shifts, companies must share information to overcome this barrier and revise their plans.

Summarizing all the barriers and possible overcome scenarios described above, the following statements were generated, regarding information sharing encouragement:

1. Partners must be selected by deep evaluation considering the long-term relationship, their technological capabilities, and trust. The more technologically capable the company is, the easier it is to implement the CPFR model, as well as the more companies can trust each other, the more common goals will be set.
2. Planning must consider all collaborating company goals. Companies are more willing to share information if there is potential to fulfil their goals.
3. Forecasting requires trusted and accurate data. Companies are looking to increase their performance as well as stimulate the performance of the supply chain. Shared information that can be trusted leads to decreased error in forecasting probability and benefits companies in cases like inventory levels and sales forecasting.

Considering the statements provided above, the CPFR model is suitable for logistics companies and other participating members of the supply chain, where there is a lack of information sharing.

2.5.2. Enterprise Resource Planning (ERP)

Cambridge dictionary defines ERP as "a system of software which is designed to manage all information and activities of a company by using shared data". Suprapto et al. (2017) describe ERP

as an information technology used to obtain quality information, so management could make accurate and timely decisions. Ince et al. (2013) describe ERP purpose as an integration of a wide range of information to create synergies with business partners, enhanced operational performance, and meet customers' requirements.

ERP implementation is a costly, time-consuming, and knowledge-requiring process. Companies usually use external consultants and build relationships with them, so companies could trust and share information about their business for ERP implementation purposes.

2.5.2.1. ERP systems evolution

Advancements in technology led many companies to the path of success and evolution of business management. The evolution of ERP is one of the leading factors, that stimulated companies to cooperate and collaborate with their partners for the overall supply chain performance improvement.

Table 6. ERP systems evolution (prepared by author).

Era	Stage of Evolution	Description	Information Sharing
Late 1980s to early 1990s	ERP	ERP systems were developed to integrate and automate various business functions across an organization. These systems were designed to provide a single, unified platform for managing and organizing business processes and data.	Information was shared electronically through the use of centralized databases and computer networks. Different business functions and departments could access and update information in real time, leading to improved accuracy and efficiency.
Late 1990s to early 2000s	ERP 2.0	ERP 2.0 systems added new capabilities such as e-commerce, customer relationship management, and supply chain management. These systems also began to incorporate advanced technologies such as artificial intelligence and machine learning.	Information was shared electronically through the use of advanced technologies such as artificial intelligence and machine learning, as well as through the integration of various business functions and departments. ERP 2.0 systems enabled organizations to gain a more comprehensive and integrated view of their operations, leading to improved decision-making and strategic planning.
Late 2010s to present	Cloud-based ERP	Cloud-based ERP systems are hosted on remote servers and accessed via the internet, rather than being installed and managed on local servers. These systems offer greater flexibility and scalability, as well as reduced upfront costs and maintenance requirements.	Information is shared electronically through the use of cloud computing and advanced technologies such as artificial intelligence and machine learning, as well as through the integration of various business functions and departments. Cloud-based ERP systems enable organizations to access and update information from anywhere and at any time, leading to improved collaboration and responsiveness.

2.5.2.2. General ERP barriers

ERP systems suggest great opportunities for companies to increase supply chain management. However, collaboration with other supply chain members is required, which might incur barriers.

1. Lack of standardization: Huppenbauer (2015) says that if partners in the supply chain are using different systems or have different processes for managing information, it can be difficult to exchange data between systems. This can lead to errors and inefficiencies, as well as increased costs due to the need for manual data entry or the use of integration tools. Standardizing a common ERP system or using integration tools can help overcome this barrier.

2. Data quality issues: If the data being shared is incorrect or incomplete, it can lead to errors and inefficiencies. This can be caused by a variety of factors, such as incorrect data entry, outdated data, or missing data fields. Ensuring the quality of data using data governance processes and tools, such as data validation and data cleansing, can help mitigate this barrier (Hasan, 2011).
3. Resistance to change: Some employees may resist using the ERP system or may be resistant to changing their existing workflows. This can be due to a variety of factors, such as a lack of understanding of the benefits of the ERP system, a lack of training, or a perceived threat to job security. Providing adequate training and support, as well as clearly communicating the benefits of the ERP system, can help overcome this barrier (Kwang, 2018).
4. Lack of integration: If the ERP system is not properly integrated with other systems or processes, it can be difficult to share information effectively. This can lead to silos of information and a lack of visibility into the entire business process. Ensuring that the ERP system is properly integrated with other systems and processes can help overcome this barrier.
5. Security concerns: Sharing sensitive information with partners in the supply chain can raise security concerns, such as the risk of data breaches or unauthorized access to confidential information. Implementing appropriate security measures, such as data encryption and access controls, and ensuring that partners have secure systems in place can help mitigate these concerns. It is also important to have robust data governance policies and procedures in place to protect the confidentiality, integrity, and availability of the data being shared (Hrischev, 2020).

In order to fulfil ERP benefits and increase the efficiency of the supply chain, all discussed barriers must be overcome. Above mentioned barrier can be assigned to two groups – technological and internal communication. In the ERP case, technological problems are more intended to cross-functionality between various ERP systems, while inter-communication problems are more related to internal staff culture and adaptability to changes.

2.5.2.3. Benefits of ERP within information sharing

Benefits of ERP in contribution to supply chain partners:

1. Integration with other systems: ERP systems can be integrated with other systems used by partners in the supply chain, such as order management systems, warehouse management systems, and transportation management systems. This allows for the seamless exchange of information between partners and helps to ensure that the supply chain is operating efficiently.
2. Collaborative planning: ERP systems can be used to collaborate with partners on the planning of production, inventory, and distribution. This can help ensure that the right products are produced in the right quantities at the right time to meet customer demand and minimize excess inventory (Su & Yang, 2010).
3. Visibility and traceability: ERP systems can provide real-time visibility into the status of orders, inventory levels, and the location of goods in the supply chain. This can help partners make more informed decisions and reduce the risk of errors, improving the overall efficiency of the supply chain.
4. Efficient communication: ERP systems can facilitate efficient communication between partners using electronic data interchange (EDI) and other communication tools. This can help reduce the time and cost of communication and improve the speed and accuracy of

information exchange, enabling partners to respond more quickly to changes in demand and other factors (Ince et al., 2013).

Summarizing the benefits of ERP systems, an association with the CPFR model is noticeable, which is collaborative planning. ERP systems help to plan because companies can exchange real-time data as well as historical, for example, seasonal information. Getting deeper into the planning context of logistics companies and other participating members in the supply chain, seasonal information about sales is useful for logistics companies to plan the possible sales and required inventory levels.

2.5.2.4. How to encourage information sharing with supply chain partners with the use of ERP systems?

ERP systems are capable to help companies to share information with their supply chain partners, but this is not done if companies do not expect to collaborate and willingly share information. Companies might have various reasons to not cooperate with their supply chain partners, but if decided to, and decided to share data within ERP systems, some steps must be taken (Figure 8.).

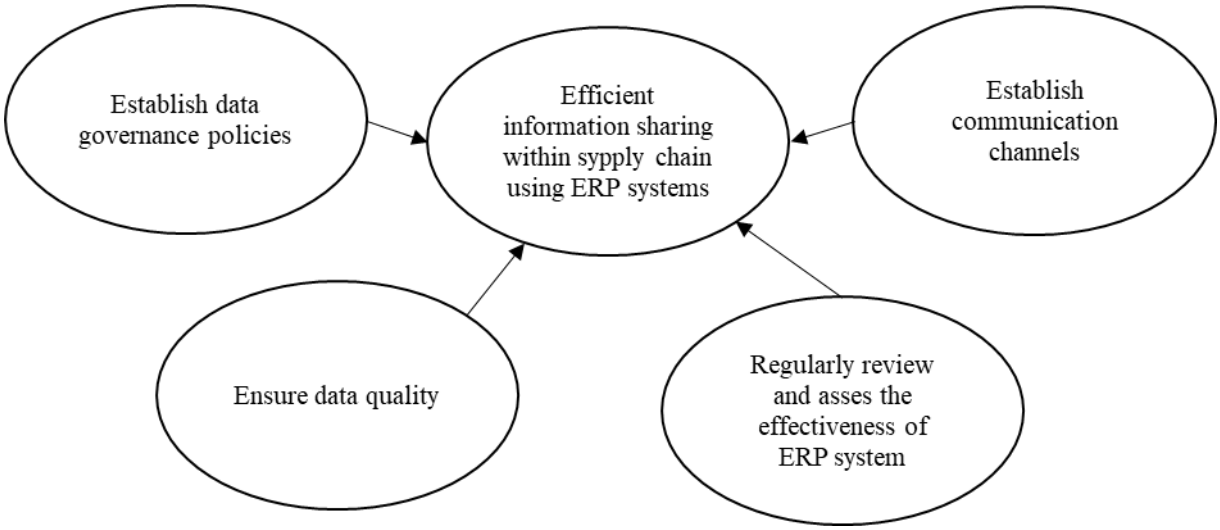

Figure 8. Steps to achieve efficient information sharing within supply chain using ERP systems (prepared by author).

Quality of information is a crucial factor as this affects management decisions, as well as, inaccurate data shared with supply chain partners might end collaboration. Research by Tarigan (2021) shows that there is no influence of ERP on information quality, as data in ERP systems might be distorted unwillingly. On the other hand, continuously developing ERP systems present many secure points to help companies with information quality.

To ensure **data quality**, To-Increase, an independent software vendor, presents 6 steps (Figure 9.):

1. Completeness – data must be comprehensive. If the information is not complete, it might be not useful. ERP systems let to set mandatory information to be filled, so nothing material will not be skipped during the data entry process.
2. Consistency – data must be correct, without duplication or mismatches. ERP systems are capable to check and inform if data is incorrect, for example, duplicated.
3. Timeliness – data must be up-to-date and available for correct management decisions. Real-time data might be one of the concerns that interest other supply chain members the most, as this is a top priority for inventory management.

4. Validity – data must be cleansed. Companies analysts usually perform data validation before reporting and making suggestions to management. ERP systems are available to mark possible data invalidity to help with overall data quality.
5. Accuracy – data must be relevant. Accuracy remains mostly on human factors, especially data entry. ERP systems might suggest that some data is not accurate, but this is currently still limited.
6. Integrity – data must be trusted. Integrity involves all 5 steps mentioned above, as without them, data cannot be completely trusted.

Figure 9. Dimensions of data quality (To-Increase, 2021).

As per Verdantis, multilingual master data consultancy, **data governance** is the complete management of the availability, utilization, and security of the data in a company. To establish governance policies, the following steps are suggested:

1. Define the data governance framework: Establish a clear set of policies and procedures that outline how data will be collected, stored, used, and shared within the organization and with supply chain partners. This can include the use of data classification schemes, data retention policies, and data access controls.
2. Identify key stakeholders: Identify the key stakeholders within the organization and its supply chain partners who will be involved in the data governance process. This can include executives, IT professionals, data stewards, and other individuals who are responsible for managing and accessing data.

3. Develop data governance roles and responsibilities: Define the roles and responsibilities of different stakeholders in the data governance process. This can include the identification of data owners, data custodians, and data users, as well as their respective responsibilities.
4. Establish data governance processes: Develop processes for the collection, storage, use, and sharing of data within the organization and with supply chain partners. This can include the use of data quality management processes, data security measures, and data access controls.
5. Communicate data governance policies and procedures: Communicate the data governance policies and procedures to all stakeholders within the organization and its supply chain partners. This can include the use of training and documentation to ensure that everyone understands their roles and responsibilities.

Regular assessment of the ERP system is a key factor to confirm that all needed processes are working. Al-Rejal (2016) emphasizes that ERP systems are complex, but the understanding of all its features leads to advanced planning and management decisions. It is suggested to follow the below steps to assess the ERP system regularly:

1. Establish performance metrics: Identify the key performance indicators (KPIs) that will be used to assess the performance of the ERP system. These metrics may include measures of system uptime, user adoption rates, data accuracy, and process efficiency.
2. Collect data: Regularly collect data on the performance of the ERP system. This can include data on system usage, user satisfaction, process performance, and other relevant metrics.
3. Analyze data: Analyze the collected data to understand the performance of the ERP system. This can involve using data visualization tools, statistical analysis, or other methods to identify trends and patterns in the data.
4. Solicit feedback: Gather feedback from users of the ERP system to understand their experiences with the system and to identify any issues or challenges they may be facing. This can be done through surveys, focus groups, or other methods.
5. Implement improvements: Based on the data and feedback collected, identify any improvements or changes that can be made to the ERP system to enhance its performance and meet the needs of the organization.

The establishment of **communication channels** is a step that requires the determination of information that will be shared. For example, if companies want to share sales data, the most common technology used to do this is electronic data interchange (EDI) which is linked to the company's ERP system. Sometimes, a barrier incurs when supply chain partners use different ERP systems which have a weak link with each other. This requires additional configurations, but in most cases, companies overcome this barrier. It is suggested to use the below steps for the establishment and maintenance of communication challenges:

1. Identify the communication needs of the organization and its supply chain partners: Determine the types of information that need to be shared and the frequency with which it needs to be shared. This can include orders, invoices, shipping notifications, and other operational data.
2. Establish communication protocols: Develop protocols for the exchange of information between the organization and its supply chain partners. This can include the use of electronic data interchange (EDI), email, instant messaging, and other technologies.
3. Configure the ERP system to support communication with supply chain partners: Set up the ERP system to facilitate the exchange of information with supply chain partners. This can

include configuring user permissions and access controls, establishing interfaces between systems, and configuring data exchange processes.
4. Communicate the communication protocols to supply chain partners: Ensure that supply chain partners are aware of the communication protocols and how to use them to exchange information with the organization.
5. Test and validate the communication channels: Test the communication channels to ensure that they are working correctly and that the information being shared is accurate and complete.

Summarizing the above-mentioned required steps for successful usage of the ERP system, the following statements were generated, regarding the encouragement of information sharing:

1. ERP systems do not encourage information sharing but help companies share their information with supply chain partners. ERP provides easy data-sharing techniques, such as data feeding, helps with data security, and prevents data leakage.
2. ERP systems provide benefits for easier CPFR model adoption. The use of ERP systems helps with data analysis, forecasting and visualization and leads to more accurate decisions to be accepted if the information is accurate.

Overall, ERP might be a perfect system to use together with the CPFR model as this system benefits CPFR model adoption.

2.6. Information sharing effect on the supply chain performance

Information sharing plays a crucial role in enhancing supply chain performance. It enables supply chain partners to collaborate more effectively, improve their decision-making processes, and ultimately deliver better customer satisfaction. In this summary, we will explore how each of the following statements increases supply chain performance through information sharing.

The following summarizes the barriers and benefits of CPFR and ERP separately and together:

CPFR model is a business strategy that seeks to enhance supply chain collaboration and efficiency between different companies. It involves an information-sharing system that helps companies to forecast demand, plan production, and manage inventory levels. CPFR involves two or more trading partners sharing data, collaborating to create a joint demand forecast, and then executing the plan to meet that demand. CPFR is based on the principle of collaborative planning, which means that multiple companies in a supply chain work together to create a plan that is beneficial to all parties involved. The model relies heavily on the exchange of real-time data, including sales data, inventory levels, and demand forecasts. This data is then used to create a shared forecast, which is used to optimize inventory and production planning. The end goal is to reduce supply chain disruptions, improve forecasting accuracy, and ultimately increase profits. The Enterprise Resource Planning (ERP) model is a business management software system that helps organizations to manage their operations more efficiently. It involves integrating various business functions, including finance, human resources, sales, and supply chain management, into a single system. The goal of an ERP system is to streamline operations, improve productivity, and reduce costs. CPFR and ERP systems can be implemented separately or in conjunction with one another. When implemented together, they can provide a powerful tool for supply chain management. By integrating the forecasting and planning capabilities of CPFR with the operational and management capabilities of ERP, companies can improve their supply chain operations, reduce costs, and improve customer satisfaction.

The integration of CPFR and ERP can provide several benefits, including:

- Enhanced collaboration: By sharing real-time data, companies can work together to optimize production and inventory planning.
- Improved forecasting accuracy: By pooling data from multiple sources, CPFR can create more accurate demand forecasts, which can then be used to optimize inventory levels.
- Streamlined operations: ERP systems can help to automate certain tasks, reducing the need for manual intervention and increasing efficiency.
- Reduced costs: By optimizing inventory levels and reducing supply chain disruptions, companies can reduce costs and improve profitability.

Reliable information sharing ensures that the data shared is trustworthy and can be relied upon for decision-making. Accurate information ensures that the data is correct and reflects the current state of the supply chain. Complete information means that all relevant data is shared, leaving no gaps in the supply chain visibility. When all these elements are present in the information shared among supply chain partners, they can make informed decisions and coordinate their actions effectively.

In contrast, unreliable, inaccurate, or incomplete information can lead to delays, inefficiencies, and errors in decision-making. For example, if supply chain partners rely on inaccurate demand forecasts, they may overstock or understock inventory, leading to wasted resources or stock-outs. Similarly, incomplete information about production schedules or delivery times can lead to delays and disruptions in the supply chain.

The Figure 10 summarizes statements that help to identify the barriers, overcome them, and improve supply chain performance:

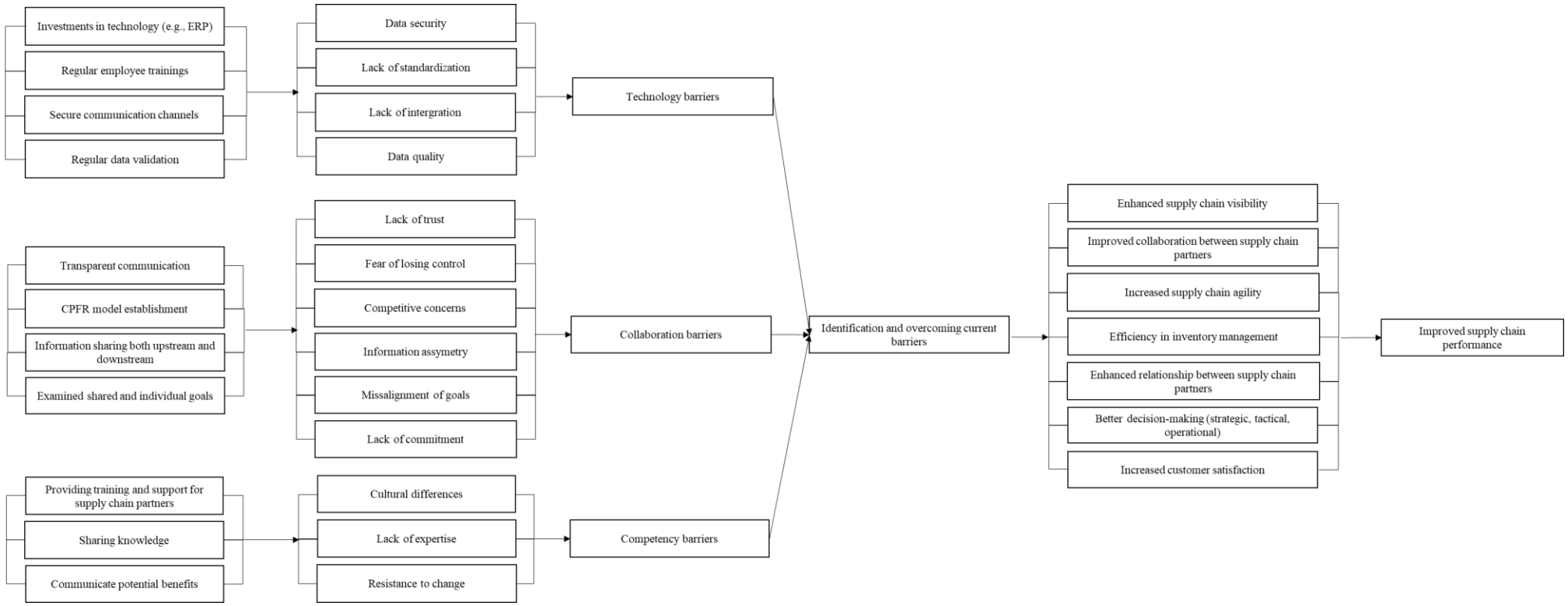

Figure 10. Theoretical model (prepared by author)

Enhanced supply chain visibility: Enhanced supply chain visibility refers to the ability of supply chain partners to have a clear and accurate view of the entire supply chain, from the raw materials to the end product. Sharing information about inventory levels, production schedules, and delivery times can help supply chain partners better understand the current state of the supply chain and respond quickly to changes in demand. This increased visibility can lead to better coordination among partners, reduced lead times, and improved delivery performance. According to Chen et al. (2017), enhanced supply chain visibility can lead to better coordination among supply chain partners and improved responsiveness to changes in demand.

Identified tools to reach enhanced supply chain visibility: Investments in technology (e.g., ERP), secure communication channels, regular data validation, and information sharing both upstream and downstream can help improve supply chain visibility by providing real-time data and enabling transparent communication among supply chain partners.

Improved collaboration between supply chain partners: Effective collaboration between supply chain partners requires frequent and transparent communication. By sharing information about production schedules, inventory levels, and quality issues, partners can work together to identify and resolve issues before they become major problems. This can lead to better coordination, faster response times, and improved overall performance. According to Heikkilä and Kärkkäinen (2012), improved collaboration can lead to reduced supply chain costs and improved delivery performance.

Identified tools to establish improved collaboration between supply chain partners: regular employee training, CPFR model establishment, transparent communication, and examined shared and individual goals can help improve collaboration among supply chain partners by fostering communication, trust, and alignment of goals.

Increased supply chain agility: The ability to respond quickly and effectively to changes in demand is critical for supply chain performance. By sharing information about inventory levels, production schedules, and customer demand, supply chain partners can adjust their operations to respond to changes in real time. This can help improve supply chain agility, reduce lead times, and improve delivery performance. According to Zhao et al. (2014), increased supply chain agility can lead to improved responsiveness to changes in customer demand and reduced supply chain costs.

Identified tools to reach increased supply chain agility: Investments in technology (e.g., ERP), providing training and support for supply chain partners, sharing knowledge, and communicating potential benefits can help increase supply chain agility by enabling rapid responses to changing market conditions and customer demand.

Efficiency in inventory management: Effective inventory management is essential for optimizing supply chain performance. By sharing information about inventory levels and demand forecasts, supply chain partners can better manage their inventory levels and avoid stock-outs or overstocking. This can lead to reduced costs, improved delivery performance, and better customer satisfaction. According to Zhou et al. (2013), effective inventory management can lead to reduced supply chain costs and improved delivery performance.

Identified tools to improve efficiency in inventory management: Regular data validation, investments in technology (e.g., ERP), and examined shared and individual goals can help improve inventory management efficiency by providing accurate data and enabling better coordination and planning among supply chain partners.

Enhanced relationship between supply chain partners: Effective communication and collaboration can help build stronger relationships between supply chain partners. By sharing information and working together to solve problems, partners can develop a sense of trust and mutual respect, leading to improved performance and better long-term relationships. According to Wang et al. (2010), strong relationships between supply chain partners can lead to improved supply chain performance, reduced costs, and improved customer satisfaction.

Identified tools for enhanced relationships between supply chain partners: Regular employee training, transparent communication, and sharing knowledge can help enhance relationships among supply chain partners by fostering open communication, trust, and a shared understanding of each other's needs and capabilities.

Better decision-making: Access to accurate and timely information is essential for effective decision-making. By sharing information about production schedules, inventory levels, and customer demand, supply chain partners can make informed decisions about how to allocate resources, manage inventory, and respond to changes in demand. This can lead to improved performance, reduced costs, and better customer satisfaction. According to Huang et al. (2016), effective information sharing can lead to improved decision-making and reduced supply chain costs.

Identified tools for better decision-making: Investments in technology (e.g., ERP), regular data validation, transparent communication, and examined shared and individual goals can help improve decision-making at all levels of the supply chain by providing accurate data, enabling collaboration, and fostering alignment of goals and priorities.

Increased customer satisfaction: Ultimately, the goal of any supply chain is to deliver high-quality products or services to customers on time and at a reasonable cost. By sharing information and working together to optimize supply chain performance, supply chain partners can improve their ability to meet customer demands, reduce lead times, and deliver products that meet or exceed customer expectations. This can lead to increased customer satisfaction, improved brand loyalty, and ultimately, increased revenue. According to Kandampully and Suhartanto (2018), improved supply chain performance can lead to improved customer satisfaction and increased revenue.

Identified tools for increased customer satisfaction: investments in technology (e.g., ERP), regular employee training, secure communication channels, and information sharing both upstream and downstream can help improve customer satisfaction by enabling faster response times, better product quality, and more transparent communication throughout the supply chain.

3. Research methodology for information sharing in logistics company

This chapter presents the methodology of research for improving supply chain performance by current means of information in the case company.

Research Problem: Information sharing between supply chain members might be distorted and asymmetrical. Companies are frightened to share information due to the potential loss of competitive advantage. It is necessary to share information between supply chain partners to increase supply chain efficiency, decrease forecasting and planning error margins, cut costs and increase overall profitability.

The aim of the research: to analyze the factors, conditions, and methods that prevent and encourage information sharing in the supply chain management of a logistics company.

Objectives of the research:

1. Find out what challenges the case company incurs that prevent effective information sharing.
2. To develop a framework and recommendations for enhancing information sharing practices in the supply chain of a logistics company.

Research method: Zailani, Jeyaraman, and Vengadasan (2012) suggest that qualitative research methods, such as interviews and focus groups, are well-suited for studying the impact of information sharing on supply chain performance. They argue that qualitative methods can help capture the perspectives of stakeholders and provide insights into the barriers and facilitators of effective information sharing in supply chains.

Data collection: Data collected using two methods:

- Semi-Structured Interview
- Document Analysis

3.1. Semi-Structured Interview

A semi-structured interview is a data collection method used to gather information from participants. Semi-structured interview combines the flexibility of an unstructured interview with a focus and structure of a structured interview. These questions are carefully designed to be clear, specific, and objective, but there is also room for interviewees to provide additional information.

Table 7. Semi-structured interview questions (prepared by author)

	Question	Theoretical background
1.	To what extent do you invest in technology to improve supply chain performance? Could you please provide examples?	Investments in technology can improve supply chain performance by increasing efficiency, reducing costs, and improving collaboration among supply chain partners. Examples of technology investments include enterprise resource planning (ERP) systems, transportation management systems, warehouse management systems, and supply chain visibility tools. These technologies can provide real-time data and analytics, which can help organizations make more informed decisions and respond to changes in the supply chain more quickly.
2.	How do you ensure that your employees are regularly trained to deal with supply chain	Regular employee training is important for ensuring that employees have the knowledge and skills they need to deal

	issues? What specific training programs do you have in place?	with supply chain issues. This can include training on specific technologies, processes, or best practices. Training can also be used to build trust and collaboration among supply chain partners. Specific training programs can include lean manufacturing, supply chain management certification programs, and cross-functional training programs.
3.	What communication channels do you use to ensure secure communication with your supply chain partners?	Secure communication channels are important for protecting sensitive information and maintaining trust among supply chain partners. These communication channels can help ensure that information is transmitted securely and that only authorized parties have access to it.
4.	How often do you validate your data to ensure that it is accurate and reliable? What tools or processes do you use to do this?	Regular data validation is important for ensuring that data is accurate and reliable, which is critical for effective decision-making in the supply chain. Data validation can be done using various tools and processes, including data profiling or data cleansing. These tools can help identify data errors and inconsistencies, and provide feedback to data owners to improve data quality.
5.	How transparent are your communication practices with your supply chain partners? Could you please provide some examples?	Transparency in communication practices can help build trust and collaboration among supply chain partners. Examples of transparent communication practices include sharing relevant data and information, providing visibility into processes and operations, and being open and honest about challenges and opportunities. This can help foster a culture of collaboration and continuous improvement in the supply chain.
6.	Have you established a Collaborative Planning, Forecasting, and Replenishment (CPFR) model with your supply chain partners? If so, how has this impacted your supply chain performance?	Collaborative Planning, Forecasting, and Replenishment (CPFR) is a supply chain management strategy that involves the sharing of information among supply chain partners to improve planning and forecasting accuracy, reduce costs, and improve supply chain performance. CPFR typically involves the sharing of sales forecasts, inventory levels, and production plans among supply chain partners. CPFR can help improve supply chain performance by reducing inventory costs, improving customer service levels, and increasing supply chain visibility.
7.	Do you share information both upstream and downstream with your supply chain partners? What type of information do you typically share?	Sharing information both upstream and downstream with supply chain partners is important for improving collaboration and coordination. Upstream information can include sales forecasts, production plans, and inventory levels, while downstream information can include customer demand and order information. Sharing this information can help reduce supply chain uncertainty, improve planning accuracy, and increase responsiveness to changes in the supply chain.
8.	How do you align your goals with your supply chain partners to ensure that everyone is working towards a common objective?	Aligning goals with supply chain partners is important for ensuring that everyone is working towards a common objective. This can be done using performance metrics, such as on-time delivery, quality, and cost metrics. Supply chain partners can also establish shared goals, such as reducing lead times, improving inventory turns, or increasing customer satisfaction. Alignment of goals can help improve collaboration, reduce conflict, and improve overall supply chain performance.

9.	What type of training and support do you provide to your supply chain partners? Could you please provide examples?	Providing training and support to supply chain partners can help improve collaboration and increase supply chain performance. Examples of training and support include supplier development programs, logistics training, and joint problem-solving initiatives. These programs can help improve the skills and knowledge of supply chain partners, which can lead to improved quality, reduced costs, and increased customer satisfaction.
10.	How do you share knowledge with your supply chain partners to improve overall performance?	Sharing knowledge with supply chain partners is important for improving overall performance. Knowledge sharing can include best practices, industry trends, and new technologies. This can be done using collaborative platforms, such as online portals, webinars, or workshops. Knowledge sharing can help improve collaboration, reduce duplication of efforts, and drive innovation in the supply chain.
11.	How do you communicate potential benefits to your supply chain partners to encourage collaboration and cooperation?	In supply chain management, effective communication is a critical component of successful collaboration and cooperation between partners. When communicating potential benefits to supply chain partners, it is important to use clear and concise language to convey the advantages of collaboration and how it can improve performance, reduce costs, and enhance customer satisfaction.
12.	How do you ensure data security within your supply chain? What specific measures do you have in place?	Data security is a major concern in supply chain management, especially given the increased use of digital technologies and the growing complexity of supply chains. Ensuring data security involves implementing a range of measures, such as access controls, data encryption, firewalls, intrusion detection systems, and data backup and recovery procedures. The theoretical background behind this question is based on the importance of data security in supply chain management, which has become increasingly critical with the rise of cyber threats and the need to protect sensitive information.
13.	How do you address concerns around lack of standardization within your supply chain? What specific steps do you take to ensure consistency?	Lack of standardization can create significant challenges in supply chain management, leading to inconsistencies, inefficiencies, and errors. To address this issue, companies can implement standardized processes and procedures, use common data formats, establish performance metrics and benchmarks, and adopt industry standards and best practices.
14.	How do you integrate data from various sources within your supply chain? What tools or processes do you use to do this?	Data integration is essential for effective supply chain management, as it allows companies to consolidate and analyze data from various sources to gain insights and make informed decisions. To integrate data, companies can use a range of tools and processes, such as enterprise resource planning (ERP) systems, application programming interfaces (APIs), data warehouses, and data management platforms.
15.	What steps do you take to ensure data quality within your supply chain? Could you please provide examples?	Data quality is critical for effective supply chain management, as it enables companies to make informed decisions based on accurate and reliable information. To ensure data quality, companies can implement data validation procedures, conduct regular data audits, establish data governance policies, and use data quality tools and software. Examples of data quality measures include data cleansing, data enrichment, data profiling, and data normalization.

16.	How do you build trust with your supply chain partners? What specific actions do you take to establish and maintain trust?	Trust is a critical component of successful supply chain partnerships, as it enables partners to share information and resources with confidence. Some of the theoretical frameworks that can inform this question include transaction cost theory, social exchange theory, and stakeholder theory.
17.	How do you address concerns around losing control within your supply chain? What specific measures do you have in place to ensure control is maintained?	Concerns around losing control can arise in supply chain partnerships, particularly when partners are required to share sensitive information or resources. To address these concerns, partners may establish clear guidelines around the use and handling of shared information or resources, or may implement governance mechanisms such as joint steering committees or performance monitoring systems.
18.	How do you address concerns around competition within your supply chain? What specific steps do you take to ensure collaboration and cooperation?	While competition is often viewed as a barrier to collaboration, supply chain partnerships can benefit from healthy competition among partners. This can encourage innovation, promote efficiency, and lead to better outcomes for all partners. To address concerns around competition, partners may establish clear guidelines around the sharing of information or resources, or may implement governance mechanisms such as competitive benchmarking or performance monitoring systems.
19.	How do you address information asymmetry within your supply chain? What specific steps do you take to ensure that everyone has access to the same information?	Information asymmetry occurs when one partner has more or better information than another partner, which can lead to power imbalances and mistrust within the partnership. To address information asymmetry, partners may establish clear guidelines around the sharing of information, or may implement governance mechanisms such as joint planning or performance monitoring systems.
20.	How do you ensure alignment of goals within your supply chain? Could you please provide examples?	Alignment of goals is critical for effective supply chain management. To ensure alignment of goals, companies should focus on creating a shared vision and goals, communication, and collaboration among supply chain partners. This can be achieved by establishing regular communication channels and sharing information among all supply chain partners.
21.	How do you address concerns around lack of commitment within your supply chain? What specific actions do you take to ensure that everyone is committed to the success of the supply chain?	Lack of commitment can be a major barrier to effective supply chain management. Companies can address this by establishing clear expectations and incentives for all supply chain partners, and by providing regular feedback on performance.
22.	How do you address cultural differences within your supply chain? What specific steps do you take to ensure that cultural differences do not impact performance?	Cultural differences can lead to misunderstandings and miscommunications that can negatively impact supply chain performance. To address this, companies should develop an understanding of the cultural norms and practices of their supply chain partners. This can be achieved by establishing regular communication channels and developing cultural training programs for all supply chain partners.
23.	How do you address concerns around lack of expertise within your supply chain? What specific actions do you take to ensure that everyone has the necessary knowledge and skills?	Lack of expertise can be addressed through training and education programs for all supply chain partners. Companies can provide training on specific supply chain processes, such as inventory management, logistics, and quality management.
24.	How do you address resistance to change within your supply chain? What specific	Resistance to change is a common barrier to supply chain improvement initiatives. Companies can address this by

	actions do you take to ensure that changes are implemented smoothly and efficiently?	involving all supply chain partners in the change management process and by providing clear communication about the changes and the expected outcomes. In addition, companies can provide training and support for new processes and technologies. To ensure successful implementation, companies can also establish a feedback mechanism to monitor and evaluate the effectiveness of the changes.
25.	How have your efforts to address the above barriers impacted your supply chain performance? Could you please provide examples of improved supply chain visibility, collaboration, agility, inventory management, relationships, and decision-making, as well as increased customer satisfaction?	By addressing the above barriers, companies can achieve significant improvements in their supply chain performance. For example, addressing the lack of trust between supply chain partners can lead to increased collaboration and agility, as partners are more willing to share information and work together to achieve shared goals. Improved communication practices can lead to better decision-making and more efficient inventory management. Addressing cultural differences can lead to better relationships and improved customer satisfaction. By addressing these barriers, companies can achieve a more efficient and effective supply chain that is better equipped to meet the needs of customers and adapt to changing market conditions.

3.2. Document analysis

Document analysis is a research method that involves examining written, visual, or auditory materials to gain insight into a particular topic. It can be used as a standalone method or in conjunction with other qualitative research methods, such as interviews or focus groups. Document analysis is a valuable method for collecting and analyzing data. Through document analysis, the researcher can review and analyze various documents related to the supply chain, which in this case is customer contracts. The need of reviewing customer contracts is the following:

- Gaps in current contracts, regarding information sharing in symmetry.
- Potential space for information transparency improvement.
- Potential space for collaboration.

In summary, logistics companies may need to review their contracts with customers to increase information sharing for a variety of reasons. These reasons could include regulatory compliance, improved efficiency, or competitive advantage. By reviewing their contracts, logistics companies can ensure that they are not violating any legal or contractual obligations while sharing more information with their customers or partners. Ultimately, increasing information sharing can lead to better customer service, improved operations, and a stronger competitive position in the market.

3.3. Research process

The research was conducted using the following plan:

1. Semi-interview questions were prepared using a theoretical model developed from theoretical research.
2. Interviewees were identified to collect data, that could help identify possible waste or challenges in the case company's information sharing practices:
    a. Sales Manager – expected to get valuable information on sales trends and demand patterns as well as information on customer preferences and feedback.

   b. Chief Financial Officer (CFO) – expected to get answers related to financial performance metrics, budgeting (forecasting), and investment decisions.
   c. Customer Relations Manager (CRM) – expected to get information on customer preferences, satisfaction levels, and feedback.
   d. Warehousing Manager – expected to get information on inventory levels, order fulfillment times, and warehouse efficiency.
   e. Vice President of Logistics – expected to get answers related to transportation and distribution networks, logistics processes, and supply chain partners.
3. Interviews were scheduled with interviewees. Interviews were held once a week on Mondays, starting March 6th and ending April 3rd. This way was selected based on the interviewees' availability.
4. Interviews were recorded and later transcribed. On average, the interview duration was ~ 1.5 hours.
5. Transcribed interviews were analyzed and categorized for later research.
6. The company's contracts with customers were analyzed: Since confirmation for review of contracts with international customers was not provided to the researcher, document analysis was performed on domestic customer contracts only. Document analysis was selected by the researcher to identify possible gaps that prevent information sharing with supply chain partners. The 3 latest customer contracts were received by the researcher on April 7th.
7. Based on insights and findings from interviews as well as from customer contracts analysis, recommendations were developed.

3.4. Limitations and perspectives of research

While semi-structured interviews and document analysis can provide valuable insights into the challenges and opportunities in supply chain management, they may not always provide a complete picture of the supply chain process. By monitoring operations, researchers can gain a better understanding of the day-to-day activities and processes that occur in the supply chain, which can provide more detailed and nuanced insights.

However, there are also limitations associated with monitoring operations. For example, the presence of researchers may affect the behavior of the participants and the accuracy of the data collected. Additionally, it may not always be feasible to monitor all aspects of the supply chain, as some processes may be confidential or sensitive.

Therefore, while monitoring operations can be a valuable addition to the research methodology, it is important to consider the potential limitations and challenges associated with this approach and to determine the most appropriate approach for the specific research question and context.

4. Research Findings and Discussion

4.1. Information sharing methods in the case company

The purpose of this analysis is to explore the perspectives of five potential interviewees on the topics of technology investment, employee training, communication channels, and data validation in the context of supply chain management. The interviewees included a sales manager, warehousing manager, customer relations manager, CFO, and VP of logistics, all of whom work for a company that currently utilizes EDI, TMS, and ERP technologies and is in the process of implementing a WMS for their warehouses.

4.1.1. Technology

Regarding the aspect of technology investment, it is noteworthy that the VP of logistics emphasized the importance of staying ahead of the competition by constantly looking for new technologies. This suggests that the company is proactive in its approach to technology adoption and recognizes the potential benefits it can bring to supply chain performance. However, the CFO also highlighted the importance of ROI, indicating that the company is mindful of the financial implications of technology investments. The sales manager's concerns about cost and training requirements highlight the need for a comprehensive cost-benefit analysis and adequate employee training before investing in new technologies.

Employee training emerged as a key theme in the interview responses, with all interviewees highlighting its importance in dealing with supply chain issues. The warehousing manager stressed the need for ongoing training to keep up with changing technologies and customer requirements, while the customer relations manager emphasized the importance of soft skills training for effective collaboration with supply chain partners. The VP of logistics mentioned that their company has a formal training program that covers topics such as safety, compliance, and technology. This highlights the need for a holistic training approach that covers both technical and soft skills.

Communication channels for secure communication with supply chain partners elicited varied perspectives from the interviewees. While the sales manager highlighted the use of email and phone calls, the customer relations manager mentioned the use of online portals and messaging apps. The VP of logistics highlighted the use of EDI and TMS. This suggests that the company should evaluate its current communication channels and consider adopting more secure and efficient communication technologies to protect sensitive information.

All interviewees emphasized the importance of data validation for accurate and reliable supply chain management. The customer relations manager highlighted the use of data analytics tools to identify patterns and trends in customer data. The CFO emphasized the need for regular audits to ensure compliance with regulations. This highlights the need for a comprehensive data management strategy that includes automated data collection, data analytics, and regular audits to ensure data accuracy and regulatory compliance.

Table 8. Methods used in the case company to overcome technology barriers (prepared by author)

Interviewee Response	Potential Barrier	Do methods established in the company prevents from potential barriers?
"We recognize the importance of data security in our supply chain. We have to make sure to protect sensitive information such as customer data and intellectual property." - VP of Logistics "We use data analytics tools to identify patterns and trends in customer data, but we also make sure to comply with data privacy regulations and protect our customers' information." – Customer relations manager	Data Security	Missing clarity on how the actual data is secured, are there any protocols established in the current process of information sharing.
"We work closely with our partners to establish common standards and ensure that everyone is aligned towards the same goals." - Sales Manager "We constantly review our processes and work instructions to ensure that everyone is following the same processes and that our operations are running smoothly." – Warehousing manager	Lack of Standardization	Internal standardization barriers are prevented with the use of constant employee training, but external standardization barriers are still a common problem as other supply chain members have not adopted the required technologies.
"We use EDI and TMS to integrate with our partners' systems and ensure that everyone is on the same page." - VP of Logistics "We have invested in technologies such as TMS and WMS to integrate with our partners' systems and improve our operations." - CFO	Lack of Integration	Internal standardization barriers are prevented with the use of constant employee training and investigation of new technologies, but external standardization barriers are still a common problem as other supply chain members have not adapted the required technologies.
"We use data analytics tools to identify trends and patterns in our data, but we also make sure to validate our data and conduct regular audits to ensure accuracy and compliance with regulations." - Customer Relations Manager "We make sure to collect data at every stage of our processes." – Warehousing manager	Data Quality	The barrier is partially prevented, the only issue identified is in warehousing operations, where there is no clarity about sharing this information with other supply chain members, only the collection of data.

Based on the insights provided by the interviewees, it is recommended that the company continue to invest in new technologies (blockchain, Internet of Things, Artificial Intelligence) to stay competitive while ensuring that there is a clear business case and adequate training for employees. Soft skills training should also be emphasized to promote effective collaboration with supply chain partners. The company should consider implementing more secure communication channels, such as blockchain technology, and regularly validate their data using automated tools and audits. The most

critical identified challenge is sharing data related to warehouse operations. There is no clarity about this, the only thing mentioned is the collection of data at every stage. As of now all data collected is stored in MS Excel, the possible data inaccuracy is overwhelming. Overall, if the company could establish data security protocols together with the implementation of WMS the potential information sharing barriers would be overcome.

4.1.2. Collaboration

In terms of transparency in communication practices, the interviewees expressed that the company strives to maintain open and honest communication with its supply chain partners. They noted that regular communication is essential in building strong relationships with partners and ensuring that everyone is aligned toward common goals. For example, the sales manager mentioned that they hold regular meetings with their partners to discuss sales forecasts and any issues that may arise, and the VP of logistics mentioned that they use real-time tracking and reporting to keep partners informed on shipment statuses.

According to the interviewees, the company does share some information with its partners, such as available schedules and shipment details. This information sharing allows the partners to plan their operations accordingly and ensure that the products are delivered on time. However, it is important to note that the company does not share warehousing data with its supply chain partners. Warehousing data refers to information related to inventory levels, storage capacity, and other details about the company's warehouse operations. This data is critical for supply chain partners to plan their operations effectively and ensure that they have sufficient inventory to meet demand. The fact that the company does not share this data with its partners may lead to inefficiencies in the supply chain and potentially result in stockouts or excess inventory.

To align goals with supply chain partners, the interviewees noted that the company sets clear objectives and regularly communicates them to partners. They also emphasized the importance of having a shared understanding of key performance indicators (KPIs) and regularly tracking progress toward these goals. The CFO noted that they use data analytics to measure performance and identify areas for improvement, which helps to ensure that everyone is working towards common objectives.

Table 9. Methods used in the case company to overcome collaboration barriers (prepared by author)

Interviewee Response	**Potential Barrier**	**Do methods established in the company prevents from potential barriers?**
"We work hard to build relationships with our partners based on trust and respect. We try to be as transparent as possible in our communication with them." - Sales Manager "We have built a strong reputation in the industry for being reliable and honest in our dealings with our largest partners. This helps to build trust over time." - VP of Logistics	Lack of trust	Interviewees mentioned that trust built is with their largest partners, but the company does not have built trust with other smaller partners (e.g., from the spot market).
"We make sure that our partners are aware of our expectations and give them the freedom to find the best way to meet those expectations." - VP of logistics	Fear of losing control	Barrier potentially prevented.

Interviewee Response	Potential Barrier	Do methods established in the company prevents from potential barriers?
"We see our partners as an extension of our team, and we work closely with them to ensure that we are all aligned towards common goals." - CFO		
"We make sure that we are not sharing any sensitive information that could give our partners a competitive advantage. At the same time, we share enough information to build trust and improve efficiency." - Sales Manager "We are always mindful of the competitive landscape, but we believe that transparency with our partners ultimately benefits everyone in the supply chain." – Warehousing manager	Competitive concerns	There is not enough information about secure channels where information is shared and the information that might be used for competitive concerns is not fully secured.
"We make sure that we are sharing information that is relevant to our partners and their needs. We also take steps to protect sensitive information." - VP of Logistics "We work hard to maintain open lines of communication with our partners, so they feel comfortable coming to us with any questions or concerns." - CFO	Information asymmetry	Company shares information with their partners, but there is no evidence that the company receives the same information back, which creates information asymmetry.
"We set clear objectives and communicate them to our partners regularly. We also track progress towards those goals and make adjustments as needed." – CFO "We work with our partners to make sure that our goals are aligned. If we have different goals, we try to find ways to reconcile them." – Customer relations manager	Misalignment of goals	Barrier potentially prevented.
"We make sure that we are committed to our partners and that they are committed to us. We try to build long-term relationships based on mutual trust and respect." - Sales Manager "We are committed to our partners and strive to build relationships that are based on open and honest communication." – Customer relations manager	Lack of commitment	Lack of evidence that partners are committed to a continued relationship with the case company.

Based on these findings, it is recommended that the company continue to prioritize communication and collaboration with its supply chain partners. This could include exploring additional communication channels and technologies that could further improve transparency and efficiency in the supply chain. Additionally, the company may want to consider establishing a CPFR model with its partners to further improve forecasting accuracy and reduce lead times. Finally, it is important that the company maintains a focus on data accuracy and reliability, particularly as it continues to implement new technologies and systems, as well as prepares a roadmap for WMS implementation and sharing inventory data with other partners.

4.1.3. Competency

Based on the previous discussions, the company invests in employee training programs to ensure that they have the necessary skills and knowledge to effectively deal with supply chain issues. However, it is also important to provide training and support to supply chain partners to ensure that they can effectively collaborate and align with the company's goals.

Interviewees have not mentioned any specific methods, how they provide training and support for their partners as there are none currently established. Without proper training, partners may not fully understand the company's processes, requirements, or expectations, which could result in mistakes or delays in the supply chain. This, in turn, could lead to customer dissatisfaction or lost sales.

In terms of sharing knowledge with supply chain partners, the Customer Relations Manager mentioned that the company shares market insights, customer feedback, and demand forecasts with its suppliers to enable them to better plan their production and inventory levels. It was expressed that some of the company's employees regularly attend American Chamber of Commerce conferences and share main insights with their bigger partners. The CFO emphasized the importance of sharing financial performance data with key suppliers to help them understand the financial impact of their decisions and actions.

To encourage collaboration and cooperation, the interviewees highlighted the importance of clearly communicating the potential benefits of collaboration to supply chain partners. The VP of Logistics mentioned that the company has established performance metrics and KPIs for supply chain partners and shares these metrics regularly to help them understand the benefits of collaboration. The Customer Relations Manager also highlighted the importance of developing long-term relationships with supply chain partners based on trust and mutual benefits.

Table 10. Methods used in the case company to overcome competency barriers (prepared by author)

Interviewee Response	**Potential Barrier**	**Do methods established in the company prevents from potential barriers?**
"The company provides training to its logistics partners on new warehouse management systems and technologies to ensure further collaboration." - Warehousing Manager	Lack of expertise	This could be a short-term barrier until the new WMS system is fully implemented.
"To encourage collaboration and cooperation, we highlight the importance of clearly communicating the potential benefits of collaboration to supply chain partners." - VP of Logistics	Resistance to change	Even if information about collaboration is presented and shared with partners, there might be more criteria from the partner's perspective, for example, trust.

Based on the above analysis, the company should consider establishing more comprehensive training and development programs for supply chain partners to help them align with the company's goals and improve overall performance. The company should also consider implementing a knowledge-sharing platform to enable easy and secure sharing of data and insights with supply chain partners. Additionally, the company should continue to communicate the benefits of collaboration and establish performance metrics to measure and track the impact of collaborative efforts.

4.2. Barriers in the case company's information sharing process

This chapter provides information collected from interviewees regarding barriers to information sharing as well as the company's readiness to overcome them.

4.2.1. Technology

Regarding data security, the interviewees discussed various measures that the company is considering taking to protect sensitive information within its supply chain. For example, the CFO emphasized the importance of establishing clear policies and guidelines for data protection, and providing regular training to employees to ensure they are aware of best practices for data security, but confirmed that yet, there are no clear data security policies in the company and that other supply partners mentioned that data security is crucial for them.

Concerns around lack of standardization within the supply chain can also present significant barriers to effective collaboration and performance. The customer relations manager highlighted the importance of having clear communication channels and expectations with suppliers, to ensure that everyone is working towards common goals. The sales manager mentioned that they conduct regular performance reviews with suppliers to ensure that they are meeting quality standards and expectations. These examples show that the company takes a multi-faceted approach to ensuring consistency and standardization within the supply chain.

Integration of data from various sources within the supply chain is critical to achieving effective performance. The interviewees provided various examples of how the company integrates data from multiple sources. The CFO stated that they use a centralized data repository to store and manage data from different systems. The customer relations manager highlighted the importance of using data analytics to gain insights into supply chain performance, and that the company has invested in software to facilitate this process.

Finally, ensuring data quality is critical to the success of the supply chain. The interviewees provided several examples of how the company ensures data quality. The VP of logistics mentioned that they have established clear data entry standards and provide regular training to employees to ensure that data is entered accurately. The CFO stated that they use automated tools to identify and correct data errors and that they conduct regular data audits to ensure that information is up-to-date and accurate. These examples demonstrate that the company takes a proactive approach to data quality, which is essential for effective performance.

Table 11. The case company's readiness to overcome technology barriers (prepared by author)

Barriers	Identified methods in case company to overcome barriers discussed in previous chapter	Company's readiness to overcome barriers
Data Security	Establish clear policies and guidelines for data protection; provide regular training to employees; take a proactive approach to data security	Discussed, but not fully implemented. Partially ready.
Lack of Standardization	Establish clear communication channels and expectations with partners; conduct regular performance reviews with partners	Only internal standardization is fully addressed, there are still common issues with external

Barriers	Identified methods in case company to overcome barriers discussed in previous chapter	Company's readiness to overcome barriers
Lack of Integration	Use a centralized data repository to store and manage data from different systems; invest in software to facilitate data analytics	Only internal standardization is fully addressed, there are still common issues with external
Data Quality	Establish clear data entry standards; provide regular training to employees; use automated tools to identify and correct data errors	The company is ready to overcome

Based on the information provided earlier in this conversation, the company is already taking significant steps to address the challenges of data security, lack of standardization, data integration, and data quality within its supply chain. However, there are additional steps that the company could take to further improve performance. For example, the company could explore opportunities to collaborate more closely with suppliers to standardize processes and improve data quality. Additionally, the company could invest in additional software and tools to facilitate data integration and analysis, such as blockchain technology, which could enhance data security and transparency.

4.2.2. Collaboration

To build trust with supply chain partners, the interviewees emphasized the importance of open and transparent communication. The customer relations manager stated that they establish clear expectations with suppliers and communicate regularly to ensure that everyone is on the same page. The sales manager noted that they focus on building long-term relationships with shippers, rather than just short-term transactions.

Maintaining control within the supply chain is critical to ensuring effective performance. The interviewees provided several examples of how the company maintains control. The VP of logistics stated that they use a centralized system (ERP) to manage and monitor all supply chain activities, which helps to ensure that everything is running smoothly. The sales manager mentioned that they have clear contracts and agreements with partners, which help to establish expectations and boundaries. The CFO noted that they use data analytics to identify potential issues before they become problems, which helps to maintain control over the supply chain.

Competition within the supply chain can present significant challenges to collaboration and cooperation. The interviewees provided several examples of how the company addresses these challenges. The warehousing manager stated that they work closely with suppliers to ensure that everyone is working towards common goals. The customer relations manager noted that they encourage suppliers to collaborate with each other, rather than just competing. The sales manager mentioned that they have clear policies and guidelines for managing conflicts of interest within the supply chain.

Information asymmetry within the supply chain can also present significant challenges to effective collaboration. From the interviews, it is not clear that the company receives the same information quality and quantity of information that they share with supply chain partners. The biggest challenge of information asymmetry is that it can lead to incorrect or incomplete decision-making as well as from the company’s forecasts it is already seen that information asymmetry exists.

Alignment of goals within the supply chain is critical to achieving effective performance. The interviewees provided several examples of how the company ensures goal alignment. The VP of logistics stated that they establish clear performance metrics and communicate them to all supply chain partners, which helps to ensure that everyone is working towards common goals. The sales manager noted that they have clear expectations for suppliers and work closely with them to ensure that their goals align with those of the company. The CFO mentioned that they conduct regular performance reviews with suppliers to ensure that they are meeting quality standards and expectations.

Finally, ensuring commitment within the supply chain is critical to achieving effective performance. The customer relations manager noted that they work closely with suppliers to ensure that they are committed to meeting the needs of the company. The sales manager mentioned that they provide incentives to suppliers for meeting performance metrics, which helps to ensure their commitment to the success of the supply chain.

Table 12. The case company's readiness to overcome collaboration barriers (prepared by author)

Barriers	**Identified methods in case company to overcome barriers discussed in previous chapter**	**Company's readiness to overcome barriers**
Lack of trust	Soft skills training; secure communication channels;	Partially ready and implemented, but not established with smaller supply chain partners
Fear of losing control	Clear contracts; regular performance reviews;	Ready to overcome
Competitive concerns	Clear communication channels; regular site visits and meetings; performance metrics;	Not enough information about secure channels to secure competitive information
Information asymmetry	Clear data entry standards; centralized data repository; data analytics;	Not confirmed if the company receives the same information load back from other partners
Misalignment of goals	Clear communication channels; performance metrics;	Ready to overcome
Lack of commitment	Clear contracts; regular performance reviews;	Not confirmed if other partners are committed to continuing relationship

It is recommended that the company should do the following:

- Develop shared goals and values: To build commitment, it's important to establish shared goals and values that everyone in the supply chain can work towards. The company could work with its supply chain partners to establish common objectives and values that align with their respective goals.
- Establish clear performance metrics: Clear and objective performance metrics can help to ensure that everyone in the supply chain is working towards the same goals. The company could work with its supply chain partners to develop clear and measurable performance metrics that align with their shared goals.
- Foster a collaborative culture: The company could promote a collaborative culture within the supply chain by encouraging partners to work together and share knowledge and best

practices. This could include facilitating joint training sessions, workshops, or other collaborative activities.

4.2.3. Competency

Based on the responses of the five respondents, there seems to be a lack of strategy in addressing cultural differences within the supply chain. Three respondents mentioned that they try to understand the cultural differences and work towards finding common ground, but none of them provided specific steps on how they do this. One respondent acknowledged the importance of diversity and inclusion in their supply chain but did not elaborate on the steps taken to ensure this.

All five respondents acknowledged the importance of having the necessary knowledge and skills within the supply chain. Three respondents mentioned the use of training programs and workshops to address the lack of expertise. One respondent mentioned having a mentorship program to transfer knowledge and skills. Another respondent mentioned having a system to identify gaps in skills and knowledge and addressing them through training.

All five respondents acknowledged the presence of resistance to change within their supply chain. Three respondents mentioned the importance of involving employees in the change process, such as providing training and support. One respondent mentioned the importance of communicating the benefits of the change to employees. Another respondent mentioned the importance of providing incentives for employees to support the change.

Table 13. The case company's readiness to overcome competency barriers (prepared by author)

Barriers	Identified methods in case company to overcome barriers discussed in previous chapter	Company's readiness to overcome barriers
Cultural differences	Understand cultural differences and find common ground	No actual strategies how to overcome this barrier.
Lack of expertise	Training programs, workshops, mentorship programs	The company is ready to overcome potential barriers
Resistance to change	Involve employees in the change process, communicate benefits, and provide incentives	Fully prepared to overcome internal barriers, but potential issues with external partners.

To address cultural differences within the supply chain, it is recommended to develop a strategy that acknowledges and respects cultural differences. The strategy should include specific steps such as cross-cultural training, appointing cultural ambassadors, and regular communication to understand cultural differences and work towards finding common ground. Additionally, having a diverse and inclusive supply chain can also help in bridging cultural differences.

To address the lack of expertise within the supply chain, it is recommended to have a systematic approach to identifying the necessary knowledge and skills for each role within the supply chain. This can be done by conducting a skills audit. Once the gaps in skills and knowledge have been identified, training programs and workshops can be designed to address them. Mentorship programs can also be implemented to transfer knowledge and skills from experienced employees to new hires.

To address resistance to change within the supply chain, it is recommended to involve supply chain partners in the change process from the start. This can be done by providing training and support to

partners to understand the change and how it will impact their roles. Communication should also be clear and frequent, highlighting the benefits of the change to the partners. Incentives can also be provided to partners to support the change. Additionally, it is important to have a change management plan in place to ensure that changes are implemented smoothly and efficiently across the supply chain.

4.3. Barriers identified in customers contracts

To get a deeper understanding of the company's agreements with customers regarding information sharing, customer contracts were investigated. Agreements that were investigated were signed with domestic customers as the access to international contracts was restricted for a researcher. The following spaces for improvement were identified:

The limited scope of information sharing: The current customer agreement only specifies a limited set of information that will be shared with the customer, such as the shipment's tracking number and delivery status. This may not be sufficient for customers who require more detailed information to manage their supply chain operations effectively. For instance, customers may need to know the carrier's estimated time of arrival (ETA), transit time, and any potential delays or exceptions that may arise during transit. By expanding the scope of information sharing to include such details, the case company can provide more comprehensive and valuable information to its customers.

Lack of clarity around the frequency of information sharing: The current agreement does not provide a clear frequency for information sharing, which can lead to frustration and dissatisfaction among customers who require up-to-date information to manage their operations effectively. Customers may need to know the status of their shipments multiple times a day, or at regular intervals, to ensure that their supply chain operations are running smoothly. By providing more frequent updates, such as every 12 or 24 hours or real-time tracking, the case company can ensure that its customers are always aware of their shipment's progress and are better equipped to manage their operations.

Lack of flexibility in communication methods: The current agreement lacks clarity around the methods of communication used for information sharing. None of the contracts specify the use of EDI, there is no mention of email or phone updates, which may be preferred sometimes. This lack of flexibility can be a hindrance to supply chain partners who prefer different modes of communication. By offering multiple methods of communication, such as email, phone, and online tracking, real-time tracking, and allowing the customer to choose their preferred mode of communication, the case company can better meet the needs and preferences of its customers.

Lack of clarity around data privacy and security: The current agreement mentions confidentiality and compliance with relevant laws and regulations, but there are no specific details provided. This can lead to uncertainty among customers about how their data is being handled and can undermine their trust in the company. Customers need to know that their sensitive information is being handled securely and in compliance with relevant laws and regulations. By including a data privacy and security policy that outlines its commitment to protecting customer information and compliance with relevant laws and regulations, the case company can provide greater transparency and assurance to its customers.

Current case company's and customer agreements have several problematic aspects regarding their information sharing policies. The limited scope of information sharing, lack of clarity around the

frequency of information sharing, inflexible communication methods, and lack of clarity around data privacy and security can lead to frustration, dissatisfaction, and uncertainty among customers. To address these issues, the case company can expand the scope of information sharing to include additional details, provide more frequent updates, offer multiple communication methods, and include a data privacy and security policy in their customer agreement. These improvements can enhance transparency, improve customer relationships, and demonstrate the case company's commitment to data privacy and security, positioning them as a reliable and trustworthy carrier and logistics company in the eyes of their customers.

4.4. Identified challenges in case company information sharing processes

The research results show that information sharing challenges are still common in the case company. The table below highlights the challenges that businesses face in managing their supply chain operations.

Table 14. Information sharing barriers identified in the case company

Challenge	Identified in	Internal or External	Waste
Data security	Interview	Internal & External	Potential data leak; Increased costs; Competitive concerns;
Lack of standardization	Interview	External	Extended process times; Increased costs;
Lack of integration	Interview	External	Extended process times;
Lack of trust	Interview	External	Decreased collaboration opportunities;
Information asymmetry	Interview & Document analysis	External	Decreased forecasting accuracy; Decreased collaboration opportunities; Decreased planning capabilities;
Cultural differences	Interview	Internal & External	Decreased collaboration opportunities;
Resistance to change	Interview	External	Decreased collaboration opportunities; Decreased service quality;

Potential data leaks can create waste in a number of ways within supply chain partnerships. Firstly, there is the direct cost of any data breaches, which can include fines, legal fees, and remediation costs. Secondly, there is reputational damage that can occur when customers and partners lose trust in the company's ability to protect their sensitive data. This can result in lost business, decreased collaboration, and a damaged brand image. Thirdly, data leaks can lead to intellectual property theft, which can result in lost competitive advantage and decreased innovation. Finally, the most important and the one already identified in the case company is decreased collaboration with supply chain partners. If there is no clarity on how the company secures other supply chain partners' data, the company is not trustworthy to collaborate with.

Increased costs are another form of waste that impacts supply chain performance. Increased costs result from inefficient processes or poor decisions, leading to reduced profitability and overall supply chain performance. In the case company, the remaining barriers that prevent information sharing lead to increased costs, for example, due to missed appointment times as data is not standardized and leads

to prohibited integration. Another example is the company's inventory management, which is usually understocked or overstocked.

Competitive concerns can create waste in the form of missed opportunities for collaboration and sharing of information, as supply chain partners may be hesitant to share sensitive information that could give a competitive advantage to their rivals. Since the case company does not have established clear collaboration contracts with partners, this can lead to inefficiencies in the supply chain, such as duplication of efforts or missed opportunities for cost savings. It can also lead to strained relationships between partners and a lack of trust, as partners may feel that their interests are not being fully considered or that the other party is not fully committed to the partnership. In extreme cases, it could even lead to the breakdown of the partnership and the loss of potential business opportunities.

Extended process times can create waste in several ways. Four main issues were identified in the case company during research. Firstly, it leads to inconsistent appointment times, resulting in longer wait times for customers and decreased customer satisfaction. Secondly, it causes delays in decision-making, leading to missed opportunities or suboptimal decisions. Thirdly, it results in increased inventory levels, tying up capital and potentially leading to excess and obsolete inventory. Fourthly, it leads to increased transportation costs as more shipments are required to make up for longer lead times.

Decreased collaboration opportunities in supply chains can lead to various wastes, including miscommunication, decreased efficiency, delayed decision-making, and increased costs. In the case company, miscommunication leads to errors and misunderstandings, which can cause delays in the supply chain. Decreased efficiency leads to increased lead times, decreased productivity, and increased costs. Delayed decision-making causes missed opportunities and a lack of agility in responding to changes in the market. Overall, decreased collaboration opportunities can significantly impact the performance of a supply chain and lead to a variety of waste.

Decreased forecasting accuracy can lead to several wastes in the supply chain. In the case company, the waste created by inaccurate forecasting was identified at the start of the research, where the company's forecasted sales were 32% of the actuals. Additionally, decreased forecasting accuracy results in inefficient transportation and logistics planning, leading to increased transportation costs, longer lead times, and lower agility in responding to changes in demand.

Decreased planning capabilities can result in various forms of waste in the supply chain. For example, in the case company, poor planning results in longer lead times and delays in delivery, which can cause frustration for customers and negatively impact customer satisfaction. This also leads to additional costs, such as rush orders or expedited shipping fees to meet customer demands. Moreover, decreased planning capabilities can limit the ability to identify potential issues and opportunities, resulting in missed opportunities for process improvement and increased efficiency. Overall, decreased planning capabilities can lead to waste in the form of excess inventory, longer lead times, reduced customer satisfaction, and missed opportunities for process improvement.

The waste created by **decreased service quality** can include customer dissatisfaction, increased returns or rework, and potential loss of future business. It can also lead to increased costs associated with addressing customer complaints and repairing or replacing products. Additionally, decreased service quality can harm the reputation of the company and its brand, leading to a negative impact on long-term profitability.

In conclusion, waste in the company's supply chain can take many forms. These forms of waste can negatively impact supply chain performance, preventing improvement and reducing profitability. To improve supply chain performance, organizations must identify and address sources of waste, optimize processes, and make informed decisions based on accurate data.

4.5. Guidelines and recommendations for the improved supply chain performance in the case company

Interviews and self-completed questionnaires show that there is space for improvement in the case company regarding information sharing, and this can be separated into two stages: 1. Internal processes review 2. Collaboration with supply chain partners.

Internal processes:

Data security: Establishing data security protocols is an essential step for any company to protect its sensitive data from unauthorized access, theft, or damage. Below are the guidelines that should help the company to establish data security:

1. Identify the sensitive data: It is recommended that the data which is the most sensitive would be concerned first. This may include customer data, financial data, supplier data, and other critical information, but at any point, all company data should be secured from any potential breaches.
2. Develop security policies: Based on the risks identified, company should develop comprehensive security policies that define the procedures and protocols for handling sensitive data. Since the case company has already established Electronic Data Interchange (EDI), the EDI provider could guide the company on what security measures they should consider and implement.
3. Train employees: It is important to provide training to employees on security policies and procedures. Employees should understand the importance of data security and their role in protecting sensitive data. Since there were no identified problems with employee training, the company should easily overcome this step.
4. Implement access controls: Implement access controls to ensure that only authorized personnel have access to sensitive data. This may include user authentication, password policies, and access restrictions based on job roles.
5. Use encryption: Use encryption to protect sensitive data in transit and at rest. This can help prevent unauthorized access and data theft.
6. Backup and disaster recovery: Implement backup and disaster recovery procedures to ensure that data can be recovered in case of a data breach or other disaster.
7. Regularly monitor and test: Regularly monitor and test the security protocols to ensure that they are working as intended. This may include penetration testing, vulnerability assessments, and security audits.

Forecasting process: Improving forecasting processes is essential for any company to optimize its operations and reduce costs. Below are guidelines on how to increase forecasting accuracy and the overall forecasting process:

1. Collect external data: The current company's forecast process is based on historical data plus extra additional plans for growth. In addition to historical data, the company should also collect external data from sources such as the government, industry associations, and

economic reports. This will help understand trends and changes in the market that may impact demand for services.

2. Use advanced analytics: Company uses Enterprise Resource Planning (ERP) which collects and stores information from separately implemented software, but without additional monitoring, it is hard to conclude if the use of analytics tools is efficiently used. In addition, utilize advanced analytics tools such as machine learning algorithms to analyze data and make more accurate predictions.
3. Use scenario planning: Develop scenarios for different outcomes based on the analysis of historical and external data. This can help you prepare for different possible scenarios and make informed decisions based on the likelihood of each scenario.
4. Monitor and adjust forecasts: Case company forecasts on a yearly basis, which is too rarely. It is suggested that the company should continuously monitor forecasting processes and adjust them as needed based on changing market conditions and trends.

In addition to these guidelines, it is important to consider the impact of external factors such as government policies, economic conditions, and other industry trends. By incorporating outside information into forecasting processes, one can make more accurate predictions and adjust operations accordingly. For example, changes in trade policies or tariffs may impact the cost of goods and the demand for certain products. Economic trends such as inflation or recession may also impact the demand for services. By staying informed of these external factors and incorporating them into forecasting processes, one can make more informed decisions and optimize logistics operations.

Warehousing operations: The most relevant issue of information sharing was identified in warehousing operations. Since the company at this moment does not have any except MS Excel and is about to transition to a new Warehouse Management System (WMS), the following guidelines for transition and the possibility increase information sharing are provided:

1. Integrate with supply chain partners: The company should establish processes for sharing warehousing information with supply chain partners. This may include integrating the WMS with other supply chain systems or using a cloud-based platform that allows partners to access the data they need.
2. Monitor and adjust: Once the WMS is implemented, the company should continuously monitor its performance and adjust processes as needed. This may include analyzing data to identify areas for improvement, such as reducing inventory levels or optimizing order-picking processes.
3. Maintain data accuracy: It is important to ensure data accuracy in the WMS by conducting regular audits and establishing procedures for data entry and verification.

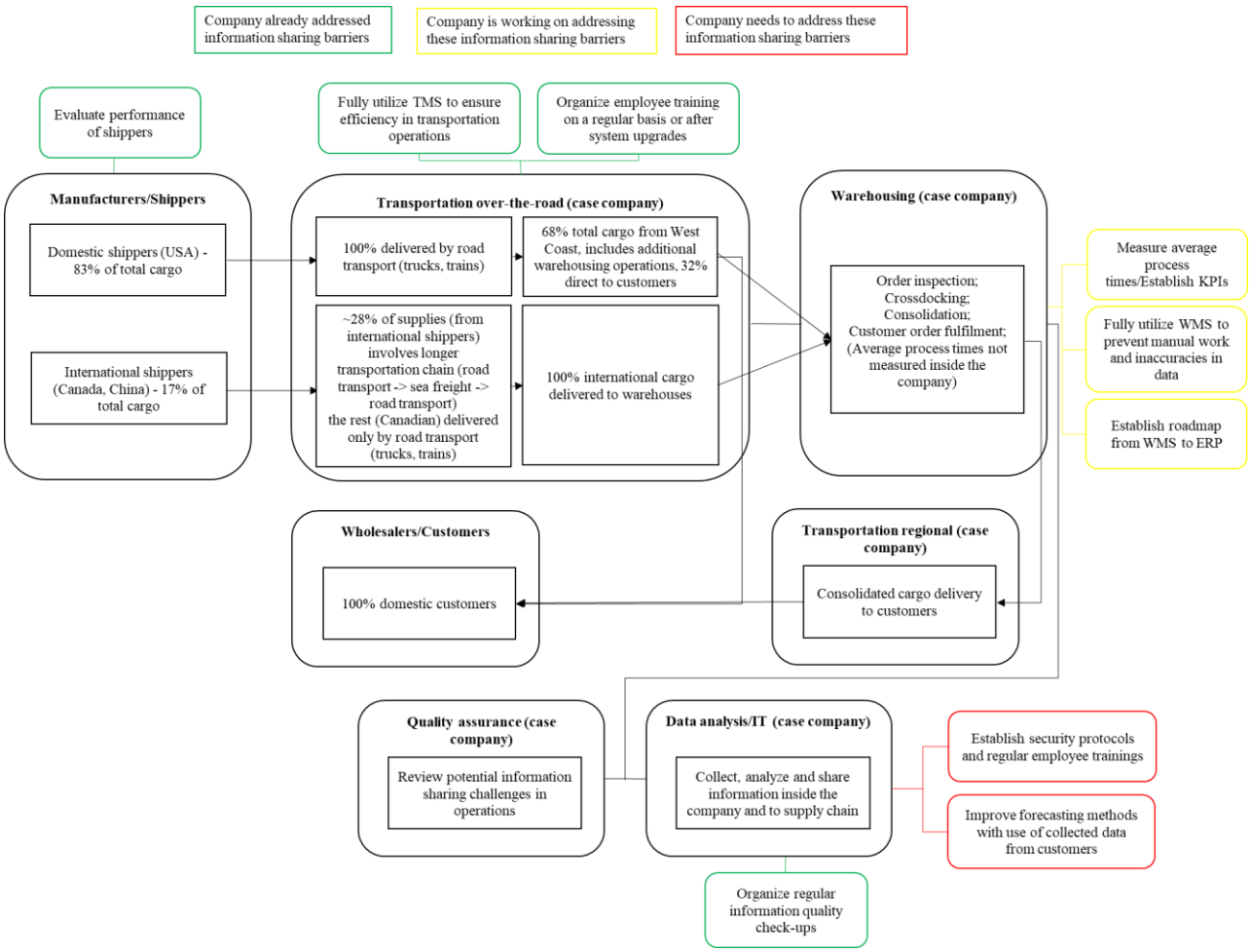

Figure 11. Detailed case company's operations and supply chain with potential areas for internal improvement (prepared by author)

The second step is to establish collaboration with supply chain partners. The following recommendations were made:

Trust and collaboration barriers could be overcome by using CPFR. CPFR is a process that involves sharing information between partners in the supply chain to improve decision-making and reduce inefficiencies. By implementing a CPFR model, the logistics company should improve its communication with shippers and customers. This should also help the logistics company and its partners make more informed decisions about production, inventory management, and transportation. CPFR overall leads to reduced costs, improved customer satisfaction, and increased profitability. CPFR can also be a valuable tool for logistics companies to improve communication and collaboration with their customers. By establishing a CPFR model with customers, logistics companies can better understand their needs and expectations, which can lead to more efficient and effective supply chain operations. Additionally, scheduling regular reviews with customers can help identify areas for improvement and enable the logistics company to make data-driven decisions to enhance its operations.

Standardizing and integrating data with supply chain partners is essential for a logistics company to achieve operational efficiency and maximize the potential of its supply chain. Here are some guidelines to help a logistics company standardize and integrate data with its supply chain partners:

1. Define data standards: The logistics company should define data standards to ensure consistency and accuracy in the data exchanged with supply chain partners. This may include data format, terminology, and data fields.
2. Select a data exchange platform: The logistics company should select a data exchange platform that enables seamless data sharing with supply chain partners. This may include cloud-based platforms, electronic data interchange (EDI), or application programming interfaces (APIs). Some of the company's supply chain partners are small companies, that do not have extraordinary technologies implemented and mostly use the basic Microsoft products capabilities to standardize and integrate this type of data provided in spreadsheets also should be considered.
3. Integrate systems: The logistics company should integrate its systems with those of its supply chain partners to enable real-time data exchange. This may include integrating the warehouse management system, transportation management system, and order management system.
4. Implement data validation processes: The logistics company should implement data validation processes to ensure the accuracy and completeness of data exchanged with supply chain partners. This may include automated data validation checks or manual data verification processes. This should also prevent information asymmetry.
5. Provide training and support: The logistics company should provide training and support to supply chain partners on how to use the data exchange platform and any data standards that have been established.
6. Monitor data quality: The logistics company should monitor data quality to ensure that data exchanged with supply chain partners is accurate and up to date. This may include conducting regular data audits or implementing data quality dashboards.

By following these guidelines, a logistics company can standardize and integrate data with its supply chain partners, enabling real-time data exchange and improving overall efficiency and information sharing.

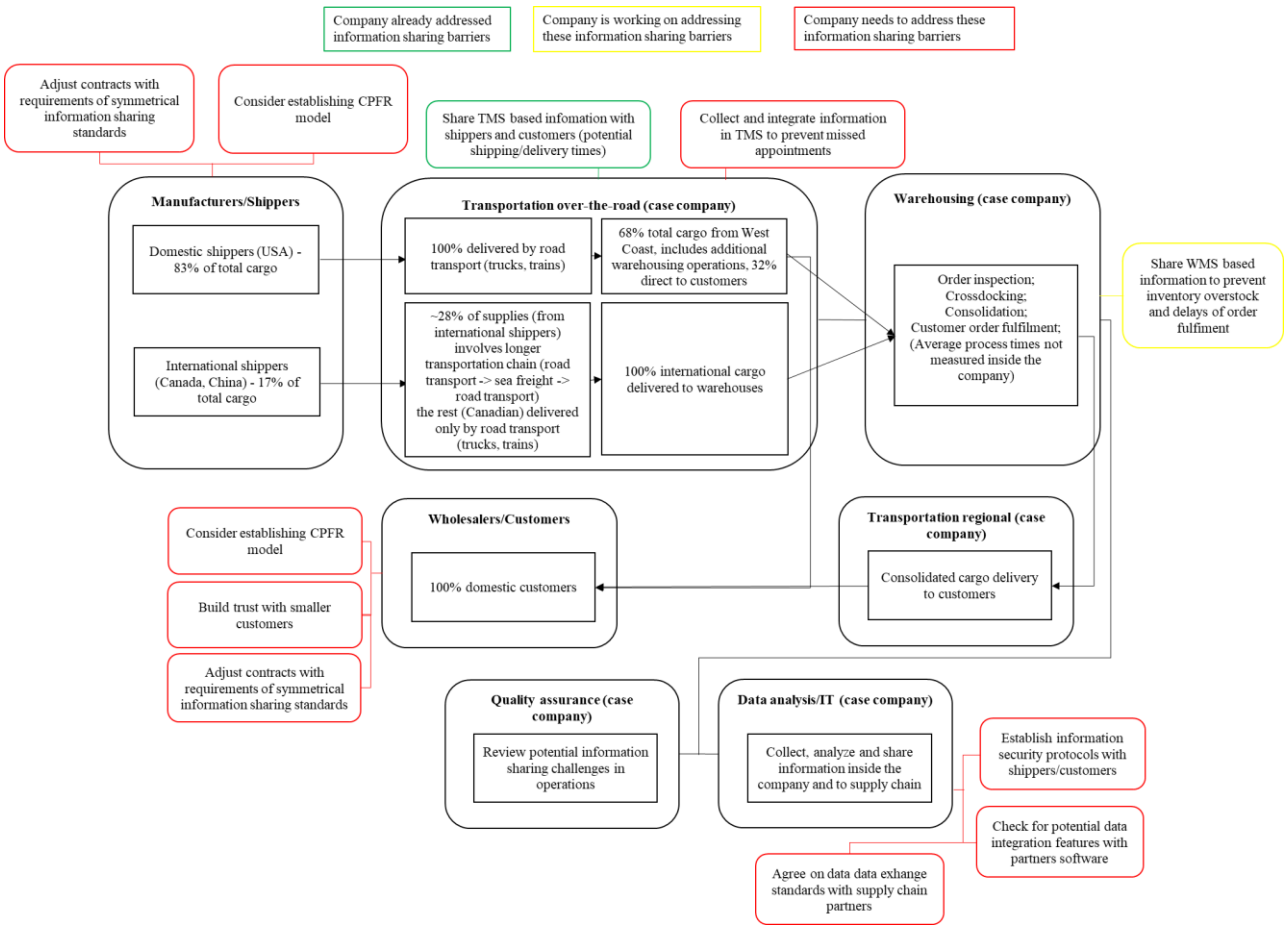

Figure 12. Detailed case company's operations and supply chain with potential areas for external improvement (prepared by author)

By fixing the above-mentioned internal challenges as well as establishing better collaborations with other supply chain partners, the company should expect not only benefits for themselves but also improvement in the whole supply chain's performance:

Enhanced supply chain visibility: Overcoming the above-mentioned barriers should enable case company to gain better visibility into their supply chain operations. Integration of data collected from supply chain partners and collaboration contracts should let to identify potential bottlenecks and make informed decisions to optimize their operations.

Improved collaboration between supply chain partners: Overcoming barriers such as lack of trust should foster greater collaboration and cooperation between supply chain partners. This should lead to better information sharing, more efficient resource allocation, and a shared commitment to achieving common goals.

Increased supply chain agility: Overcoming barriers such as inflexible processes should enable the company to respond more quickly and effectively to changes in demand, supply, and market conditions. This can help them adapt to unexpected disruptions, seize new opportunities, and improve overall operational efficiency.

Efficiency in inventory management: Overcoming barriers such as inaccurate demand forecasting and inadequate inventory tracking should enable the company to optimize its inventory levels and reduce waste. This will lead to lower costs, faster turnaround times, and better customer service.

Enhanced relationship between supply chain partners: Overcoming barriers such as misaligned incentives and conflicting priorities can help foster stronger, more collaborative relationships between the company and its partners. This can lead to better long-term strategic planning, more efficient resource allocation, and a greater ability to respond to changing market conditions.

Better decision-making (strategic, tactical, operational): Overcoming barriers such as inadequate data analysis and lack of cross-functional coordination can enable the company to make better, more informed decisions at all levels of the supply chain. This can lead to improved performance, greater efficiency, and a better ability to anticipate and respond to future challenges.

Increased customer satisfaction: Overcoming barriers such as poor communication and inefficient processes can enable the company to improve the overall customer experience, from order placement to delivery and post-sales support. This can lead to higher levels of customer satisfaction, greater loyalty, and an improved brand reputation.

Conclusions

1. The problem analysis results revealed that the company's forecasted sales and mileage compared to actual sales and mileage vary up to 32% and require more information from other supply chain partners to be collected. Also, understocked/overstocked inventory results in unnecessary costs and decreases customer satisfaction.
2. Analysed theoretical part identifies information sharing barriers and potential overcome, as well as proposes the use of a Collaborative Planning, Forecasting and Replenishment model and the establishment of an Enterprise Resource Planning system to encourage information sharing.
3. 7 barriers that limit information sharing were identified. It can be concluded that the logistics company faces several significant barriers, including data security, lack of standardization, integration, trust, information asymmetry, cultural differences, and resistance to change. These barriers create various wastes, such as potential data leaks, increased costs, competitive concerns, extended process times, decreased collaboration opportunities, decreased forecasting accuracy, decreased planning capabilities, decreased service quality, and decreased collaboration opportunities. Therefore, it is essential for the company to address these barriers to improve its overall efficiency and effectiveness in providing logistics services.
4. The barriers that can hinder supply chain performance in logistics companies include data security, lack of standardization, lack of integration, lack of trust, information asymmetry, cultural differences, and resistance to change. These barriers can cause delays, errors, and increased costs in the supply chain. Overcoming these barriers requires a concerted effort and a commitment to collaboration and transparency among supply chain partners.

   Data security is a major concern in the supply chain, as sensitive data can be compromised during transmission or storage. Therefore, the logistics company needs to prioritize data security by implementing robust cybersecurity measures and data encryption protocols. This will help to protect sensitive information from unauthorized access and reduce the risk of data breaches.

   Lack of standardization can result in inconsistencies and inefficiencies in the supply chain, making it difficult to achieve optimal performance while lack of integration can lead to information silos, resulting in poor visibility and coordination among supply chain partners. To overcome these barriers, the logistics company needs to define its data standards, also consider the possibilities of other supply chain partners, select data exchange platforms, and constant employee training.

   Lack of trust is a common barrier in the supply chain, as partners may be wary of sharing sensitive information or collaborating closely due to concerns about competition or other factors. To build trust among partners, the logistics company should establish clear communication channels, build relationships based on mutual respect and shared goals, and incentivize collaboration through shared risk and reward frameworks.

   Information asymmetry can result in misunderstandings, delays, and suboptimal decisions in the supply chain. To overcome this barrier, the logistics company should revise their contracts with supply chain partners to share and get the required information that could be used for the supply chain decisions, inside the company and overall supply chain.

   In conclusion, overcoming the barriers to supply chain performance in the logistics company requires a holistic approach that prioritizes collaboration and transparency. To achieve this,

the logistics company should focus on identified barriers. By adopting these recommendations, the logistics company can optimize its supply chain performance, reduce costs, and improve overall customer satisfaction.

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