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Invoicing of storage costs for ready-to-deliver goods in case of delayed pick-up from the customer

Encouraging collection of finished goods

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ABSTRACT:
The research investigates the integration of invoicing for storage costs of ready-to-deliver goods when customer pick-up is delayed, focusing on its impact on operational business processes. The theoretical framework is based on contract management theories and supply chain practices while exploring how contracts and invoicing can improve operational efficiency and customer relationships. This integration is seen as a factor in reducing the risks associated with delayed delivery of products.

The objective of the study is to examine the critical factors for successfully integrating storage cost invoicing into business processes and to assess its organizational implications and provide recommendations for middle management. These research questions are intended to increase understanding of the logistical and financial implications of introducing such invoicing methods and to provide the case study company with practical insights to improve its current operations and cost management.

The study uses a simple mixed methods approach, using both qualitative and quantitative methods to investigate the key factors to consider when integrating contract and storage cost invoicing into business operations and the implications of integrating the two for the business process. The qualitative method is implemented in the form of a comprehensive literature review, which provides the framework for the study based on numerous prior and peer-reviewed academic references. The quantitative method studies more the implications for the organization based on order and product data collected over a five-year period from a case company's ERP system. The compiled database consists just under a hundred thousand units, which constitutes a representative sample of the population, and is used statistically to analyse the potential impact that this work can contribute to improving operational performance. The results show that the key factors for contract integration are clear contract guidelines, legality, definition of responsibilities and communication, while the key factors for storage cost invoicing are operational and financial monitoring, resource planning and alignment of responsibilities and consequences. In addition, the implications for business processes show that more than a fifth of the sample is delayed due to customer pick-ups, which is equivalent to almost a quarter of the value of manufacturing production highlighting the importance of this study while providing additional revenue streams.

To address these practical concerns, the study proposes strategies to improve business efficiency and customer responsibility through appropriate invoicing mechanisms. These results contribute to both the academic literature and practical applications by providing a model for improving inventory management, reducing additional costs due to delays, and aligning business processes with contractual responsibilities. The research provides a framework for further improvements in inventory cost management, in particular how organizations balance operational efficiency and customer service.

KEYWORDS: Storage costs, ready-to-deliver, delayed pick-up, contract management, storage cost invoicing

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ABSTRAKTI:
Tutkimuksessa tutkitaan toimitusvalmiiden tavaroiden varastointikustannusten laskutuksen integrointia, kun asiakkaan nouto viivästyy, ja keskitytään sen vaikutukseen liiketoimintaprosesseihin. Teoreettinen viitekehys perustuu sopimusten hallinnan teorioihin ja toimitusketjun käytäntöihin, ja samalla tutkitaan, miten sopimukset ja laskutus voivat parantaa toiminnan tehokkuutta ja asiakassuhteita. Tätä integrointia pidetään tekijänä, joka vähentää tuotteiden viivästyneeseen toimitukseen liittyviä riskejä.

Tutkimuksen tavoitteena on tarkastella kriittisiä tekijöitä, jotka liittyvät varastointikustannusten laskutuksen onnistuneeseen integrointiin liiketoimintaprosesseihin, ja arvioida sen organisatorisia vaikutuksia ja antaa suosituksia keskijohdolle. Näiden tutkimuskysymysten tarkoituksena on lisätä ymmärrystä tällaisten laskutusmenetelmien käyttöönoton logistisista ja taloudellisista vaikutuksista ja antaa case-yritykselle käytännön näkemyksiä sen nykyisten toimintojen ja kustannustenhallinnan parantamiseksi.

Tutkimuksessa käytetään yksinkertaista sekamenetelmää, jossa käytetään sekä kvalitatiivisia että kvantitatiivisia menetelmiä tutkimaan keskeisiä tekijöitä, jotka on otettava huomioon integroitaessa sopimus- ja varastointikustannusten laskutusta liiketoimintaan, sekä näiden kahden yhdistämisen vaikutuksia liiketoimintaprosessiin. Kvalitatiivinen menetelmä toteutetaan kirjallisuuskatsauksen muodossa, joka muodostaa tutkimuksen kehyksen lukuisille ajankohtaisten ja vertaisarvioitujen akateemisten lähteiden avulla. Kvantitatiivisella menetelmällä tutkitaan enemmän organisaatioon kohdistuvia vaikutuksia, jotka perustuvat case-yrityksen ERP-järjestelmästä viiden vuoden ajalta kerättyihin tilaus- ja tuotetietoihin. Kootussa tietokannassa on muutama vähän alle satatuhatta yksikköä, mikä muodostaa edustavan otoksen perusjoukosta, ja sitä käytetään tilastollisesti analysoimaan mahdollisia vaikutuksia, joita tämä työ voi edistää operatiivisen suorituskyvyn parantamisessa. Tulokset osoittavat, että sopimusten integroinnin avaintekijöitä ovat selkeät sopimusohjeet, laillisuus, vastuiden määrittely ja kommunikointi, kun taas varastointikustannusten laskutuksen avaintekijöitä ovat toiminnallinen ja taloudellinen seuranta, resurssien suunnittelu sekä vastuiden ja seurausten yhdenmukaistaminen. Lisäksi vaikutukset liiketoimintaprosesseihin osoittavat, että yli viidennes otoksesta viivästyy asiakkaiden noutojen vuoksi, mikä vastaa lähes neljäsosaa valmistustuotannon arvosta.

Näiden käytännön ongelmien ratkaisemiseksi tutkimuksessa ehdotetaan strategioita liiketoiminnan tehokkuuden ja asiakkaiden vastuuvelvollisuuden parantamiseksi asianmukaisten laskutusmekanismien avulla. Tulokset edistävät sekä akateemista kirjallisuutta että käytännön sovelluksia tarjoamalla mallin, jolla voidaan parantaa varastonhallintaa, vähentää viivästyksistä aiheutuvia lisäkustannuksia ja sovittaa liiketoimintaprosessit yhteen sopimusvelvoitteiden kanssa. Tutkimus tarjoaa puitteet varastokustannusten hallinnan parantamiselle edelleen, erityisesti sille, miten organisaatiot tasapainottavat toiminnan tehokkuutta ja asiakaspalvelua.

AVAINSANAT: Varastointikustannukset, toimitusvalmius, viivästynyt nouto, sopimusten hallinta, varastointikustannusten laskutus

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Abbreviations

CPT	**Carriage Paid To**
ERP	**Enterprise Resource Planning**
FCA	**Free Carrier**
FOB	**Free on Board**
JIT	**Just-In-Time**
MTO	**Make-to-order**
MTS	**Make-to-stock**
PGI	**Post Goods Issue**
SCM	**Supply Chain Management**

1 Introduction

The timely pick-up of ready-to-deliver goods is crucial for maintaining efficient warehouse operations and minimizing storage costs. In a situation where customers delay their pick-up, businesses often face the challenge of invoicing these additional storage expenses, mainly as there is no system or procedure established for this specific purpose. The prior literature has focused much on inventory models with a penalty cost for delivery lateness and a nonlinear cost model to minimize total inventory operation costs whilst being unable to tackle the issue of late pick-ups on ready-to-delivery goods that are not due to the manufacturer.

In this first part of the study, a general introduction to the topic and research gaps are provided. The introduction is divided into five subsections which, after the background and theoretical framework, present the objectives, questions and limitations of the study. The third subsection provides a general overview of the methodology used in the research, the collection of empirical data and its analysis. The fourth section presents the case company for which this study is being conducted and the last section presents the overall structure of the thesis.

1.1 Background and theoretical framework

In today's global manufacturing and supply chain, Gholami et al. (2023) list that operational efficiency, cost optimization and customer service excellence are increasingly important factors in competitiveness. Manufacturing and distribution companies, according to Hossain et al. (2017), are progressively adopting systematic approaches to inventory management to effectively manage customer demand while minimizing logistics and storage costs. Market trends show an increasing trend on automated, customer-responsible logistics for ready-to-deliver goods and delays in customer pick-up present challenges for suppliers (Miguel et al., 2022; Juan and Li, 2023). Efficient inventory management and timely dispatch of goods are not only to ensure

smooth internal operations but also to maintain competitive cost structures and customer satisfaction.

Storage cost management has its role in manufacturing operations, and Khakdaman et al. (2015) describe that it affects both efficiency and profitability, especially in make-to-stock (MTS) and make-to-order (MTO) production environments. They continue that in MTS environments, where products are manufactured in advance of future demand, efficient storage practices help control inventory levels and inventory holding costs. In MTO environments, where products are manufactured only after receiving customer orders, the focus is on minimizing the storage of finished goods in order to match production with customer requirements (Chen et al., 2014; Dohale et al., 2019). Khakdaman et al. (2015) describe that balancing these approaches requires understanding demand variations, optimizing storage capacity and introducing efficient storage management solutions.

Contract management is part of effective storage cost invoicing management in industry and logistics, as highlighted for instance by Feng et al. (2013) and Aboolian et al. (2021). Feng et al. (2013) provide a further insight while highlighting that it involves establishing, negotiating and executing contract terms that define the responsibilities of both parties for handling goods. Well-structured contracts can mitigate misunderstandings and ensure that all costs associated with storage, including those due to delays or extended storage periods, are clearly identified and agreed upon. Kapsali et al. (2019) discuss that effective contract management provides a framework for dealing with situations such as customer delays where responsibilities and financial implications need to be clearly shared. They continue that contract management supports transparency and accountability in the cost allocation process by defining terms and conditions related to storage fees, penalties and invoicing procedures.

Storage cost invoicing is a supply chain management practice that provides a fair method of charging for the costs associated with the storage of goods. Di Giannatale and

Passarelli (2018) describe it involves charging for storage services when goods are stored for long periods of time. According to Cheng (2010), this practice helps to manage costs and maintain transparency in business relationships. The author continues that by creating a clear framework for dealing with storage costs, it reduces potential misunderstandings between stakeholders. Invoicing storage costs can encourage timely pick-ups and transfer of goods which contributes to overall supply chain efficiency.

The scientific framework of this study focuses on storage cost management in manufacturing, contract management and storage cost invoicing. Bulula et al. (2020) describe that storage cost management focuses on strategies and practices to minimize the costs associated with storage, handling and space utilization of inventory in a manufacturing environment. Through effective storage cost management, manufacturers can reduce overhead costs and improve overall operational efficiency by maintaining optimal inventory levels and managing space effectively (Hoque, 2011). Integrating these practices into contract management, which defines the responsibilities, expectations, and potential consequences for both manufacturers and customers, is essential for establishing clear contractual agreements on storage duration and terms under which additional costs can be applied (Kapsali et al., 2019; Hossain et al., 2017). When invoicing for storage costs, invoicing conditions should be specified in the contracts to ensure that extended storage costs are applied in a fair and transparent manner. By including specific terms for storage costs in contracts, organisations can ensure that customers are aware of their responsibilities regarding timely pick-up and the financial impact of delayed pick-ups (Davis and Vogt, 2019). Brunaud et al., (2018) point out that the use of delivery terms further clarifies these responsibilities by specifying the transfer of risks and costs at different steps in the logistics process. The framework for the research is presented below in figure 1, with storage cost management in manufacturing as a macro factor and contract management and storage cost invoicing as micro factors.

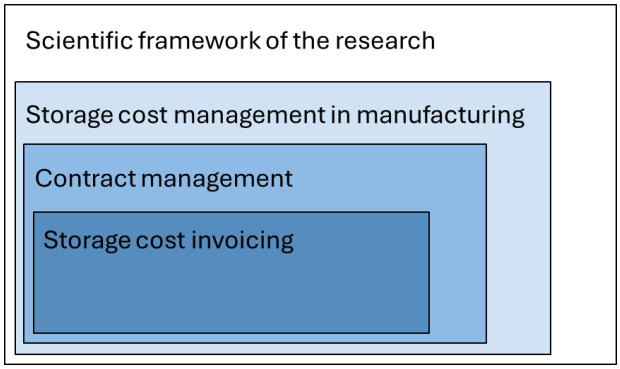

Figure 1. Scientific framework of the research.

The scientific framework of this study builds on recent academic research and professional literature on the topics mentioned above to provide a coherent framework of storage cost invoicing within the context of contract and storage cost management in a manufacturing environment. The main ideas of the applied scientific framework are presented in table 1 below.

Table 1. Main topics of the scientific framework.

Storage cost management in manufacturing
Storage cost management in manufacturing can be described as a method of minimizing the costs associated with storing, handling and optimizing inventory space, which in make-to-stock (MTS) systems, it aims to control inventory levels and storage costs, while in make-to-order (MTO) systems it minimizes storage by closely matching production with customer demand (Khakdaman et al., 2015; Chen et al., 2014; Bulula et al., 2020).
Contract management
Contract management in industry and logistics is the process of defining, negotiating and executing contractual terms that outline the responsibilities of both parties for handling goods and ensure clear accountability for costs, including storage fees, additional costs and invoicing in the event of delays or extended storage periods (Feng et al., 2013; Aboolian et al., 2021; Kapsali et al., 2019; Davis and Vogt, 2019).
Storage cost invoicing
Storage cost invoicing is a process whereby storage services are charged when goods are in storage for extended periods of time, promoting transparency and encouraging timely pick-ups to improve supply chain efficiency (Di Giannatale and Passarelli, 2018; Cheng, 2010; Davis and Vogt, 2019).

This research addresses the research gap in storage cost management by analysing how a streamlined invoicing framework for storage costs and contract management can improve operational efficiency and financial performance in manufacturing company. Feng et al. (2013) identify the lack of scenario-based optimization in MTO supply chains which this study addresses by analysing the cost of delayed pick-up and proposes contract-based strategy to mitigate storage costs. Kapsali et al. (2019) discuss combining contractual conditions for optimal performance which this study explores by matching specific delivery terms with storage cost invoicing to improve on-time pickups. Davis and Vogt (2021) propose further research on the impact of delivery terms on efficiency which this study investigates with data collected under specific delivery terms. Also, this study

provides a framework for inventory cost management that combines operational, financial and contractual considerations, responding to the need identified by Pfaff et al. (2004) to improve the synergy between financial and operational management of the supply chain. This study contributes to a recognised research gap by presenting an empirical analysis on how contractual management could improve organizational processes in an MTO environment. The research gap is visualized in the figure 2 below:

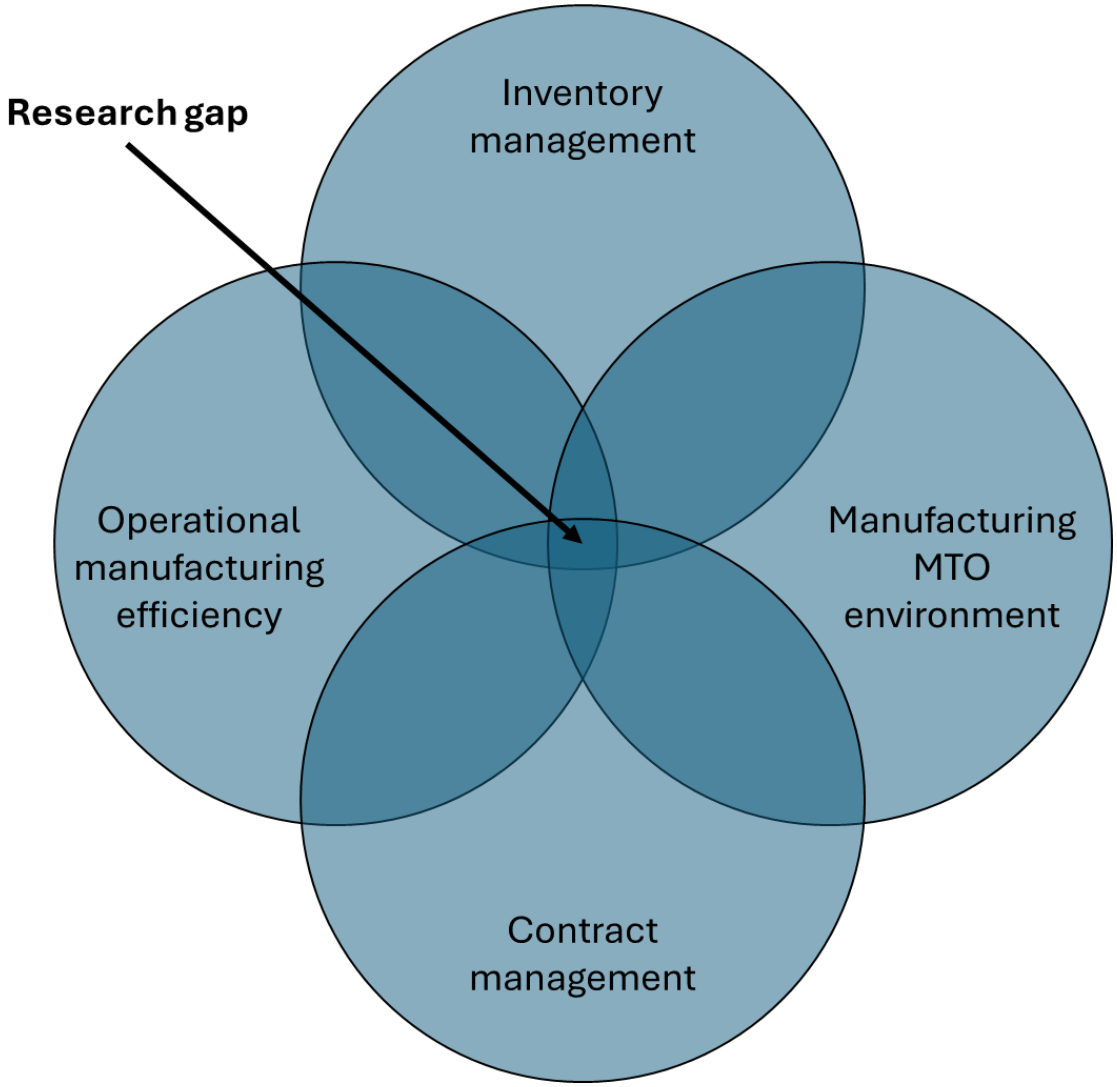

Figure 2. Visualization of the research gap.

1.2 Methodological approach

One of the key frameworks for constructing research methodology is Saunders' research onion, as proposed by Saunders (2023). The author continues that the research onion provides a detailed description of the steps involved in creating an effective research design and guides researchers step-by-step through the different layers that need to be addressed. Starting with the furthest layer and working inwards, the onion helps to structure the whole research process from philosophy to data collection. The Saunder's research onion is shown in the figure 3 below:

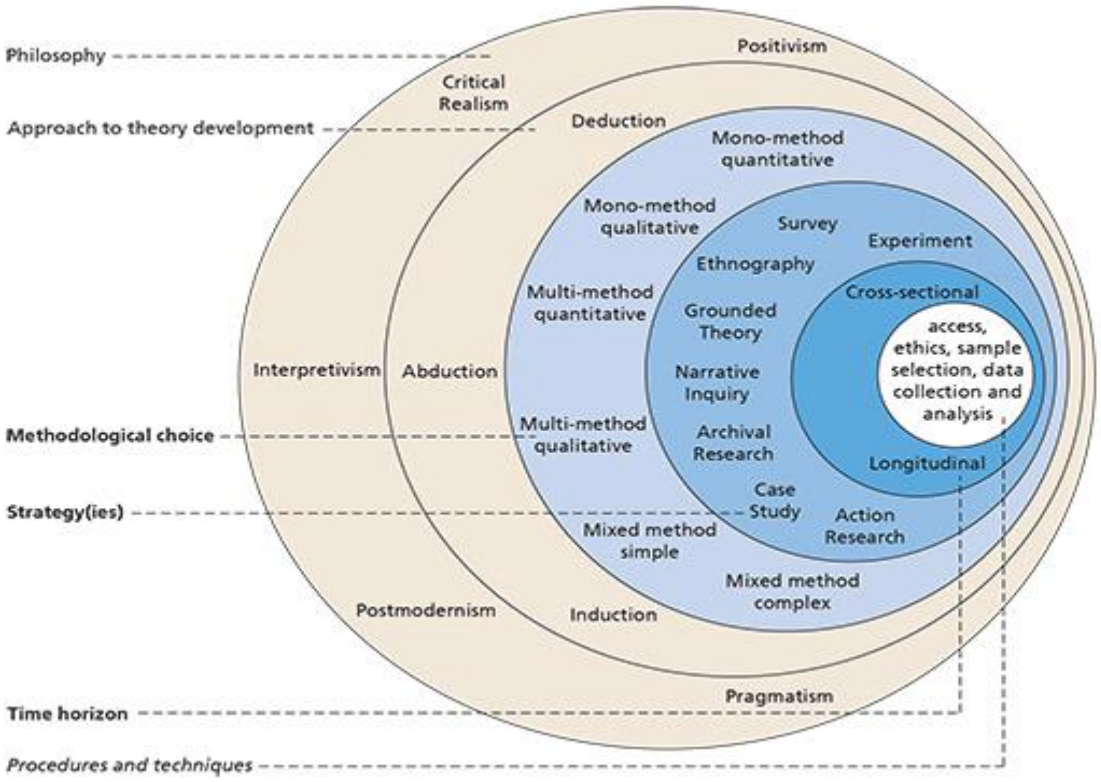

Figure 3. Saunder's research onion (Saunders, 2023).

The research onion comprises six primary layers, as illustrated in figure 3. The outermost layer is the research philosophy, which according to Saunders (2023) forms the foundation of the study by defining the perspective on reality, the sources of knowledge, and the role of values in the research. The author continues that this layer helps

researchers establish their worldview, which influences all decisions later in the research process. Common philosophies include positivism, interpretivism, critical realism, postmodernism and pragmatism. This thesis adopts a pragmatist philosophy, recognising that both qualitative and quantitative approaches can provide valuable insights into research questions.

Next comes the approach to developing the theory, which is influenced by the philosophy chosen. Saunders (2023) list that researchers may use deduction, which starts from existing theories to develop and test hypotheses, induction, which builds theories from observations, or abduction, which moves between induction and deduction to produce the best possible explanation of the observed phenomenon. The author describes the deductive approach as suitable for testing existing theories, while the inductive approach is better suited to developing new theories from data. Induction is often used when an unexpected finding encourages further research. In this study, the abductive approach is used because it allows flexible movement between existing theories and empirical findings which is needed for understanding the complex nature of storage cost invoicing.

The third layer of the Saunders research onion is the methodological choice which determines whether the research will use mono-method quantitative, mono-method qualitative, multi-method quantitative, multi-method qualitative, mixed method simple or mixed method complex. This layer is relevant because it defines the overall research design and how the data will be collected and analysed to answer the research questions. Saunders (2023) describes several types of methodological choices. These include mono-method quantitative or mono-method qualitative, which focuses on a single data collection and analysis approach. Multi-method quantitative or multi-method qualitative combines multiple forms of either quantitative or qualitative methods. Mixed method integrates both quantitative and qualitative techniques. Mixed methods can be further categorized into simple or complex depending on the level of integration between the two approaches. In this study, a simple mixed method is used, combining

both qualitative and quantitative methods to provide a comprehensive understanding of the research problem. The qualitative part includes a literature review to explore contextual factors while the quantitative part includes an empirical data analysis using a case study company's information system. This combination allows for a richer and more sophisticated analysis of the research questions, taking advantage of the strengths of both qualitative and quantitative approaches to improve the reliability and depth of the research findings.

The fourth layer deals with the research strategy, which refers to how data will be gathered and analysed. Strategies may include experiments, surveys, case studies, ethnography, action research, grounded theory, archival research and narrative inquiry. As Saunders (2023) points out, the choice of strategy depends on the research question, objectives and available resources. For example, experiments are often used to explore cause and effect relationships, while case studies provide in-depth insights into specific contexts. The choice of strategy should be in line with the overall methodological approach. This study uses a case study strategy, focusing on a case study company, to provide in-depth insights into the implementation of storage cost invoicing mechanisms.

The next layer addresses time horizons, determining whether the study will be cross-sectional or longitudinal. Saunders (2023) emphasises that a cross-sectional study collects data at a specific point in time, which makes it suitable for studies that aim to obtain a snapshot of a particular occurrence. On the other hand Saunders (2023) continues, a longitudinal study involves collecting data over a longer period of time to identify changes and trends, making it useful for understanding the dynamics of a phenomenon over time. This research uses cross-sectional analysis the data is collected once over the last five years.

The final innermost layer includes techniques and procedures for data collection and analysis. These include selecting sampling methods, designing questionnaires, conducting interviews and analysing the data collected. Saunders (2023) suggests that

the choice of techniques and procedures is influenced by the previous layers of the research design to ensure that data collection is aligned with the research philosophy, approach and strategy. Techniques may include the collection of primary data, such as interviews or surveys, or the analysis of secondary data, such as the review of existing documents or datasets. In this study, data was collected from the information system of a case study company, focusing on actual orders, in order to understand the impact of invoicing for inventory costs. The size of the sample is a little bit less than hundred thousand units which constitutes a representative sample of the population of the dataset. Data analysis included both statistical methods to examine quantitative data and thematic analysis to analyse qualitative data.

1.3 Research objectives, questions and limitations

The main objective of this study is to examine the integration of storage cost invoicing into business processes in cases where customers delay the pick-up of ready-to-deliver goods. This study explores the contractual and operational aspects necessary for establishing an effective inventory cost invoicing mechanism, offering a detailed overview of the critical elements that facilitate smooth integration. The study also seeks to understand the organizational implications of such integration, with a particular focus on its impact on operational efficiency, financial management and customer relations. Further, this study aims to provide practical insights and recommendations for the case study company and to provide a framework to support both operational and strategic decision-making in relation to storage cost invoicing. To reach this objective and tackle an important industrial relevant subject, the research in this study is guided by two main research questions:

RQ1: What are the key factors that need to be considered in integrating the contract and implementation of storage cost invoicing into a business process?

RQ2: What are the implications of integrating the contract and implementation of storage cost invoicing into a business process?

The first research question focuses on the various key factors that need to be taken into account when integrating the contract and the related invoicing of storage costs into the company's processes. Understanding these factors is crucial for ensuring efficient and effective implementation of the new process. The answer to this question is mainly covered in the literature review section, which reviews academic literature, empirical studies, and case studies related to the topic. The main aim of the case company is to understand the current state-of-the-art knowledge in the literature relevant to this topic, therefore being the most preferable approach to this question. The literature review is based on the relevant and prior literature, which is peer-reviewed. Various databases such as Business Source Premier, Emerald Journals, IEEE Xplore, Sage Journals Online, Science Direct (Elsevier), Scopus, Google Scholar and ABI Inform have been used to search for quality studies while ensuring relevance to the topic through the abstract screening process. By examining the existing literature, the study aims to identify best practices, potential challenges, and opportunities for improvement in the integration process. Furthermore, the second research question is answered by first analyzing the relevant information in the literature while combining this knowledge with empirical data analysis, for which data is collected from the case company.

Like other studies, this study also has a few limitations that require attention. The topic of this study is limited to the evaluation of the final storage of finished industrial products from the perspective of a manufacturing company. It excludes topics related to energy storage, indirect orders and service-centred organizations. In the empirical part, the calculation of storage costs has been based on a formula provided by a case company to cover the costs of extended storage. This formula, while suitable for the case company, may not be universally applicable to all manufacturing contexts. In order to limit the data collection and increase the validity, delivery terms are excluded from the data sample, where the manufacturing company is fully responsible for the delivery arrangements. This exclusion may limit the generalizability of the findings, as different delivery terms can significantly impact storage costs and inventory management strategies. The empirical analysis identifies the profitability of the different delivery terms, the

performance of the company, and the estimation of the realised sales profit, but these are excluded from the analysis of this study. While these factors can influence storage costs indirectly, their direct impact on storage costs is not explicitly examined in this study.

1.4 Case company

The case company chosen for this study is a multinational manufacturing company specialising in highly customised products, tailored to meet specific customer requirements. The company's product range includes products of different sizes and types that can be further customised according to pre-defined conditions. These conditions not only enhance the uniqueness of each product but also allow customers to express their preferences in a way that aligns with their specific needs and expectations. Further, these conditions can be directly related to the product or to the delivery terms, which customers can modify and change according to their needs at any point in the process. This type of flexibility is a key selling point for the company, as it empowers customers to have greater control over their orders, fostering stronger relationships and loyalty. Although these pre-defined conditions are optional for the customer, they are commonly included in most of the company's products and orders, adding complexity to the company's production and operational processes. Because the company makes fully customised products, it works in a MTO manner which requires careful attention to ensure efficiency, customer satisfaction and to balance operational resilience. This operational model not only demands precision in manufacturing but also demands a robust communication strategy with customers to manage expectations effectively.

In the current situation, the case company has a gap in its operational processes, as there is no formal way of invoicing customers for extended storage. The lack of a mechanism for invoicing storage costs exposes the company to extended storage situations, where customers whose projects may be delayed or whose demand for products is prolonged take advantage of free storage. This situation creates a financial stress on the company,

as it incurs costs associated with storing these products in without any corresponding revenue. Since the company has no financial interest in encouraging timely pick-ups, the case company continues to handle the storing of the finished products in ideal storage conditions without compensation. This not only affects potential cash flow but also ties up valuable warehouse space that could be utilized for other projects or inventory. Integrating a system of invoicing storage costs into the company's operations would solve this problem by motivating customers to pick up their products more quickly. In addition, once the products are delivered, the company would be able to record sales and recognize revenue thereby improving its financial and operational efficiency. By implementing such a system, the case company could enhance its overall profitability while also streamlining its inventory management processes. This study focuses on addressing this highly relevant gap and examines the impact that the introduction of inventory cost invoicing would have on the company's processes.

1.5 Structure of the research

This thesis is structured in five main chapters as follows. The first chapter introduces the research topic and provides background information and an introduction to the recent scientific literature relevant to the study. It also includes a description of the case study, defines the research questions and highlights the limitations of the study. The second chapter provides a comprehensive literature review, organised into three main sections based on the theoretical framework, and a subchapter on identifying research gaps. The third chapter presents in detail the methodological approach applied and focuses on the data collection and analysis techniques used throughout the study. The fourth chapter presents and discusses the empirical findings of the study, including the results of the data analysis. Finally, chapter five presents conclusions, provides an outline of practical applications for business management, discusses limitations, evaluates the results and makes recommendations for the future research.

2 Literature review

This literature review introduces the main topics and recent scientific studies related to logistics and supply chain management, the storage costs in the manufacturing industry, the integration of contract and storage cost invoicing and their implications for business processes. The focus of the literature used is on peer-reviewed literature, which includes academic articles as well as empirical and case studies. The literature review in this section uses both current and recent literature. The section is divided into three main sections on storage costs in production, theoretical framework in contract management, and identification of research gaps which together provide a qualitative framework for the study.

2.1 Logistics and supply chain management

Logistics and supply chain management (SCM) are essential components in the operational framework of businesses, which further influences efficiency and effectiveness in delivering products and services (Cooper et al., 1997). At the core, logistics involve, for example, the phases of planning, implementation, and control of the flow and storage of goods and related information from the point of origin to the point of consumption (Cayhun and Keser, 2020). Logistics provides a foundational framework for planning and coordinating the efficient flow of products and information within a business, while the definition has been evolving (see table 2) throughout history from military operations to business activities (Lummus et al., 2001). The common understanding of logistics is that it is not just a synonym for supply chain management, it is a subset of it (Cooper et al., 1997). Nowadays, in the commercial context, logistics term is associated with a focus on the physical movement of goods, including transportation, warehousing, and inventory management. Moreover, it is seen as a tactical function aimed at ensuring the efficient flow of products from suppliers to customers (Burda, 2015; Cayhun and Keser, 2020) while in today's dynamic business environment, it is becoming a strategic function greater than a simple transportation management (Adeniran et al., 2024).

Building upon the foundation of logistics, supply chain management extends this concept by promoting collaboration and integration between various entities involved in the supply chain, including suppliers, customers and the organization itself (Christopher, 2016: 1-26). Like logistics, the conceptual understanding and definition of the supply chain (see table 2) has been evolving hand-in-hand with academic and industrial attention (Lummus et al., 2001). Conversely, supply chains cover the entire network of organizations involved in the creation and delivery of a product, ranging from raw material suppliers to end consumers. Both logistics and supply chain management significantly impact a company's cost-efficiency, responsiveness, resilience and sustainability within a globalized economic landscape (Richey et al., 2022; Rathor et al., 2022). Through the digitalization and development of digital technologies, supply chain management is undergoing changes where big data analytics and AI can be adapted to many activities, for instance even monitoring customer behaviour (Adeniran et al., 2024; Maheshwari et al., 2021).

Table 2. Definition evolution of logistics and supply chain. Adapted from Lummus et al. (2001), Rathor et al. (2022) and Burda (2015).

Logistics		**Supply Chain**	
Author	**Description**	**Author**	**Description**
Luttwak (1971)	Logistics involves planning, calculating, and physically executing the supply of equipment and supplies to armed forces, aiming to optimize quantities and minimize shortages and overstocking.	Ellram and Cooper (1993)	Supply chain management is an integrated philosophy for managing the entire flow of a distribution channel from supplier to customer.

Cavinato (1982)	Logistics manages the inbound and outbound flow of materials, parts, supplies, and finished goods, integrating purchasing, transportation, and storage across pre-production, in-production, and post-production channels	The Supply-Chain Council (1997)	Supply chain management encompasses the planning, sourcing, manufacturing, and delivery processes, including managing supply and demand, sourcing raw materials, manufacturing, warehousing, order management, distribution, and customer delivery.
Simpson and Weiner (1989)	Logistics is the art of moving and quartering troops in a military context.	Lummus and Alber (1997)	Supply chain management involves managing the network of entities, including suppliers, manufacturers, distributors, and customers, through which materials flow.
Cox et al. (1998)	Logistics encompasses the management of material and product acquisition, production, and distribution in industry and the movement of personnel in the military	Monczka and Morgan (1997)	Integrated supply chain management focuses on managing all processes necessary to deliver value to the external customer in a horizontal manner.

Council of Logistics Management, CLM (1998)	Logistics is the process of planning, implementing, and controlling the efficient and effective flow and storage of goods, services, and related information from origin to consumption, meeting customer requirements and considering inbound, outbound, internal, exter-nal, and return movements	Lummus and Vokurka (1999)	Supply chain management involves all activities from raw material sourcing to customer delivery, including manufacturing, warehousing, order management, distribution, and information systems for monitoring these activities.
Burda (2015)	Logistics is a management tool that coordinates the flow of materials from suppliers to customers. It involves planning, implementing, and controlling the efficient, effective flow and storage of goods and related information. By coordinating supply and demand in terms of time and place, logistics aims to improve customer satisfaction while minimizing costs.	Rathor et al. (2022)	Supply chains are networks that facilitate the movement of goods from suppliers to customers. They involve various entities like buyers, producers, and transportation modes. Supply chain management focuses on controlling the flow of materials and finished goods throughout this network.

Enterprise Resource Planning (ERP) and SCM have gained increasing popularity across diverse industries while enhancing corporate cross-functions and reducing transaction costs (Tarn et al. 2002). ERP is a software system that integrates and manages a firm's core business processes such as customer relationship management, order processing, and resource allocation, using a single database (Gupta et al., 2018). ERP systems consist of modules tailored to specific departmental functions, such as manufacturing, human resources, and finance (Ullah et al., 2017; Hasan et al., 2017) while by integrating internal and external processes, ERP systems enable firms to improve efficiency, reduce costs, and make informed decisions (Njihia and Mwirigi, 2014; Ullah et al., 2017). It has been discovered that ERP tools can support supply chain integration and minimize total supply chain system cost, but still, it may require a multi-level framework for policy coordination (Kelle and Akbulut, 2005). Contrarily, ERP and SCM have been seen as prominent operational aids for organizations while study by Shatat and Udin (2012) shows that ERP system components positively and significantly improve supply chain management performance in Malaysian manufacturing companies, but workflow management does not show a significant relationship. However, on the other hand, it is also noticed that ERP systems offer some potential for enhancing future supply chain effectiveness, as they may struggle to adapt to evolving requirements and integrate complex, multi-enterprise networks (Akkermans et al., 2003).

Implementing ERP systems empowers companies to adopt an extended enterprise business model, thereby enhancing value creation across the entire supply chain. To further reach optimal levels of supply chain efficiencies, companies must exchange substantial amounts of planning and operational data, which may contain information from annual contracts and regular progress reports to real-time delivery and billing data (Kelle and Akbulut, 2005). The integration of ERP and SCM systems has gained significant popularity, further fostering cross-functional collaboration within organizations and possibly leading to significant reductions in transaction costs. Additionally, ERP systems have demonstrated their efficacy in streamlining business financial operations by reducing costs and accelerating transaction times (Ahmad et al., 2021).

As manufacturing companies worldwide have gone through a change, ERP systems offer a highly integrated solution to an organization's information system requirements, thereby capturing interest across diverse functional domains. For instance, it has been found that in the automotive industry, the SAP ERP system has enabled advanced customer logistic services, improving supply chain quality, costs, and timeliness through Just-in-Time (JIT) methods (Lorenc and Szkoda, 2015). JIT philosophy, developed by Taiichi Ohno, focuses on the principle of delivering raw materials and producing products precisely when required, minimizing inventory levels of raw materials, work-in-process, and finished goods. This approach further reduces inventory costs and exposes possible inefficiencies, for instance, poor maintenance, inspection, and backlogs, within the manufacturing cycle (Vuppalapati et al., 1995). The main goal of JIT is to eradicate waste throughout the entire supply chain through continuous improvement (Frazier et al., 1988; Ufua et al., 2022). Maintaining inventory levels can increase product costs and reduce profitability across industries, which has led companies to seek to control stock levels to minimize costs and maximize profits whilst being an important part of supply chain management (Singh et al., 2012). Likewise, for organizations, regardless of the production philosophy, it is important to control, plan, and optimize both storage and supply chain activities to aim for positive firm performance (Mahajan et al., 2024).

2.2 Storage cost management in manufacturing

Effective inventory management strategies play a key role in the management of ready-to-deliver goods and their storage cost for manufacturing companies. As production processes advance, customer demands develop and businesses need to adapt by optimizing their inventory practices. This section analyses various strategies that support the efficient handling of ready-to-deliver goods, focusing on aspects such as different inventory management strategies, cost drivers in storage management, financial and operational implications of delayed pick-ups.

2.2.1 Inventory management strategies

Inventory management strategies have evolved from traditional practices to advanced data driven models that prioritize cost-effectiveness and quality of service. Routroy and Kodali (2005) describe that the strategies were originally based on holding large inventories to reduce risk factors, often leading to the tying up of excess capital, limited storage space and problems such as obsolescence and shrinkage. As supply chain practices have been evolving, different stock reducing strategies and data collection methods have become more common, allowing organizations to refine inventory levels through supply chain and real-time information. The application of data, as Feng (2019) mentions algorithms and technological integrations, have further improved inventory management by enhancing decision making and resource allocation across the supply chain, which according to Routroy and Kodal (2005) improve both operational efficiency and customer service. These developments highlight a wider trend towards integrated systems designed to reduce costs while efficiently meeting customer demand and achieving competitive advantage (Mahajan et al. 2024).

In manufacturing, inventory management strategies can be divided into two main categories: material and component inventory and finished goods inventory. Material and component inventories include the raw materials, sub-assemblies and parts required for production processes (Kim et al., 2022). Effective management of these stocks is essential to maintain a steady flow of production and minimize possible production downtime. Here, it should be remembered that the production department is responsible for coordinating the combination of raw materials, the firm's resources, and machinery to create products and services (Ahmad et al., 2021).

Pathak et al. (2024) describe that inventory management can be divided into materials and components and into finished goods. The finished goods inventory consists of finished products awaiting delivery to customers. This category of finished goods inventory management can be divided for two business models: make-to-stock (MTS) inventory management and make-to-order (MTO) inventory management (Dohale et al.,

2019). Dohale et al. (2019) further describe that in MTS, the finished products are stocked in the end inventory and aims to satisfy the demand of customers. They continue that MTO inventory management is consumer demand driven thus products are manufactured in response to orders placed by the customers. With MTO methods, often referred to as the pull method, orders trigger production, which is characterized by longer lead times, minimal storage costs and high ability of customization.

To classify stocks according to production stages, companies must also adopt specific methods and techniques to improve stock control. One of the most used approaches is JIT inventory management (Vuppalapati et al., 1995) which ultimately aims to reduce wastage by taking goods only when they are needed in the production process, thus minimizing inventory costs (Ufua et al., 2022; Tortorella et al., 2021). JIT is beneficial in lean manufacturing environments where efficiency and waste reductions are a priority. Bond et al. (2019) highlight that the success of JIT depends heavily on reliable suppliers and accurate demand forecasting. Any disruption in the supply chain can lead to production delays which is why organizations should have supply chain management strategies. The breakdown of the inventory management is defined below in figure 4:

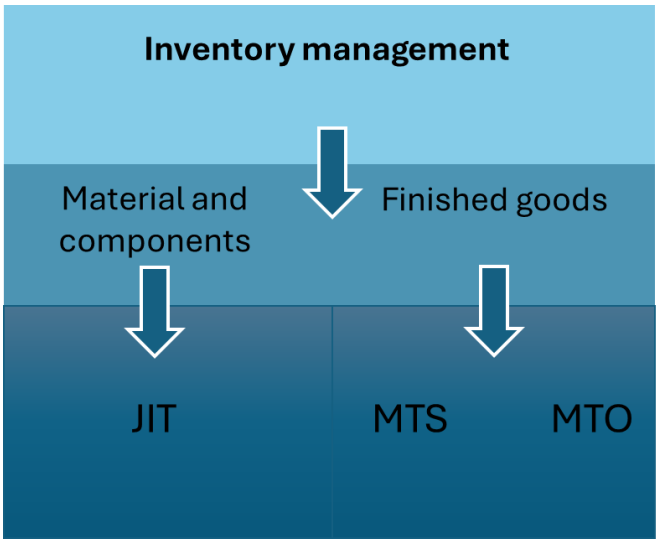

Figure 4. Inventory management and its subcategories.

One way to improve the efficiency of the inventory management process is to use technological advances such as enterprise resource planning (ERP) systems. Faccio and Gamberi (2021) highlight the role of ERPs in integrating inventory management with other business processes such as sales, procurement and production. Feng (2019) describes that ERPs provide real-time data and analytics that enable manufacturing companies to plan the production, monitor inventory levels and follow the overall process from registering the order to dispatching the products. Feng (2019) continues that the modular design of ERP systems ensures that they can be customized to the specific needs of an organization whether MTS or MTO. ERP systems reduce inefficiencies and improve the overall responsiveness of the supply chain by providing an overall view of the inventory and enabling better coordination between different departments (Faccio and Gamberi, 2021).

Lean inventory management practices, such as those related to total quality management and six sigma, have an effect on optimizing inventory strategies. Tortorella et al. (2021) highlight that lean practices focus on reducing excess inventory improving production processes and improving quality. De Vries and van der Laan (2020) mention that by integrating lean principles into inventory management, manufacturing companies can minimize wastage, improve flow of the processes and improve product quality while maintaining sufficient inventory levels to meet customer demand. They continue that as well lean practices are particularly effective in MTO environments where customized production requires flexibility and accurate monitoring of inventory levels. Continuous improvement tools, according to Tortorella et al. (2021), such as Kaizen further support inventory optimization by encouraging regular evaluation and refinement of inventory processes.

2.2.2 Cost drivers in storage management

Understanding the cost drivers associated with storage management is essential to optimize the total cost of storing goods that are ready for delivery. Several studies highlight that the key cost factors for inventory management are storage costs,

transportation costs and administrative costs associated with inventory management (Hoque, 2011; Bulula et al., 2020). Storage costs, which include storage space, insurance, spoilage and expiry costs, are often the most significant cost components (Hoque, 2011). For example, Bulula et al. (2020) found that storage space accounted for a significant share (20%) of the total cost of storing finished goods highlighting the critical importance of efficient space utilization in minimizing storage costs. This is also supported by Alrjoub and Ahmad (2017), who find that optimizing storage levels through robust management systems can significantly reduce storage costs and improve financial performance. These findings highlight the importance of implementing cost-effective storage strategies that consider different cost drivers, especially in manufacturing environments where delays in customer pick-ups can increase storage-related costs.

Transport costs are another important factor in managing inventory. According to Hoque (2011), transportation costs, including fuel and logistics costs, are among the critical factors that can affect inventory costs, especially in integrated supply chains where inventory must be moved or redistributed frequently. Bulula et al (2020) identify transport costs as a significant cost factor, accounting for 21% of total costs in their study of finished goods storage and distribution. The authors highlight the need for effective supply chain management to minimize these costs. Integrating warehouse management with ERP systems can further improve cost-effectiveness by streamlining logistics operations and improving the visibility of warehouses (Feng, 2019). By applying model data and providing real-time insights, ERPs help organizations reduce transportation-related costs and improve the overall efficiency of inventory management practices.

Administrative and management costs also a one part to determine the total cost of storage management. Costs associated with personnel, receiving and dispatching and program management are often cited as important factors in the overall cost structure (Bulula et al., 2020). Peiqiang (2018) highlights the role of customized financial management systems in reducing these administrative costs by improving financial controls, data accuracy and operational efficiency. Integrating such systems with existing

ERP systems facilitates more accurate monitoring of inventory and related costs, thereby improving strategic planning and decision-making capabilities. Continuous evaluation and adaptation of these systems is necessary to adapt to changing business environments and technological advances, which can further reduce administrative overheads and improve the overall management of inventory costs (Peiqiang, 2018; Feng, 2019). The cost drivers in storage management are visualized in the following hierarchy diagram figure 5:

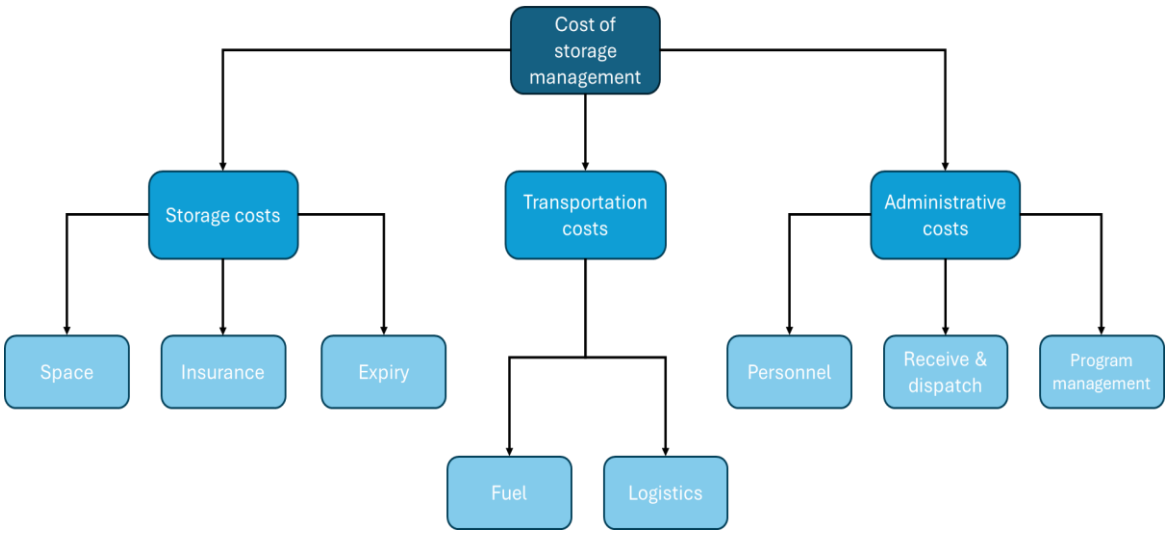

Figure 5. Cost drivers in storage management.

The introduction of advanced inventory management practices can have a significant impact on the cost dynamics of inventory management. Bah et al. (2023) argue that efficient inventory management systems, that focus on optimizing inventory cycle times, can positively affect profitability by minimizing costs associated with holding and maintaining inventory. Advanced systems that leverage data analytics and automation technologies enable companies to maintain optimal inventory levels and reduce excess inventory which lowers maintenance costs and improving overall cost-effectiveness (Alrjoub and Ahmad 2017). Mahajan et al. (2024) caution that while inventory cycle rate optimization is important for managing inventory costs, it may not always correlate directly with overall company performance which suggests that companies need to adopt an approach that balances cost management with wider strategic objectives.

2.2.3 Financial implications of delayed pick-ups

Incoterms are standardised delivery terms and trade rules developed by the International Chamber of Commerce to streamline international trade by clearly defining responsibilities, costs and risks between buyers and sellers as explained by Baena Rojas et al. (2024). The key purpose of incoterms is to create a common language for international trade and ensure that both parties clearly understand their roles and responsibilities, which López et al. (2024) describe, helps to reduce potential disagreements that may arise during cross-border transactions. Baena Rojas et al. (2024) continue that these rules specify which party is responsible for the different stages of the transport process, such as transportation, insurance and handling, and are divided into categories that progressively increase the level of seller responsibility, ranging from minimum responsibilities in group E to maximum responsibilities in group D. The categorization allows firms to choose terms that match their logistical capabilities and risk tolerance, enabling strategic alignment in international trade. López et al. (2024) note that incoterms are updated approximately every ten years to reflect changes in global trade practices and the latest revision is incoterms 2020 which introduced updated terminology and rules to reflect modern logistical needs.

This study focuses mainly on the incoterms CPT (Carriage Paid To), FCA (Free Carrier) and FOB (Free on Board), as these are the only incoterms used by the case company when customers are responsible for arranging transport at some point in the process. The choice of these incoterms matters because they clearly define the sharing of costs and risks between customers and manufactures and influence the management of financial and operational risks in the supply chain (Davis and Vogt, 2021). According to CPT, the manufacturer is responsible for the transportation costs to the destination specified by the customer but the risk is transferred when the goods are handed over to the original carrier, often leading to confusion between cost and risk responsibilities (Davis & Vogt, 2022). Similarly, FCA provides that the manufacturer’s responsibility ends when the goods are handed over to the designated carrier, offering flexibility and better risk management, especially in multimodal transport (Stojanovic and Ivetic, 2020). FOB used

in sea freight transport transfers the risk once the goods are loaded onto the vessel, according to Davis and Vogt (2022), making it less suitable for container transport, where risk transfer can present complex problems. Each of these terms affects the assignment of responsibility, and their incorrect use can introduce hidden risks related to insurance, responsibility and costs (Davis & Vogt, 2021). Therefore, focusing on these specific incoterms allows the study to focus on scenarios where the customer is responsible for the transport and to provide evidence on how these responsibilities affect operational performance and financial results in international trade, as Stojanovic and Ivetic (2020) argue. By understanding the specific requirements and potential pitfalls associated with CPT, FCA and FOB, this study aims to evaluate how the accurate application of incoterms can improve logistics performance and help to ensure risk and cost sharing and coordination of logistics objectives (Davis & Vogt, 2022; Stojanovic & Ivetic, 2020). CPT, FCA and FOB are shown in the figure 6 below:

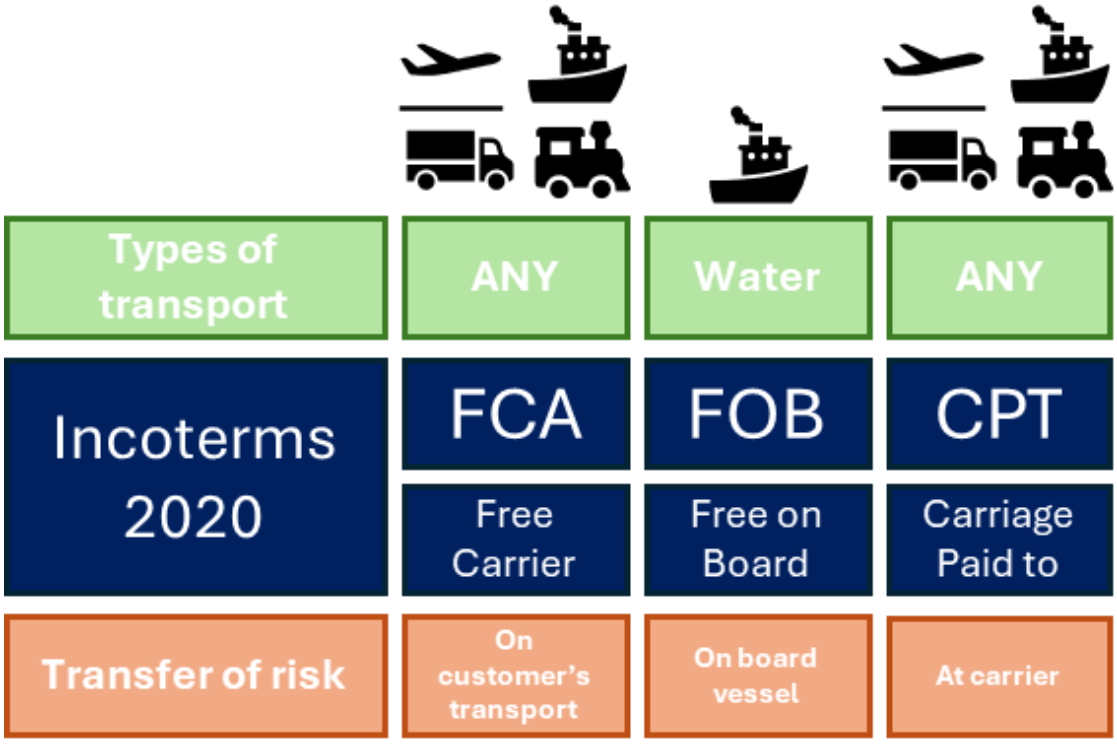

Figure 6. FCA, FOB and CPT.

Delays in pick-ups in supply chains have financial effects, especially when contractual commitments and risk-sharing are not clearly defined. Delays can significantly increase storage costs, disrupt the flow of cash and create additional risks for both customers and manufacturing companies. Davis and Vogt (2021) highlight the hidden risks associated with the incorrect application of incoterms where the incorrect allocation of responsibilities for transportation, insurance and risk transfer can lead to costly delays and disagreements over responsibility. For example, incorrect use of FCA or FOB terms can lead to misunderstandings about when risk is transferred from manufacturing company to customer, leaving companies vulnerable to unexpected storage costs and legal responsibilities (Davis and Vogt, 2021; Stojanovic and Ivetic; 2022). In addition, incorrect application of incoterms, such as CPT, creates additional complexity because risk may shift earlier than responsibility for transportation costs, increasing the additional costs of delayed recoveries (Davis and Vogt, 2022). Proper understanding and strategic application of these terms of trade are important to reducing these financial risks. Failure to follow these terms of trade can increase storage costs, damage to goods, and operational inefficiencies, highlighting the need for more formal training and risk management strategies in incoterms and warehouse invoice management (Davis and Vogt, 2021).

Delayed collections of goods ready for delivery have a financial impact on organizations, as they can directly affect operational efficiency, cost control and overall financial performance. According to Juan and Li (2023), supply chain delays, including those caused by delayed customer deliveries, can significantly increase costs and reduce profitability by disrupting the flow of goods and extending inventory holding times. This inefficiency leads to increased storage costs, which ties up capital that could otherwise be directed to more productive uses. This view is further supported by Arslan and Yildiz (2022) as the authors show that supply chain disruptions, such as delayed pick-ups, cause immediate and significant negative reactions in the stock market, indicating that investors are concerned about the financial stability and operational performance of the company. These studies highlight the critical importance of implementing effective risk

management and disruption management strategies to reduce the financial risks associated with delays in customer pick-ups.

The financial impact of delayed pick-ups is also affected by the use of penalty costs and invoicing methods designed to control and recover costs. Hossain et al (2017) suggest that the application of penalty costs for late deliveries or delayed pick-ups can be an effective strategy to improve system reliability and encourage timely deliveries. In the context of invoicing for storage costs, such invoiced additional costs not only help cover the additional costs of delayed storage, but also help prevent customers from being late in the future. This is in line with Quan-bin (2009), who finds that a well-implemented invoice management system can make it easier to better monitor inventory levels, sales transactions and purchase orders, and so improve financial management processes. Integrating these systems into existing business processes allows companies to effectively manage the financial costs of delayed pick-ups and improve their overall financial performance by recovering some of the costs associated with extended storage lead times.

Delayed pick-ups also have indirect financial impacts as it affects the flexibility of the supply chain and requires more robust risk management practices. Juan and Li (2023) suggest that supply chain delays, including delays caused by late pick-ups, require improved resilience strategies to maintain financial stability. This may require the implementation of proactive actions such as diversifying suppliers, improving forecasting accuracy and developing backup plans. Arslan and Yildiz (2022) highlight the importance of such practices and find that companies with strong supply chain resilience are more resilient to financial disruptions and maintain the trust of investors. As a result, the financial consequences of delayed pick-ups go beyond the direct costs to wider strategic concerns, such as maintaining supply chain resilience and tolerating long-term financial risk. These implications are defined in the figure 7 below:

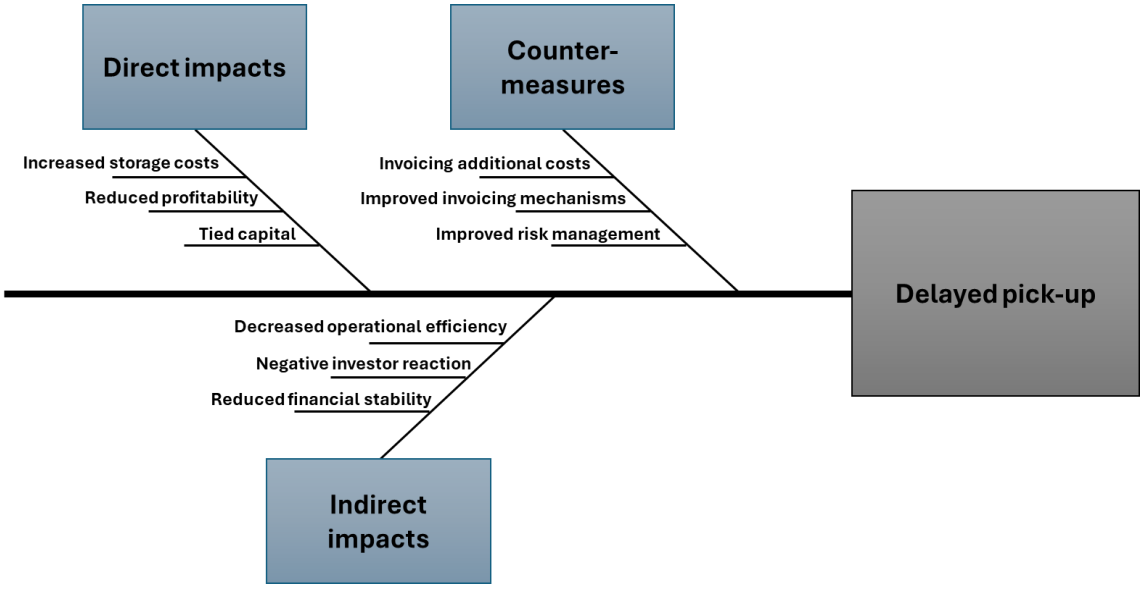

Figure 7. Fishbone diagram of financial and indirect implications of delayed pick-ups.

2.2.4 The impact of finished goods on operational efficiency

Insufficient storage capacity, either due to limited space or outdated logistics systems, acts as a bottleneck in both manufacturing and distribution environments, as noted in studies by Mapanga (2024) and Kizil (2010). Kizil (2010) highlights that efficient storage allocation is essential in manufacturing production to avoid bottlenecks and ensure that space supports new production needs. Groten and Gallego-García (2021) describe when products take up storage space originally intended for temporary use, these spaces may become semi-permanent storage areas, leading to a loss of operational flow. They continue that the semi-permanence of temporary storage areas disrupts the planned movement of materials and goods throughout the production process, causing delays and reducing the company's responsiveness to customer orders. Gallego-García et al. (2021) show that delays in distribution increase the reliance on these temporary storage spaces and reduce the continuous flow of operations.

Poor inventory management of finished goods waiting for pick-up disrupts production scheduling and affects overall efficiency by delaying production schedules and reducing responsiveness to critical orders. Groten and Gallego-García (2021) discuss how

inefficient production optimization can reduce schedule flexibility leading to critical orders not being completed. In addition, as Kizil (2010) notes, poor inventory allocation can prevent the on-time fulfilment of more critical orders, affecting production priorities and impacting customer satisfaction. More coordination is needed for the management of delayed goods when delays in pick-ups increase which increases the need for monitoring and slows workflow (Groten and Gallego-García, 2021). Abdollahpour and Rezaian (2017) highlight that manufacturing capacity combined with disruptions in logistics decreases operational efficiency by requiring additional resources to monitor and manage delayed inventory. Such disruptions often lead to a MTS production scenario although the production operating model is MTO, as described by Abdollahpour and Rezaian (2017), where limited storage capacity leads to an inventory build-up that eventually disrupts production flow. They further highlight that these restrictions create bottlenecks in the combination of MTO and MTS models forcing manufacturers to postpone new orders until inventory space becomes available.

Gallego-García et al. (2021) highlight that delays require logistics management efforts as maintaining accurate inventory levels and ensuring efficient handling increases operational activities. As Mapanga (2024) points out, this challenge is complicated by skills gaps in logistics planning, with supply chain management skills playing a key role in reducing handling complications and maintaining operational consistency. The implementation of optimized warehouse allocation, as Kizil (2010) suggests, can reduce logistical demands streamlining the entire warehousing process. However, if such optimizations are not applied efficiently, temporary storage requires additional logistical coordination, as Sharma et al. (2020) point out, which increases the need for accurate inventory management to handle products in a limited space. Abdollahpour and Rezaian (2017) further highlight the logistical challenges associated with manufacturing where production flow demands require careful management to avoid interruptions. Moreover, the effects of these operational inefficiencies reach further than internal processes, Chen et al. (2012) describe affecting directly key performance indicators. They continue to discuss how performance indicators of reliability have a multiplier effect on overall

supply chain performance which delayed pick-ups have affect on. Similarly, Dai et al. (2016) show how strategic contracting methods, such as incentive-based contracts, improve performance and enhance supply chain stability suggesting that clear contract terms can align the interests of manufacturers and customers and thereby improve overall supply reliability.

2.3 Theoretical Framework on contract management

2.3.1 Contractual conditions

The contractual conditions should be considered in the order process when an order is being placed between a customer and a company. A good contract should clearly define the roles, responsibilities and conditions under which additional costs, such as storage charges, will be incurred and invoiced. Kapsali et al. (2019) suggest that combining relationship and associative terms in contracts can significantly improve operational performance by promoting benefits, flexibility and long-term cooperation between the parties. They continue that relational contract, that emphasize cooperation and trust, can be particularly useful in situations where pick-up delays are common, as they promote a cooperative approach to resolve disagreements and additional cost management. Traditional contractual conditions, which are more restricted and formal, may not be as effective in this context because they do not take advantage the potential for cooperation needed to adapt to unforeseen delays (Kapsali et al., 2019). This is in line with the findings of Grâu-Panțureac (2023) that contracts should provide a framework for dealing with unforeseen situations, ensuring clarity of commitments and reducing risks through well-defined legal contracts. Therefore, a strategic combination of relationship conditions promoting cooperation and formal conditions defining legal responsibilities can create a robust contractual framework.

The storage costs of ready-to-deliver goods can be divided into fixed and dynamic factors, both of which have an financial impact on delayed pick-ups. Fixed costs are incurred regardless of the amount of inventory to be stored, such as rental fees for warehouse

space or wages for warehouse staff, as highlighted by Melega et al. (2025). For example, a company that stores products in a third party warehouse will incur fixed costs related to for example the maintenance of the products and the facilities. Dynamic costs vary with the activity of the warehouse, including handling and transfer costs incurred when moving goods to and from the warehouse, which vary with the frequency and volume of these transfers (Melega et al., 2025). Fan and Wang (2018) further emphasize the importance of considering both fixed and variable costs, noting that storage costs can also be optimized by dynamically adjusting storage space based on changes in demand. From a contractual perspective, costs could be structured on a product-by-product basis, with a fixed charge for each product stored, combined with time based charges such as weekly storage fees. Belderbos et al. (2017) describe that this kind of approach could ensure that both fixed general costs and variable handling costs are covered and provides transparency and predictability in the invoicing of delayed collections. A well-defined contract can clearly define costs, ensuring that customers are aware of their financial responsibilities bringing operating costs in line with contractual terms.

It is helpful to specify in the contract terms and conditions the factors affecting the invoicing of storage costs. Di Giannatale and Passarelli (2018) suggest that there should be some flexibility on both sides in contracts between businesses, which could also be applied to a storage cost invoicing contract. Storage costs should not start as soon as production is completed, but customers can be given a buffer period to allow them time to arrange pick-up at no extra cost. This flexibility, as Miguel et al. (2022) point out, considers logistical variations and helps reduce potential inefficiencies caused by early invoicing, such as customer dissatisfaction.

When looking at contract terms, the factors that should be identified are when the contract is in validity, for example in special cases or specific delivery terms. Sugiono et al. (2024) point out that in FCA terms, the customer is responsible for pick-up once the manufacturer has delivered the goods to the external location, and delays beyond the agreed collection schedule can result in additional storage costs. Bergami (2013)

describe that in FOB terms the responsibility proceeds to the customer once the goods have been passed to the ship, making the manufacturer responsible for any delays in pick-up, which may lead to storage charges at the port. The author continues that in a CPT contract, the manufacturer arranges delivery to a specific location, but delays in the customer's pick-up after the arrival of the goods can also lead to additional costs. These situations highlight the importance of clearly defining in contracts when and how storage costs are incurred. There could be special cases in the process before pick-up, such as a special customer who has been promised free storage or a customer who asks order change. These factors should be considered when the contract is being made.

Clearly defined contract terms provide a clear framework for both parties. Well designed contracts should specify the starting date for storage costs but should also provide mechanisms for flexibility and risk sharing, as highlighted by Farhad et al. (2023), who discuss that such contracts can provide economic signals and stability. The integration of option contracts into storage contracts can increase flexibility in cost management, allowing both parties to adapt to unexpected delays while maintaining supply chain management, as suggested by Cai et al. (2016). This combination of clearly defined responsibilities and adaptable terms ensures that storage costs are managed in a transparent and fair manner, reducing risk and ensuring customer compliance in case of delays.

2.3.2 Contract integration into business processes

The overall management of contracts should be considered to ensure that they remain compliant with the organization's objectives and regulatory requirements throughout their lifecycle. Schuhmann and Eichhorn (2019) promote a holistic approach to contract management, covering all stages from contract drafting and negotiation to execution and monitoring. This approach ensures that the contractual terms for storage cost invoicing are continuously reviewed and adapted to meet changing business conditions, minimizing risk and optimizing performance. Effective contract management should also include digital tools to increase transparency and efficiency of invoicing processes

(Schuhmann and Eichhorn, 2019). This is supported by the work of Roehrich et al. (2019), who highlight the importance of balancing formal contract terms and relational management to reduce uncertainty and improve supply chain performance. Contracts that are carefully designed to combine both legal executability and relation-based elements can provide a flexible but structured approach, ensuring that all parties are aware of their responsibilities and minimizing potential conflicts.

Integrating contracts into business processes for invoicing storage costs requires careful coordination of operational practices and supply chain. Lee et al. (2016) highlight that integrating storage cost methods of allocation into storage contracts can significantly improve supply chain coordination, especially in manufacturing systems with limited storage capacity. By aligning drivers between suppliers and customers such contracts ensure that storage costs and risks are shared and thereby motivating better inventory management and minimizing potential disruptions caused by delayed pick-ups. This approach, where penalties for stock losses are built into the contract, effectively models the performance of the integrated system and improves overall cost-effectiveness. Cheng (2010) notes that this level of integration included in contracts is essential to enhance collaboration and improve communication between supply chain stakeholders. Clear contract terms and trust on both sides play an important role in ensuring that both parties are aligned in their objectives, reducing operational risks and improving supply chain performance over time.

Effective contract integration should use digital tools to increase the transparency and efficiency of invoicing processes. Penttinen et al. (2010) consider how the introduction of e-invoicing can streamline the exchange of information between manufacturer and customers making the inventory invoicing process more responsive and flexible to changing conditions. Electronic invoicing not only improves the accuracy of financial transactions, but also enables real-time updates, which are needed when invoicing for storage costs. Vandana and Das (2022) point out that by integrating digital invoicing into contract management practices, companies can more quickly adapt to changing

inventory needs while maintaining clear, auditable records that ensure both parties are aware of their financial commitments. Combining this digital integration with well-structured contracts, as highlighted by Cheng (2010), ensures that storage cost invoicing is seamlessly integrated into wider supply chain processes, optimising both financial and operational outcomes.

In order to fully integrate the invoicing of storage costs into business processes, it is also important to ensure that contracts are flexible enough to adapt to changing business needs and market conditions. As highlighted by Cheng (2010), the dynamic nature of supply chain relationships requires contracts that evolve over time and respond to new operational challenges and opportunities. Inflexible contracts may prevent firms from quickly adapting their storage strategy in response to fluctuations in demand or unexpected delays in customer pick-ups. By continuously reviewing and adapting contract terms, according to Lee et al. (2016), companies can ensure that storage cost invoicing methods remain aligned with their business objectives and regulatory requirements. The use of storage cost sharing, fixed transfer fees and digital invoicing tools also ensures that such methods are flexible and responsive, laying the foundation for long-term supply chain success (Lee et al., 2016; Penttinen et al., 2010). The framework of contract evaluation should be continuous improvement and the cycle is described in the figure 8 below:

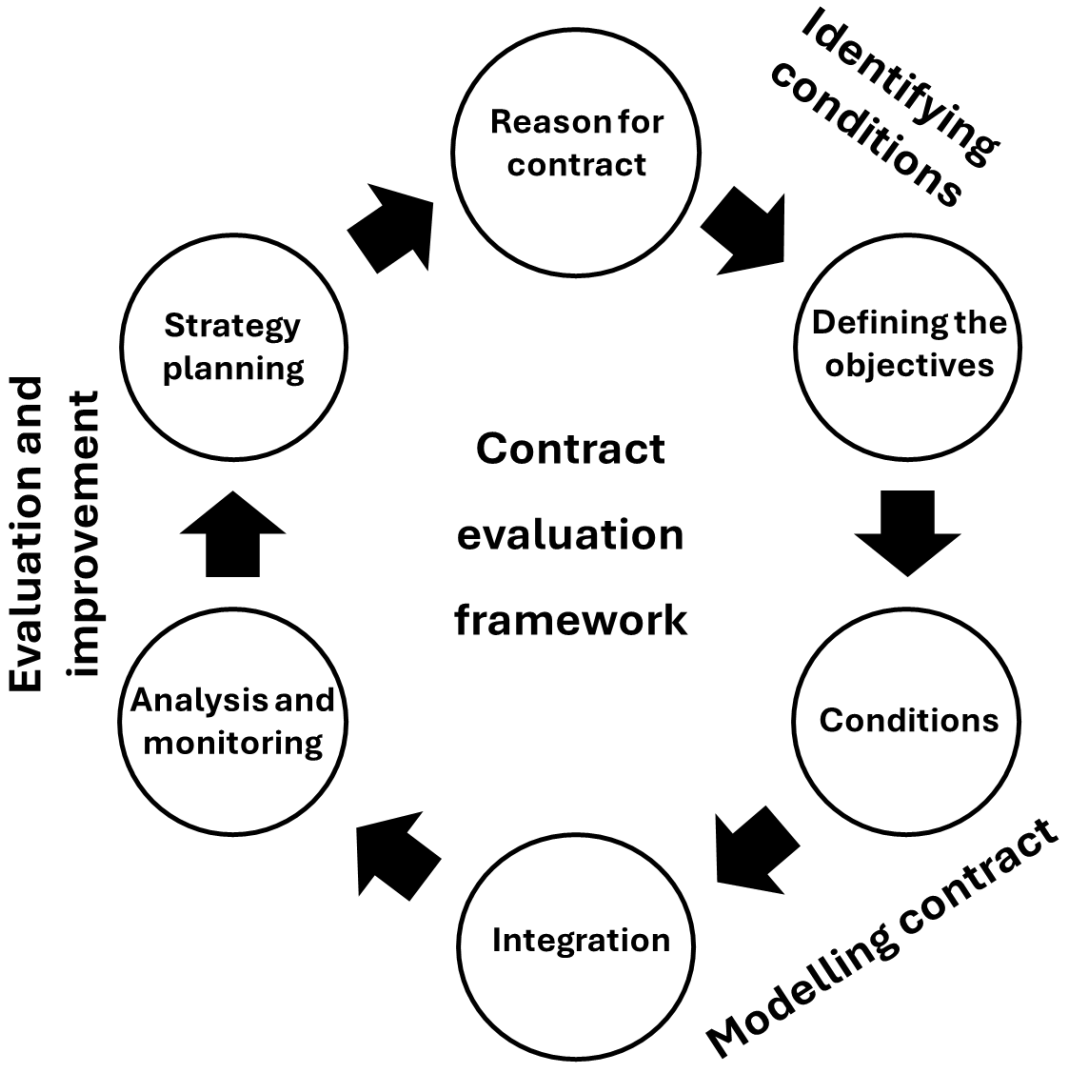

Figure 8. Contract evaluation framework.

Integrating contracts into the business processes requires a balance between formal and relational management to achieve both flexibility and compliance. Zacharia, Sanders and Fugate (2021) highlight that while formal contracts are essential to ensure compliance and reduce risk of uncertainty, relational governance promotes trust and adaptability, which are essential when managing the complexity of delayed pick-ups. This combination allows companies to adapt to changing operational requirements without reducing the contractual framework that ensures responsibility. Klein et al. (2012)

further stress that formal contracts provide the necessary resilience against opportunistic behaviour, such as failure to meet pick-up deadlines, by ensuring that contract mentioned costs are clearly defined.

2.3.3 Operational and financial implications for business processes

The integration of inventory cost invoicing into an organization's processes has a number of implications for both operational efficiency and financial performance. One of the main challenges is to ensure proper coordination between manufacturers and customers. Hoque (2011) highlights the importance of aligning customer and manufacturer objectives to minimize costs throughout the supply chain. When storage costs are included in contracts, this reconciliation is crucial for decision making, as it encourages better inventory management and ensures that both parties are accountable for delays. Chen and Kang (2007) add that the use of negotiation rates in contracts ensures a fair distribution of savings, which helps maintain long-term partnerships. A fair distribution of costs and savings not only optimizes financial outcomes but also strengthens relationships and promotes cooperation throughout the supply chain.

From a wider organizational perspective, the introduction of advanced inventory management practices, can improve financial performance. Alrjoub and Ahmad (2017) show that companies with effective inventory management systems have higher profitability and greater operational efficiency. By integrating inventory cost accounting into these systems, organizations can better control inventory turnover and reduce the financial risks associated with delays in customer pickups. This approach also requires investment in advanced technologies and data management systems to ensure that invoicing is transparent, accurate and aligned with organizational goals. Adopting these ways of methods will contribute to competitiveness and profitability by streamlining internal processes and reducing operational inefficiencies (Alrjoub and Ahmad, 2017).

One aspect of gaining better supply chain performance, financial stability and operational efficiency is aligning the interests of manufacturers and companies through

collaborative strategies that reduce the risks and costs associated with delayed pickups. Hossain et al. (2017) point out that a cooperative approach improves supply chain coordination and enhances performance by ensuring that both parties invest in minimizing delays. Chakraborty et al. (2022) propose different storage management models, such as vendor managed inventory, that protect the interests of customers while enabling distributed decision making, promoting a cooperative environment in which all supply chain stakeholders benefit from reduced delays and optimized inventory levels. The cause-and-effect relationships of the integration of the contract into the business are shown in the figure 9 below:

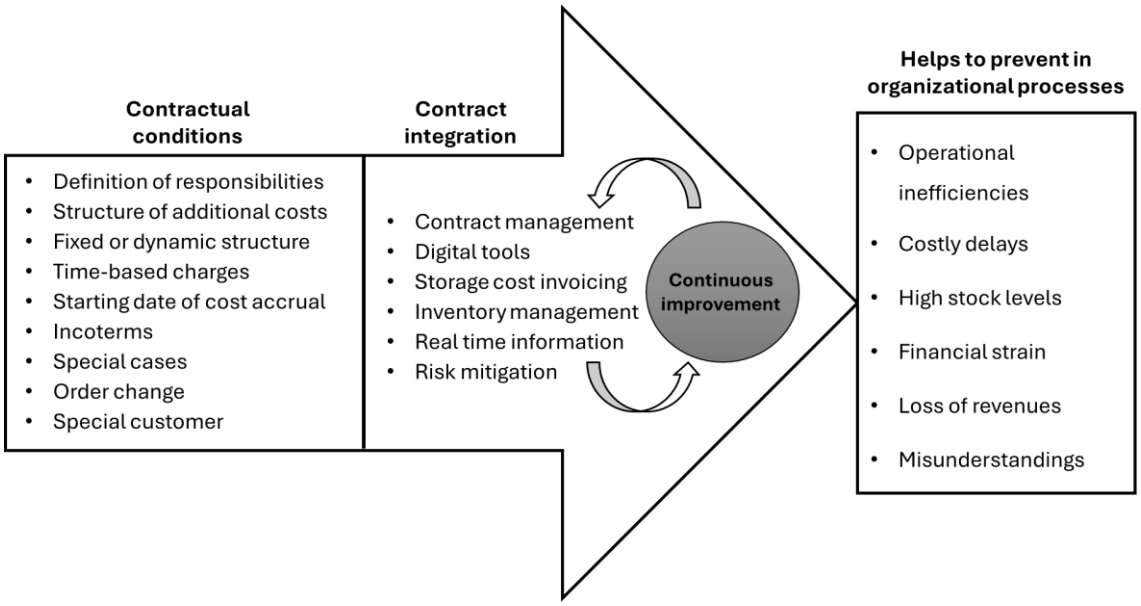

Figure 9. Cause-and-effect relationship of contract integration.

The use of option contracts, as suggested by Cai et al. (2016), can help balance the risks and benefits between supply chain members by integrating the invoicing of storage costs into business processes. Because option contracts allow for flexible invoicing and penalty terms, they provide a buffer to help organizations manage uncertainties related to storage costs. This resilience, combined with the continuous improvement of financial chain management practices, ensures that storage cost invoicing remain effective even as market conditions and supply chain dynamics evolve (Pfaff et al. 2004). They continue

that the impact on organizational processes therefore goes beyond financial transactions as the integration strengthens supply chain relationships, increases operational transparency and ultimately leads to more flexible and adaptable business models.

The market position has an effect on the strategic aspect as well as on the resilience of the company's operations when contracts are integrated into the business. According to Tufan et al. (2024), companies that manage storage costs efficiently and transparently can strengthen their market position because they are seen as lean, efficient and cost-conscious partners. This can increase their attractiveness to potential partners and customers looking for reliable supply chain solutions. Utilizing storage cost invoicing as part of a broader strategy that includes investing in advanced inventory management systems, as noted by Anantadjaya et al. (2021), can further strengthen this market position. They continue that poor implementation or lack of flexibility in invoicing can cause companies to be seen as inflexible and difficult to work with especially in fast changing industries where delays may have major impacts. This recognises that a well-executed integration of inventory cost invoicing and contracting increases operational performance and reduces additional costs for the company, while developing the robustness of the company. Therefore, the implementation of storage cost invoicing needs to be carefully considered and ensured that it is aligned with the company’s market positioning strategy and supports both operational excellence and customer satisfaction. These implications are shown in the figure 10 below:

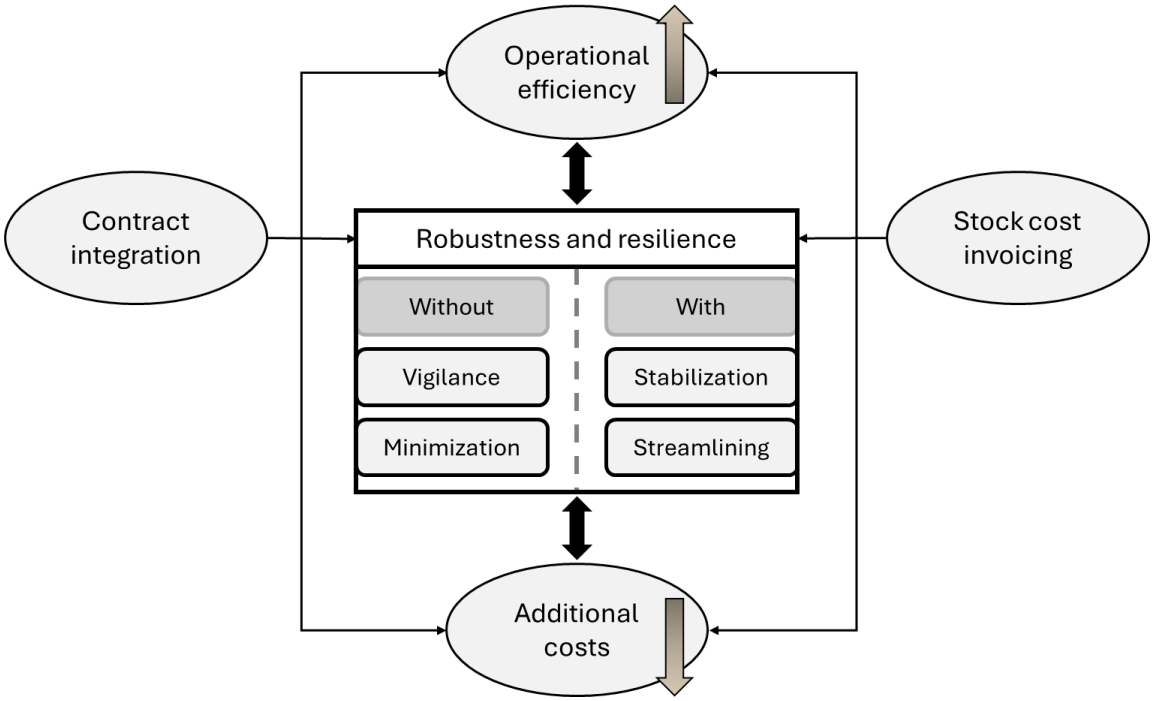

Figure 10. Implications of contract and stock cost invoicing.

2.4 Future of MTO inventory management

One noticeable research gap in the current literature is that there is little research on advanced inventory management systems, such as ERP and JIT systems, in MTO environments. Although the benefits of these systems are well documented in industry, their implementation in MTO environments, where production lead times and customer requirements are more volatile, has not yet been sufficiently studied. Feng (2019) highlights that future research needs to explore in more detail how ERP and JIT systems can be customized for MTO manufacturing companies to improve responsiveness and cost-effectiveness. This gap is especially challenging given the increasing relying on data-driven warehousing systems in modern supply chains. Ufua et al. (2022) support this view and highlight the potential of ERP systems to improve operational flexibility in dynamic environments. While the integration of these systems has been studied in more traditional manufacturing environments, the unique requirements of MTOs require a more specialized approach that focuses on how these technologies can be customized to manage the complexity of customer orders and varying production schedules. Future

research should examine these systems in more detail and explore how they can be optimized to balance the need for customization with operational efficiency, which is needed to remain competitive in the MTO market.

Another important gap in the current literature relates to the role of digitalization in managing storage costs, especially in terms of real-time monitoring, automation and predictive analytics. While the current literature framework briefly discusses ERP systems for managing inventory costs, Mahajan et al. (2024) describe that it does not focus enough on the wider digital tools available, such as artificial intelligence which could offer advanced capabilities for real-time monitoring and cost optimization. Faccio and Gamberi (2021) argue that digitalization, particularly in the management of inventory costs, offers the opportunity for change by automating the invoicing process and enabling predictive analytics to forecast and reduce delays. Feng (2019) further suggests that these digital tools can not only reduce human error but also improve the accuracy of decision-making by providing real-time information on inventory levels and storage costs. Despite the clear benefits of digitalization, there is still little research on its application to inventory cost management in delayed pick-up situations. Future research should therefore explore how these advanced technologies can be effectively applied to the complex real-time management of inventory costs, especially in MOT manufacturing industries that depend on accurate inventory control and just-in-time deliveries.

3 Methodology

This chapter of the thesis explains in detail the methods used in the empirical part of the study. As the first research question is primarily addressed through a comprehensive literature review, this chapter focuses more on the second research question and the associated empirical data collection, analysis, and validity. The primary objectives are to identify the empirical methods, outline the research strategy adopted, explain the scientific framework used, and provide a thorough explanation of the data collection process, organizational techniques and statistical analysis methods used. Finally, the quality of the research is evaluated by applying the principles of validity and reliability.

3.1 Methodological approach

This study uses a research design that combines both qualitative and quantitative research methods, which together form a simple mixed-method approach to address the research questions. According to Green et al. (2002), a mixed-methods approach improves the research by allowing a comprehensive study of the integration of storage cost accounting into business processes. Research question 1 is fundamentally addressed through a qualitative exploratory literature review. This approach enables in-depth understanding of the factors influencing the adoption of contract and storage cost invoicing. In contrast, research question 2 uses a mixed-methods strategy, combining both qualitative and quantitative techniques to explain the organizational effects of these invoicing methods. The second research question, on the other hand, employs a mixed-methods strategy that involves a combination of qualitative literature review and quantitative data analysis. The qualitative outlook provides contextual insights into organizational practices and perceptions. Further, the quantitative component, through data analysis, allows for a rigorous assessment of the financial and operational impacts of inventory invoicing. By applying this multi-method approach, the study is in line with the principles outlined by Green et al. (2002) in that it provides both in-depth qualitative research and quantitative evaluation to provide a comprehensive analysis of the storage cost invoicing process. Both research questions are defined in the following figure 11:

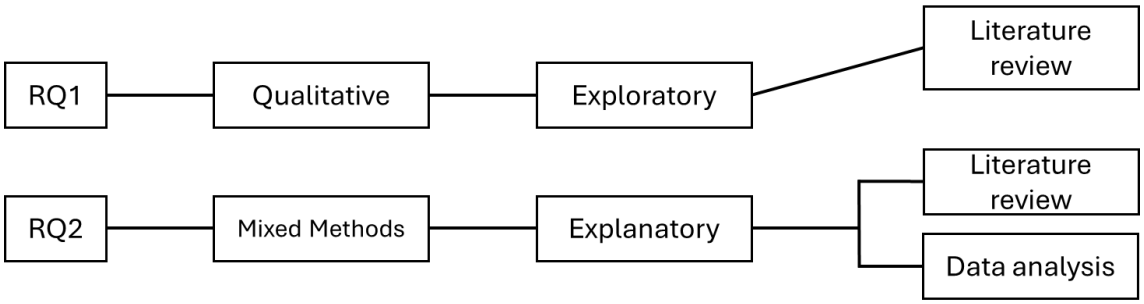

Figure 11. Methodological approach of the study.

According to Aspers and Corte (2019), qualitative research is an iterative process that refines understanding by being close to the subject under study, making it well-suited for exploratory studies of this type. The literature review serves as the primary method for answering research question 1, as it provides a detailed examination of how contractual terms, business processes and industry standards shape the adoption of contract and invoicing into the system. Aspers and Corte (2019) highlight that qualitative research generates new and important distinctions that help researchers understand complex systems, such as those related to invoicing processes. Furthermore, Freeman, Cameron and Burrell (2024) argue that qualitative research is essential to understanding the lived experiences of practitioners and stakeholders.

The use of simple mixed methods allows for triangulation, which increases the depth of the analysis by combining findings from both qualitative insights and quantitative data (Östlund et al., 2011). In this study, a literature review is conducted alongside data analysis to understand the broader implications of storage cost invoicing for operational efficiency, financial performance and organizational behaviour. Östlund et al. (2011) argue that parallel analysis, where qualitative and quantitative data are analysed simultaneously, can provide a comprehensive understanding of complex behaviours. This strategy is particularly effective in answering research question 2 as it allows to identify the financial effects of stock cost invoicing while exploring the complex ways in which these systems affect organizational processes. By using this methodology, the research is in line with Freeman et al. (2024), who support combining qualitative and

quantitative research to gain a more comprehensive understanding of business challenges, leading eventually to better informed decisions and more solid theoretical insights.

3.2 Data collection and delimitation

In this study, data collection was conducted using the case study company's ERP system, focusing on closed orders over a five-year period from May 2019 to May 2024. The ERP system provided complete transactional data that included only completed or partially delivered orders, ensuring that at least one product was delivered for each order in the dataset. Cancelled or deleted orders were excluded from the analysis as the scope of the study was limited to those that had progressed to delivery. This focus on completed orders allows a more detailed analysis of the invoicing mechanisms and the impact of storage costs in cases where delivery was delayed. By using this particular dataset, the study maintains a clear boundary to ensure that the results reflect the true impact of storage cost invoicing on completed orders, and thus provides insight into how storage cost management is integrated into ongoing business operations.

The data extracted from the ERP system provides a detailed overview of both product and order-related information. Product information includes details such as the type of product, what it contains, and the tax-excluded net price paid by the customer. In addition, the order information includes details on how many products were ordered, delivered and how many are still to be delivered, as well as production dates such as the start and end dates of production. It also tracks changes made to the order and records when changes were made and finalized. Another essential piece of information is the Post Goods Issue (PGI) date, which indicates when the product officially left the factory. Delivery information is also included, indicating the destination of the order and the applicable incoterms which define the responsibilities between the company and the customer. This comprehensive data set ensures that all essential factors are considered and provides a solid basis for analysing the impact of delayed collections.

In terms of data delimitation, the study narrows the focus of the study by limiting the analysis to orders under incoterms, where the customer is responsible for arranging the collection of goods at some stage of the process. More specifically, these incoterms that were used by the case company over the five-year period from May 2019 to May 2024 are CPT, FCA and FOB. By limiting the data to these incoterms, the study takes into account scenarios in which pick-up and transport arrangement delays could lead to storage cost invoicing. This restriction resulted in a significant reduction of 69,45% in the number of products analysed.

The data were further delimited by excluding the quantities of products that are still within the company and for which the final cost of storage has not yet been realized. These cases are only for orders where products have been partially delivered to the customer. As these undelivered products are still held by the company, the storage costs have not yet been realized and are therefore outside the scope of this study. In addition, the study does not take into account internal orders with a zero price, such as warranty orders and prototype orders produced by the research and development department. These zero-price orders do not give an increase to invoiceable storage costs because they either serve internal purposes or are part of special arrangements not subject to normal invoicing processes. This delimitation ensures that the analysis focuses only on customer-specific orders where the invoicing of storage costs is relevant and directly linked to the pick-up delay. The process of data collection and delimitation is presented in the figure 12 below.

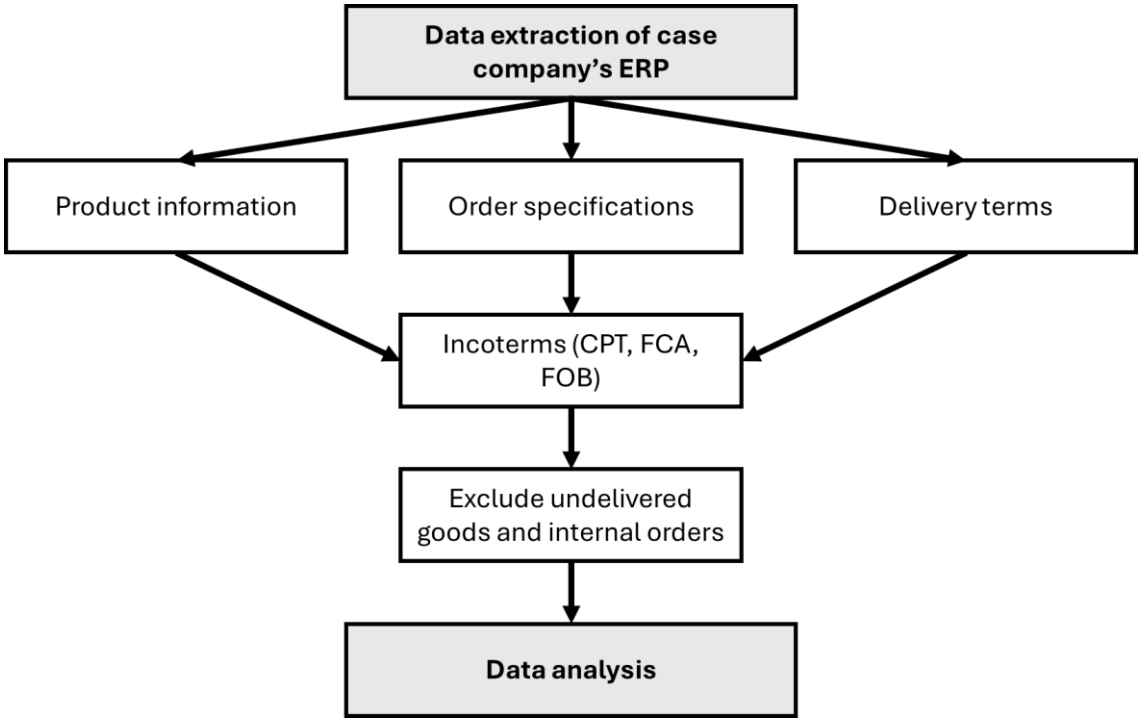

Figure 12. Data collection and delimitation process.

3.3 Data analysis method

The data analysis for this study starts by collecting, delimiting and reviewing the data from the ERP system of the case study company. This process involves a careful filtering of the data to include only relevant orders and exclude those that are incomplete, cancelled or related to internal orders that do not incur storage costs. Once the data has been extracted and checked for accuracy, it is compiled in an Excel spreadsheet for further analysis. From this table, the key data are extracted to make the structural analysis easier. The variables selected for analysis are order number and order line number, ordered quantity and open quantity, condition value, loading date and revised loading date, test date, actual production finish date, rework, incoterms and PGI date. These variables are classified and grouped into smaller items for more detailed analysis where necessary, allowing a more comprehensive evaluation of storage costs, delivery delays and the impact of contractual terms on invoicing processes. This methodology ensures that all relevant data are systematically collected and analysed to achieve the objectives of the study effectively.

The order number and order line number are used to identify each transaction in the dataset, ensuring that each product order can be accurately identified throughout the analysis. These identifiers are important for distinguishing between different transactions, especially when multiple products are ordered within a single order. The quantity ordered and open quantity variables are for determining the quantity of products delivered versus products still in process. Although the dataset has already been delimited to exclude incomplete orders, this step acts as a double-check to ensure that only fully delivered orders are taken into account when invoicing storage costs. By comparing open quantities to delivered quantities, the analysis can more effectively detect late pick-ups.

Another necessary aspect of the analysis is the condition value, which reflects the sales value of each order line. This variable is important for understanding the financial impact of delayed pick-ups, as it provides a financial reference for each transaction. In addition, the loading date and the revised loading date are examined to identify differences between the planned and actual shipment date. Any significant differences between these dates provide valuable information on where and why shipments are delayed, allowing the company to investigate potential bottlenecks or inefficiencies. The test date is also included for orders that require post production testing, which is typically the last step before packing. If testing is not completed on time, or if additional testing is required, this can directly impact the shipment schedule and delay the pick-up process.

Other key variables include the actual production finish date that records the time at which the manufacturing process is completed. This date is for understanding when the product was ready for further processes such as testing and packaging and can also reveal whether there were delays due to rework or modifications requested by the customer. The rework variable covers all cases where products have had to be modified after production, either due to quality problems or customer requests for changes. This information is for understanding the impact of production problems on the invoicing of storage costs. In addition, the incoterms used for each order play an important role in

determining the company's and the customer's responsibility for transport and risk. Data is already once delimited to CPT, FCA and FOB incoterms but this is for double check and more detailed visualization. The PGI date marks the date the products have officially left the factory. By analysing these variables together in a study, it is possible to identify the key factors that influence the delay of pick-ups and the corresponding invoicing of storage costs.

To ensure the accuracy and validity of the dataset, a verification process was carried out to ensure that the delimitation criteria had been successfully applied before. First, it was checked that the open quantity of all orders was set to zero, ensuring that only orders with no undelivered items remaining were included. At this stage, all incomplete orders were removed and it was ensured that the analysis focused only on those orders for which it was possible to invoice storage costs. Secondly, the pricing of orders was checked and it was verified that the sales value of all orders was above zero. This excluded any internal or special orders, such as warranty or prototype products, which do not incur storage costs. Finally, the dataset was checked to ensure that only specified incoterms (CPT, FCA and FOB) were included. This step ensured that the analysis was limited to situations where customers were responsible for pick-up at some stage of the delivery process. The delimitation process was successful in the beginning and the dataset was validated for accuracy, providing a solid basis for further data analysis. The key variables are concluded in the table 3 below:

Table 3. The key variables of the data collection.

Order number	Order line number	Ordered quantity	Open quantity	Condition value	Loading Date	Revised Loading Date	Test Date	Actual production finish date	Rework	Incoterms	PGI date

To accurately determine the last date a product is ready for dispatch, it is required to determine the last possible date of the production process. In manufacturing, even if the product is completed earlier than the planned loading date, the order remains waiting to be dispatched until the specified loading date. In addition, certain products may

require separate tests to be carried out after the production end date. If the product fails these tests, it will have to be reworked and a new test date will be set to replace the previous one. This ensures that the latest test date of completion is always documented. If production is delayed, the ERP system generates a revised loading date, which is always later than the original loading date, to indicate the delay in the process. In addition, if the customer requests changes to the order during production, new loading dates are calculated and replaced, as the changes usually extend the overall production schedule.

In the analysis, the latest available date is always used to identify when the product is actually ready to be shipped, and this date is then compared to the PGI date to estimate how much time has gone by between completion and actual shipment. The formula "PGI – Production finish" is used to calculate the number of days between the end of production and the product leaving the factory. The formula dynamically takes into account whether a test day exists and takes into account the additional time needed for testing. The formula "PGI – Production finish" is presented below.

$$IF(TestDate = ""; PGIDate - ProductionActualFinish; PGIDate - TestDate)$$

Similarly, the formula "PGI – Loading date" counts the number of days between the time the product is ready for dispatch and the time it actually leaves the factory and takes account of delays by selecting either a revised or an original loading date, depending on the need. The formula "PGI – Loading date" is presented below.

$$PGIDate\text{-}IF(RevisedLoadingDate="";LoadingDate;IF(RevisedLoadingDate< LoadingDate;LoadingDate;RevisedLoadingDate))$$

To ensure accuracy, the formula "Lowest PGI Difference" compares the two measures and selects the smaller of the two to indicate the shortest possible shipping delay. The formula "Lowest PGI Difference" is presented below.

$$IF(PGI - Production\ finish < PGI - Loading\ date;\ PGI - Production\ finish;\ PGI\ -Loading\ date)$$

Once the actual completion and waiting times have been identified, it can now be determined whether the product meets the criteria for storage cost invoicing. The manufacturing company will allow invoicing if the product has waited more than two weeks after completion. The formula "Over 2 weeks" is used to check if the Lowest PGI Difference exceeds 14 days, which is the free storage time after order line completion. If the waiting time is more than 14 days, the result is "OVER", which means that the storage costs can be invoiced at least one week. Otherwise, the result is "under", which means that no storage costs are applied to the order in question. The formula "Over 2 weeks" is presented below.

$$IF(Lowest\ PGI\ Difference > 14; "OVER"; "under")$$

When the two-week threshold is exceeded, the formula “Invoiceable weeks” calculates the number of weeks to be invoiced. This is done by subtracting the 14 days off from the total waiting time and dividing the remaining time by seven to convert it into weeks. The result is rounded up to the nearest whole number to ensure that all decimal fractions of a week are included in the calculation. For example, if the waiting time exceeds the 14-day limit by only one day, the result is still one invoiceable week. The formula "Invoiceable weeks" is presented below.

$$IF(Over\ 2\ weeks = "OVER";\ ROUNDUP((Lowest\ PGI\ Difference - 14)/7; 0); 0)$$

The final step is to calculate the “Invoiceable value", which determines the actual amount of money the company can charge the customer for storage costs. The first step in this calculation is to check whether the order has exceeded the two week limit. If it has, it compares the percentage (determined by the case company) of the condition value to be charged for storage costs with a predefined minimum amount. If the percentage is lower than the minimum, a fixed storage cost (determined by the case company) is applied. If it exceeds the threshold, the value to be charged is determined by multiplying the percentage of the sales price by the number of weeks the product is

stored outside the free two-week period. The formula "Invoiceable value" is presented below.

*IF(Invoiceable weeks=0;0;IF([redacted]*Condition value<=[redacted];[redacted]*Invoiceable weeks; [redacted]*Condition value*Invoiceable weeks))*

The calculated variables are concluded in the table 4 below:

Table 4. The calculated variables of data processing**.**

Prod fin - PGI	Loading - PGI	Lowest PGI Difference	Over 2 weeks	Invoiceable weeks	Invoiceable value

After analysis, the data analysed in Excel is transferred to Power BI Desktop software, where the processed data can be efficiently visualised. The software can use a variety of graphs and tables to illustrate the impact of variables on the overall picture. For example, Power BI can show which of the three incoterms is the most common, how many items in terms of quantity and sales value are waiting in stock for more than two weeks and how these orders are spread over five different years. The overall process from ERP to Power BI is illustrated in the figure 13 below:

Figure 13. Overall process of dataset collection and analysis.

3.4 Validity and reliability

To ensure the credibility of the analysis of the data in this study, both the validity and reliability of the research methods should be ensured. Validity, as outlined by Heale and Twycross (2015), refers to the level to which the data accurately reflects the concepts it is intended to measure. This study specifically addresses content validity by including all relevant aspects of storage costs in a contractual context collected from an ERP system. Given the nature of the data, which includes key variables such as order details, loading dates and incoterms, the analysis provides a comprehensive picture of the storage costs associated with delayed customer pickups. Mohajan (2017) further highlights the importance of construct validity, which is achieved by ensuring that each measurement correctly reflects the intended construct in the invoicing framework.

Reliability is maintained in this study by applying consistent data collection and delimitation methods. According to Mohajan (2017), reliability ensures that the data collection process produces consistent results over time, which is particularly important when using an ERP system. For example, if an ERP system uses the same search criteria over different time periods, the data should reflect similar trends, and variations would only be due to changes in order volumes or delays, rather than inconsistencies in data extraction. This stability is also supported by the reliability of tests to ensure that key metrics, such as storage cost calculations, remain consistent when applied over different time periods or across different product lines. By following these principles, the analysis can confidently produce data that are reliable and repeatable, consistent with Heale and Twycross (2015) view of stability and Mohajan's (2017) view of reducing systematic error. This comprehensive approach ensures that both validity and reliability are effectively integrated, making the findings of this study robust and useful.

4 Results and discussion

This chapter presents the results of the empirical study, which are structured under two subheadings corresponding to the research questions. The chapter begins by discussing research question 1 and introducing the results, followed by a detailed analysis and summary of the results. The second subheading focuses on research question 2 and starts with a presentation of the qualitative results. This is followed by the development of a data model and a visual representation of the data. The chapter concludes with an in-depth analysis, discussion, and summary of the results of research question 2.

4.1 Integrating contract and storage cost invoicing

4.1.1 Key factors for the integration of contract and storage cost invoicing

The integration of contracts into business processes is needed to align operational activities with agreed terms and conditions between different stakeholders, such as suppliers, customers and internal departments. Schuhmann and Eichhorn (2019) describe that contracts provide a framework for managing these relationships, particularly in supply chains involving the handling and storage of goods. By clearly defining terms such as the invoicing of storage costs, contracts help to ensure that both parties understand their responsibilities when the collection of goods is delayed (Davis and Vogt, 2021). In these cases, the invoicing of storage costs is based on predefined conditions, which usually include agreements on free storage periods and the charges to be applied after these periods. Kapsali et al. (2019) mentions that including contractual terms in operational business operations helps to maintain consistency and clarity, prevent potential misunderstandings and ensure that terms are respected.

The integration process requires close coordination between different departments, such as finance, logistics and sales (Feng, 2019). For example, the finance department is responsible for calculating storage fees based on contractual terms, while the logistics team manages the actual storage of goods (Lee et al., 2016). Sales teams may be

responsible for communicating these details to customers and ensuring that they are aware of their commitments regarding pick-up times and any charges for delays. Without this level of coordination, Schuhmann and Eichhorn (2019) emphasize that there is a risk of inefficiencies such as disputes over invoicing or delays in payment. They continue that integrating contractual terms into the workflow of these departments will enhance a smoother process, increase transparency and minimize the chances of non-compliance.

Fan and Wang (2018) mention that storage costs can also be affected by external factors and variations in customer behaviour, which means that contracts need to take into account possible delays due to factors beyond the control of either party, such as transport problems or changes in demand. Contracts that include clauses for such exceptional situations allow for some flexibility in the application of storage costs depending on the duration and cause of the delay. Feng (2019) points out to support accurate invoicing, companies also need systems to monitor these delays and apply appropriate charges in line with the contract. This approach ensures that invoicing processes remain in line with agreed terms, even in the event of unexpected changes in the supply chain (Penttinen et al., 2010; Feng, 2019).

Integrating the invoicing of storage costs into business processes requires a systematic approach that aligns operational activities with financial responsibility (Vandana and Das, 2022). Storage cost invoicing becomes relevant in situations where customers delay the pick-up of goods beyond the agreed time. To this end, companies should put in place invoicing methods that reflect the exact storage period and take into account any contractually agreed free storage periods. Integrating the invoicing of storage costs requires seamless coordination between different systems, in particular the ERP system, which monitors the status of products and delivery times, and the financial system, which generates invoices on the basis of contractual conditions (Faccio and Gamberi, 2021; Feng, 2019).

The process of invoicing storage costs is linked to a company's capability to monitor and control the movement of goods in its supply chain. When a product is ready for delivery and the customer fails to arrange collection within the agreed time, storage charges are incurred (Melega et al., 2025). The ERP system plays a key role here, according to Feng (2019), recording key information such as the completion of production, the date of delivery after the goods have been dispatched and any revisions to the loading schedule. This information is used to determine whether the storage time has exceeded the agreed limits and to calculate the amount to be invoiced. By integrating this functionality into the company's business process, the invoicing of storage costs becomes an automated and transparent process that reduces the risk of manual errors and ensures that customers are invoiced accurately and on time (Vandana and Das, 2022; Penttinen et al., 2010).

Integrating storage cost invoicing into the business requires a clear understanding of how storage costs are structured and how they are calculated. Melega et al. (2025) highlights that this requires defining storage unit costs in advance, usually in the form of weekly or monthly charges, and ensuring that these charges are consistently applied to all related operations. Businesses may also need to take into account different storage conditions, according to Routroy and Kodali (2005), such as temperature-controlled environments or specific handling requirements, which may affect the cost of storing goods. By integrating these aspects into the invoicing process, companies can ensure that storage costs are properly reflected in the invoices they issue to customers. This not only enhances the financial aspects of warehouse management, but also ensures contract compliance (Cai et al., 2016).

Effective integration of storage invoicing requires constant communication with customers to ensure that they are aware of any storage charges (Cheng, 2010). This can include regular updates on the status of orders and highlighting any late pick-up costs. By maintaining transparency in this area, Cheng (2010) continues that companies can help foster better customer relationships and minimize the chance of storage cost

disagreements. In addition, the use of electronic invoicing systems can enhance this process by providing customers with real-time access to their invoices, ensuring a smooth and efficient invoicing process (Penttinen et al., 2010).

4.1.2 Analysis and summary of results

Integrating the invoicing of storage costs into business processes, as discussed in the literature review, requires multiple considerations based on contract theories and supply chain management practices. By analysing the use of specific incoterms information can be obtained on how the case company manages its storage cost invoicing processes and the impact on both customer relationships and internal efficiency. As stated in the theoretical framework, supply chain process contracts need to balance legal obligations with operational objectives, taking into account customer satisfaction. This principle is reflected in the company's choice to offer a two-week free storage period to give customers time to arrange transport for their goods and to improve overall satisfaction. This decision is in line with the theories supporting customer-centered contract design.

The contract for the invoicing of storage costs will be included in the order acknowledgement for each order using the CPT, FCA and FOB incoterms, which are the only terms used by the case company that include customer’s responsibility to arrange a pick-up at some point of the deliver process. By including the contract in the order acknowledgement, the case company will ensure that customers are fully aware of their responsibilities from the beginning, as regards the pick-up of the goods on time. The contractual form provides clear documentation and serves as proof that the responsibility for arranging the pick-up lies with the customer in case of disagreements or misunderstandings later. This proactive approach enhances transparency and minimizes potential conflicts related to late pick-ups, allowing the company to protect its business interests and effectively invoice all storage costs occurred. The integration of storage cost terms in these contracts will also ensure that the company will not be held responsible for indefinite storage in cases where the customer delays pick-up. This approach shows how a company can apply contract management theories in a practical

way by sharing the risks of delay and storage in advance and clearly defining the methods of invoicing.

The exclusion of certain orders, such as warranty or prototype orders, from the invoicing process is also an indication of the considered application of contract theory. By excluding these orders from automatic invoicing, the company avoids the complications that could arise from charging internal departments or customers dealing with warranty issues. The exclusion of certain orders, such as warranty or prototype orders, from the invoicing process is also an indication of the considered application of contract theory. By excluding these orders from automatic invoicing, the company avoids the complications that could arise from charging internal departments or customers dealing with warranty issues. This practice is consistent with relational contract management, which focuses on maintaining long-term relationships and building trust between the parties. The exceptions for warranty and prototype orders reflect a customer-friendly approach that demonstrates both flexibility and fairness by not imposing additional financial obligations where this would not be appropriate. This decision, supported by the literature, strengthens the relationship between the manufacturer and its customers by demonstrating a commitment to cooperative practices.

The method of calculating storage costs, using a formula applying a percentage of the value of the order line or a fixed minimum threshold, is linked to financial theories of cost allocation and value-based pricing. One of the key ideas behind contract integration is to ensure that pricing models are both fair and transparent, and this invoicing method follows these principles. With the percentage-based formula, storage costs are directly linked to the value of the goods being stored, ensuring that higher value orders are charged at relatively higher rates. A fixed minimum quantity ensures that even smaller valued orders continue to encourage customers to arrange pick-up on time. This pricing approach is in line with literature review as it ensures that the company is compensated fairly and promotes operational efficiency while maintaining a pricing structure that is justifiable from the customer's point of view.

The invoicing strategy discussed is based on efficiency and transparency in both supply chain management and contract management. The literature points out that successful contract integration must take into account not only the ability to implement, but also operational efficiency and customer relationships. The integration of storage cost claims into the order acknowledgement phase achieves this by providing clarity for both parties and minimizing the possibility of future disagreements. The process will streamline the invoicing of storage costs and is in line with supply chain management practice, which emphasises transparency and cooperation between all parties involved in the process.

4.2 Implications for business processes of storage cost invoicing integration

In this section, research question 2 is addressed using a simple mixed method, combining both qualitative theoretical framework and quantitative data to investigate the organizational implications of integrating storage cost invoicing. The literature review provides a theoretical framework, while the data analysis provides concrete insights into how these invoicing systems affect different organizational processes. First, qualitative results are presented to provide insights into organizational behaviour and internal reactions to the integration of storage cost invoicing. The data discussed are then visualised to highlight the main trends and relationships. The results are then analysed to understand the impact of storage cost invoicing on operational efficiency, financial performance and the overall dynamics of the organization. This section thus combines theoretical insights with empirical data to provide a comprehensive view of the subject.

4.2.1 Impact of storage cost invoicing

Integrating contracts for storage cost invoicing into business processes has noticeable implications for organizational efficiency and customer relations (Schuhmann and Eichhorn, 2019). The authors continue that the integration of such contracts requires the alignment of contractual commitments with wider operational and strategic objectives. Fugate (2021) suggests that contracts are not only legal tools, but also management tools

that help coordinate supply chain activities and manage risk. The strategic use of contracts, in the context of incoterms, enhances the pick-up responsibility directly on the customer, shifting some of the operational responsibility from the manufacturer to the customer (Baena Rojas et al., 2024). This shift of responsibility ensures that the company is not financially accountable for extended storage protecting the organization from unexpected operational costs due to delayed pick-ups (Fugate, 2021).

Adapting contractual conditions to operational processes, according to Belderbos et al. (2017), improves consistency in the management of order fulfilment and logistics. They continue that by defining the terms and conditions for invoicing storage costs in contracts, a company can develop more predictable business processes and schedules and reduce the fluctuations often associated with delayed customer-arranged transports. Consistency can benefit the company by streamlining internal operations, enabling better allocation of resources and improved logistics planning (Mapanga, 2024). The use of incoterms in contracts also helps a company to comply with international trade practices by ensuring that responsibility for goods at different stages of the supply chain is clearly defined (López et al., 2024; Baena Rojas et al., 2024).

Cheng (2010) highlight the importance of integrating these agreements into a company's risk management strategy. The author continue that clearly defining the customer's responsibilities, especially with regard to the pick-up schedule, the company reduces the financial risks associated with long-term storage and delayed dispatch. The integration of contracts therefore plays a useful role in protecting a company's financial interests and improving operational efficiency further reinforcing the importance of structured contract management in business practices.

Integrating the invoicing of storage costs into the business process has a number of operational and financial implications for the company. One aspect is the impact on financial management and more specifically on cash flow and cost recovery (Alrjoub & Ahmad, 2017). By introducing a structured invoicing for storage costs, the company

creates a new revenue stream to compensate for the use of storage space after an agreed free period (Hossain et al., 2017). This mechanism ensures that the resources allocated to storage are not used without compensation, which helps to reduce the financial impact of late pick-ups by customers. From an financial point of view, invoicing for storage costs is in line with pricing strategies, according to Quan-bin (2009), as it makes sure that customers who take part in longer storage periods cover the costs incurred, which promotes a more fair financial relationship between the company and its customers.

Juan and Li (2023) also point out that resilience strategies, such as the introduction of storage cost invoicing, help operational efficiency and thereby encourage customers to pick up their goods on time. When customers are aware of the possible additional charges for late pick-ups, they are more likely to arrange transport on time. This minimizes the number of goods on hold into the warehouse and optimizes the use of storage space, allowing the company to maintain a streamlined storage system. This in turn reduces the need for special actions such as organizing extra storage space or reallocating internal resources to manage excess stock (Groten and Gallego-García, 2021). The introduction of such invoicing mechanisms will therefore directly support the company's logistical functions and help match customer behaviour with internal capacity management as Klein et al. (2012) discuss. Additionally, formalizing the invoicing process will improve internal accountability and ensure that all departments involved in logistics, sales and financial management are aligned in managing and invoicing storage costs (Cheng, 2010; Routroy and Kodal, 2005).

4.2.2 Data visualization

Power BI, described by L. T. and Gould (2019), is a powerful data analysis and visualisation tool that builds on the familiar interface of Microsoft Excel and extends its capabilities to manage and analyse large, diverse datasets from multiple sources. They continue that the tool plays a particularly important role in the self-service business intelligence toolkit which democratises data analytics by making advanced data views

easy to use for non-technical users. This principle of self-service BI allows individuals from different industries to engage in complex data processing, visualization, and analysis without in-depth programming skills (Nickell et al., 2023). Nickell et al. (2023) describe that the integration of Power BI with Excel allows users to move seamlessly to advanced features such as interactive dashboards and visual reports that promote improved data-driven decision making.

The analysed and processed data is exported from Excel to Power BI, where it is visualised to provide an overview of the orders placed over the last five years. A visualized dashboard was compiled to present invoiceable inventory data for three incoterms: CPT, FCA and FOB, including a detailed breakdown of order quantities, condition values and invoiceable weeks with a specific focus on cases where order pickup was delayed by more than two weeks. To ensure confidentiality, actual values are not shown, but visual representations provide key information on storage costs and invoicing rates. The dashboard is compiled on a single main page, so that all relevant information is displayed at a single view, making it easier to monitor key performance indicators and identify problem areas. The dashboard provides a comprehensive view of the data through various visual elements such as pie charts, bar charts and summary tables showing the distribution of order volumes by incoterms, the share of delayed orders and the annual distribution of order volumes.

The use of Power BI's drill-through features makes the dashboard even more useful. By assembling the dashboard on a single page, it simplifies the drill-through and filtering process by providing a clear and organized overview. Users can interact with specific data visualizations, such as a bar or pie chart displays, and drill down to more detailed information, such as individual order details or project manager performance. Power BI allows for dynamic data visualization and analysis by giving users the ability to select specific filter criteria when drilling down, making it easier to focus on specific areas of the data. This functionality allows for a seamless transition from an overall view to detailed level of data, making it easier to gain a deeper understanding of trends, such as

years when delays are more common, and enabling customized analyses based on filters. See the figure 14 of main dashboard below:

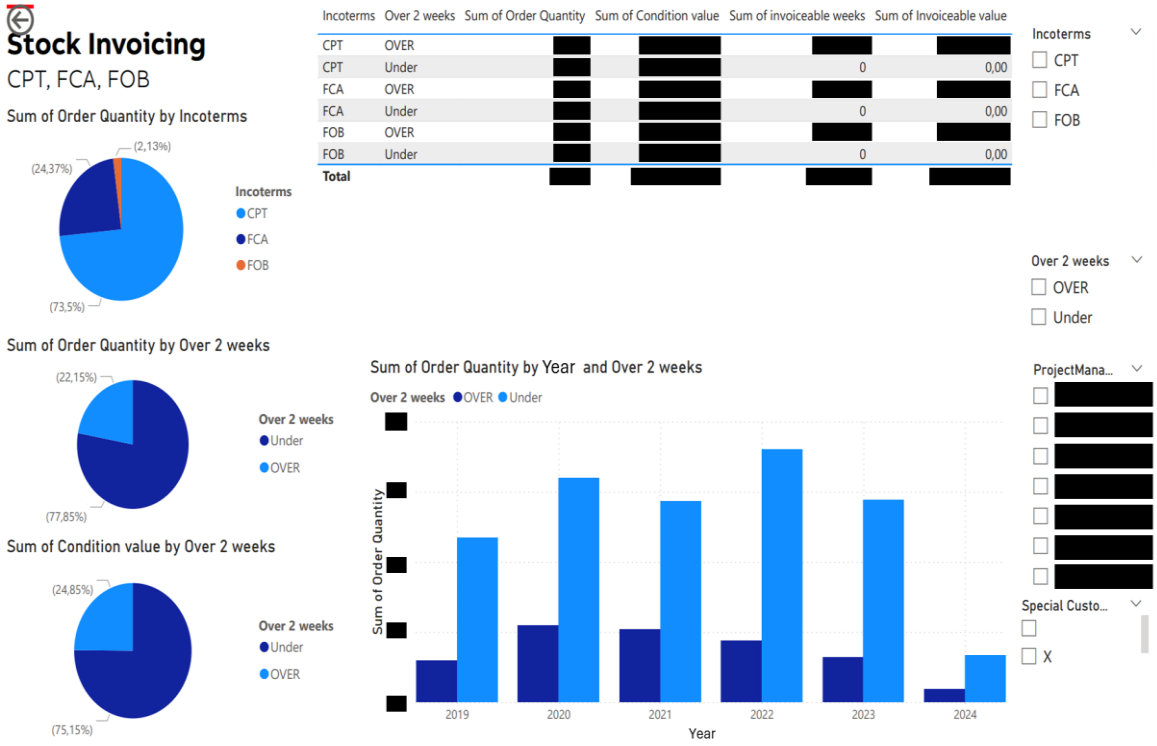

Figure 14. Main data dashboard.

The first pie chart titled "Sum of Order Quantity by Incoterms," shows a breakdown of the order quantities according to the incoterms used. The chart shows that CPT is the most frequently used term, accounting for 73,5% of the orders, followed by FCA at 24,37% and FOB at 2,13%. This distribution gives an overview of how responsibility for pick-up is allocated between customers, depending on the incoterms selected. See the figure 15 below:

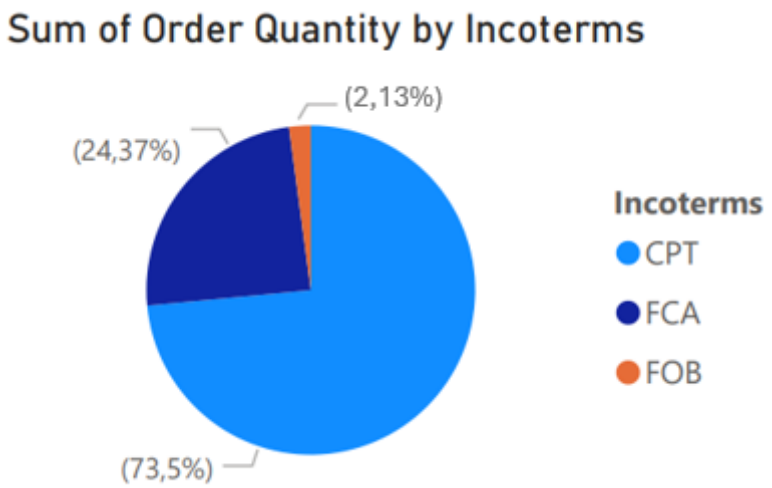

Figure 15. Sum of order quantity by incoterms.

The second pie chart “Sum of Order Quantity by Over 2 weeks” focuses on the number of orders that exceed the free 2-week storage period, indicating which orders are subject to storage cost invoicing. The data shows that 22,15% of orders exceed the 2-week limit, which means that they are eligible for invoicing, while the remaining 77,85% fall below the free storage period. This chart helps to understand the level of invoicing a company can expect based on the timing of customer pick-ups. See the figure 16 below:

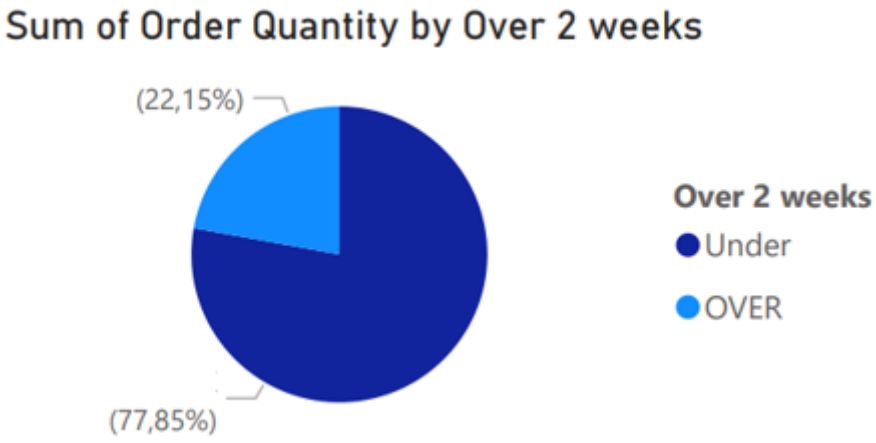

Figure 16. Sum of order quantity by over two weeks.

The third pie chart “Sum of Condition value by Over 2 weeks” shows the condition value of orders that exceed 2 weeks of storage compared to those that do not. The graph shows that 24,85% of the total order value relates to products that were stored for more than 2 weeks, confirming the potential financial impact of delayed pick-ups. See the figure 17 below:

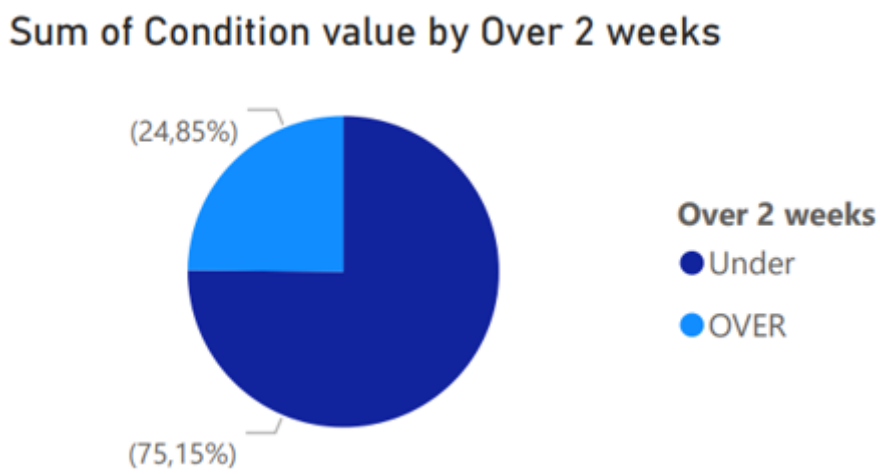

Figure 17. Sum of condition value by over two weeks.

The bar chart "Sum of Orders Quantity by Year and Over 2 weeks" provides an annual analysis of how the number of delayed orders (over 2 weeks) compares to the number of orders picked within the free stock period. As the data are collected from May 2019 to May 2024, there are only almost half a year of data in the years 2019 and 2024. Compared to 2020 - 2023, these years are complete and comparable. This historical trend is useful for identifying customer behaviour patterns and how stocking delays develop over time potentially reflecting external factors affecting the picking process. The Y-axis values, sum of order quantity, are hidden as they are confidential. See the figure 18 below:

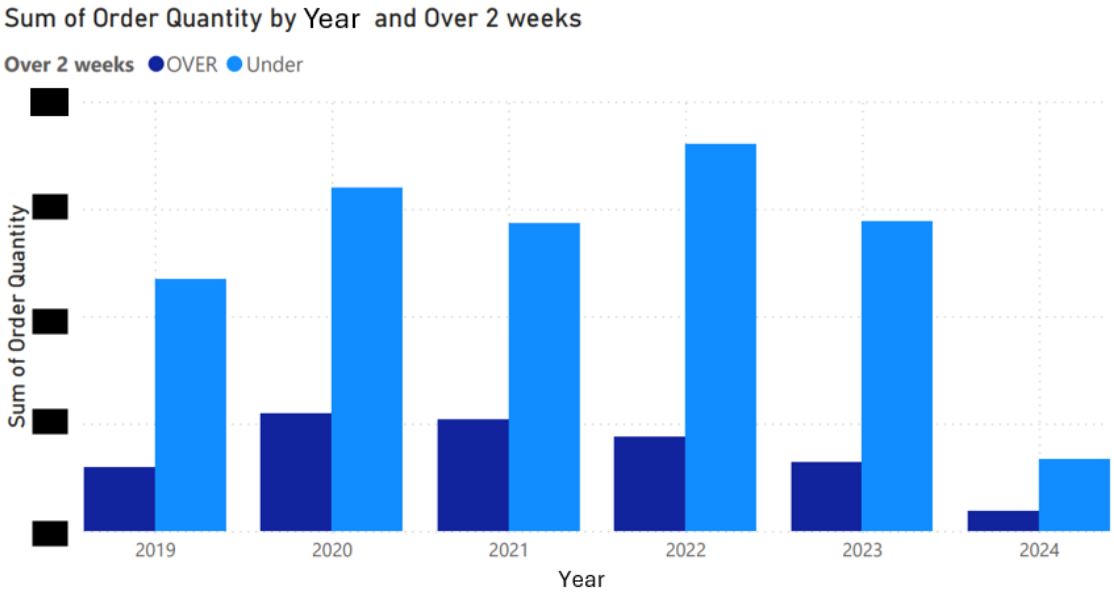

Figure 18. Sum of order quantity by year and over two weeks.

The figure at the top summarizes the detailed numerical information on the sum of the order quantities, condition values, invoiceable weeks and invoiceable values for each incoterm. This figure allows a more detailed analysis, but for confidentiality reasons most of the values are hidden. However, the figure shows the structure of the invoicing process and the difference between orders that exceeded the two week limit and those that did not. In addition, the figure proves that the processed data for orders picked up within the two-week limit does not show the weekly quantity or price to be invoiced, which means that the data analysis has been successful. See the figure 19 below:

Incoterms	Over 2 weeks	Sum of Order Quantity	Sum of Condition value	Sum of invoiceable weeks	Sum of Invoiceable value
CPT	OVER	[redacted]	[redacted]	[redacted]	[redacted]
CPT	Under	[redacted]	[redacted]	0	0,00
FCA	OVER	[redacted]	[redacted]	[redacted]	[redacted]
FCA	Under	[redacted]	[redacted]	0	0,00
FOB	OVER	[redacted]	[redacted]	[redacted]	[redacted]
FOB	Under	[redacted]	[redacted]	0	0,00
Total		[redacted]	[redacted]	[redacted]	[redacted]

Figure 19. Concluded data by incoterms and over two weeks**.**

For internal analysis, filtering options were added to the right-hand side of the dashboard to help further analysis and specification of the data. These filterable variables include project managers, who are responsible for coordinating their own responsibility orders, and the special customer indicator, which are flagged in the ERP system as a special case.

Data processing allows further analysis by filtering order lines with the variable "OVER" under Over 2 weeks. This allows to see order lines that have been in stock for delivery for more than 2 weeks and to see the distribution of incoterms by number of pieces and by value. The distribution of incoterms by number of products for late picked is illustrated in the figure 20 below:

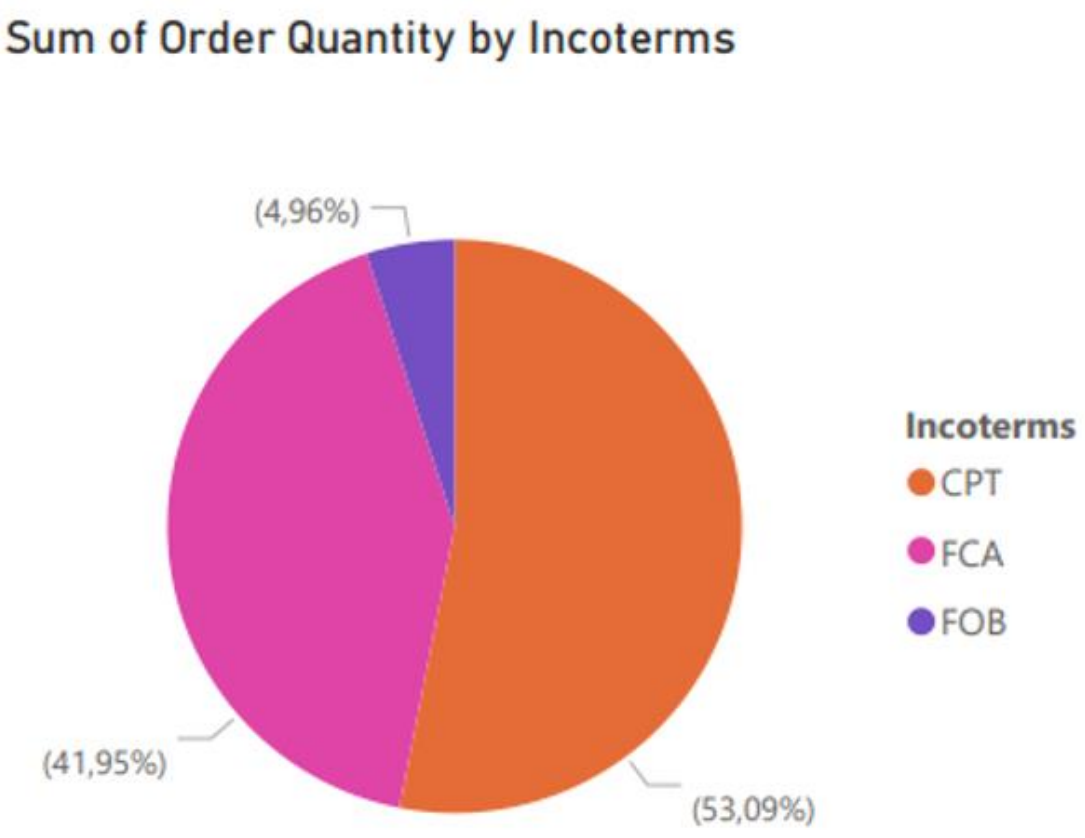

Figure 20. Sum of order quantity by incoterms.

At the same time, we can filter the value of the order lines instead of the number of pieces. The figure 21 below shows the value of the order lines picked up late by incoterms.

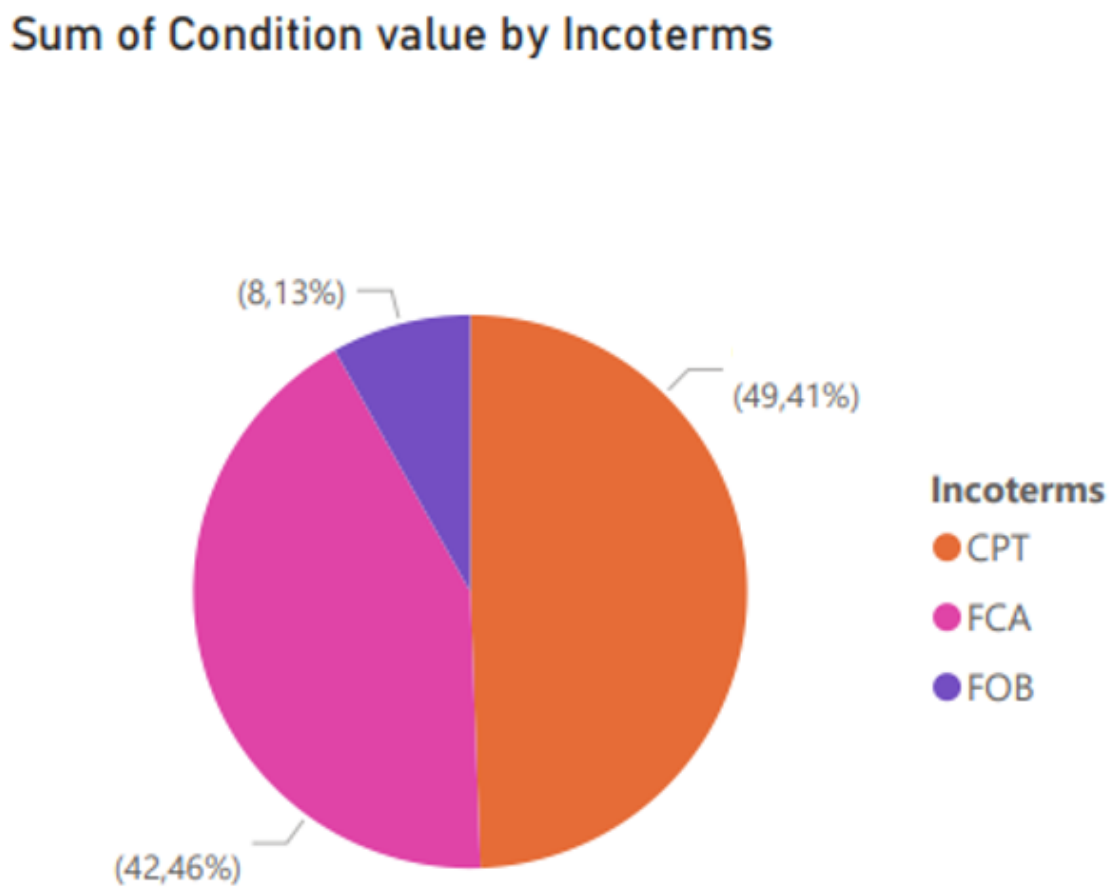

Figure 21. Sum of condition value by incoterms.

4.2.3 Analysis and summary of results

The data visualized in figure 18 gives a comprehensive picture of the delays that could have been reduced in previous years by integrating storage cost invoicing into the business process. One of the most important aspects highlighted in the data is the year-on-year adjustments that need to be taken into account when analysing the dataset from May 2019 to May 2024. In 2019, the data only starts in May, which explains the lower

order volume in that year compared to the following years. Similarly, the data for 2024 are incomplete as they only include orders from January to May, which also leads to an apparent decrease in orders for that year. These factors need to be taken into account when comparing trends between years, as they can lead to a misleading picture of annual performance if not properly correlated. Given the limitations of these data, a company should be careful when using trends based on partial data sets to avoid drawing inaccurate conclusions about ordering patterns and the impact of inventory cost invoicing over time.

Another notable finding is the distribution of incoterms across orders. The data shows that the company uses CPT terms a lot, accounting for 73,5% of the total number of orders. This use of CPT terms reflects the company or customer’s preference to take responsibility for delivery until the goods are delivered to the carrier, transferring the responsibility for transport arrangements and costs to the customer thereafter. Compared to other two incoterms, FCA is used in 24,37% of cases and FOB in only 2,13% of cases. The frequency of CPT suggests that the company has strategically chosen incoterms that clearly define the customer's responsibility for picking up the goods from the carrier. This choice reduces the operational risks associated with delayed collections, but it also highlights how the company strategically uses the incoterm to match the customer's responsibility with its own invoicing for storage costs. As noted in the qualitative findings, the integration of these contractual terms helps to streamline internal processes, ensure clearer responsibility and reduce the financial risks associated with delayed storage. This strategic approach to the selection of contractual terms ensures that the customer is more actively involved in the logistics process, which directly affects the company's ability to invoice storage costs in the event of delays.

An analysis of the data on delayed collections reveals some significant trends in the organization's handling of storage costs and customer responsibilities. The pie chart "Sum of Order Quantity by Over 2 Weeks" (figure 16) shows that 77,85% of orders are being collected within the free two-week timeframe, which reflects positively on the

company's logistical processes and customer cooperation. However, the remaining 22,15% of orders are delayed by more than two weeks, causing additional operational difficulties and storage costs. Although this is only a small share of orders, it is still significant when considering the total financial and logistical costs. Delays increase storage requirements and reduce warehouse efficiency, forcing the company to allocate resources to managing products in stock for longer than planned. This highlights the importance of establishing clear contractual terms to reduce the operational risks and financial costs of delays.

When analysing the bar chart "Sum of Order Quantity by Year and Over 2 Weeks" (figure 18) it is noticed that the years 2020 and 2021 had the highest number of delayed collections which can be seen indicated by the darker blue bars. These differences align with global supply chain disruptions such as the COVID-19 pandemic and shipping crises which likely contributed to logistical challenges on both the company and customer sides. The decrease in delayed pick-ups from 2022 onwards suggests that these external disruptions have been reduced and that the customer is more willing to arrange pick-ups for the orders. The downward trend in delays is a positive indicator that MTO products are leaving the factory on time. However, the increase in delays in 2020 and 2021 is an indication that external factors and customer behaviour need to be constantly monitored to ensure that the storage cost invoicing system is effective in preventing long-term problems.

The financial impact of late pick-ups gives a clear picture of the impact of delays on both storage costs and overall revenue collection. The chart “Condition Value by Over 2 Week” (figure 17) shows that 24,85% of the total order value is related to delayed orders that are waiting for more than 2 weeks of free storage time. This is a considerable share, especially since only 22,15% of orders are delayed, indicating that pick-up delays are more likely to affect orders with a higher value. From a cash flow management point of view, this creates difficulties for the company as revenue from these high-value orders cannot be recognised or invoiced until the goods have been delivered to the customer. Delays in invoicing disrupt financial forecasts, making it more difficult for the company

to accurately forecast its revenue streams, which can lead to an increase in working capital requirements as inventory is held longer.

Analysis of the financial data shows that the total storage costs that may be invoiced for these delayed orders over a five-year period amount to 1,27% of the total value of goods delivered for CPT, FCA and FOB. Although this percentage may seem small, it is a concrete cost that a company has been covered from its revenues. Delays in picking up goods increase the load on warehouse space, which can lead to reduced efficiency and additional costs. These findings highlight the importance of including the invoicing of storage costs in the contract to ensure that the financial costs of delayed pick-ups are not passed on to the company alone. The strategic use of Incoterms such as CPT, FCA and FOB plays a role in transferring the pick-up responsibility to the customer, allowing the company to pass on these costs when necessary and minimize the financial impact of delays.

An analysis of the processed data, with a particular focus on order lines where the variable "OVER" is set to more than two weeks, reveals the distribution of the incoterms of orders that have exceeded the free stock period. The distribution of late orders shows that 53,09% of these orders are CPT, 41,95% FCA and 4,96% FOB. This distribution reflects the significant role of CPT in delayed pick-ups, suggesting that when the manufacturer takes responsibility for delivery up to the carrier, as in CPT, delays may be common. In this data set, CPTs are 11,76% late. The analysis of FCA orders in delayed inventory suggests that delays still occur even when the customer is responsible for picking up the goods earlier in the process. However, the high share of FCA orders in delayed pick-ups compared to the total of 24,37% suggests that delays occur at a significant rate in relation to their volume, even when the customer is responsible for picking up the goods earlier in the process. More than two out of five FCA orders are delayed due to pick-up and, overall, almost one in ten products (9,29%) are delayed due to FCA reasons. The lower number of FOB orders suggests that this term is used less frequently (1,10% of total dataset), but it should be noted that delays occur for all terms,

suggesting that the specific logistical arrangements associated with each term affect the timing of pick-ups. These shares are grouped in the figure 22 below:

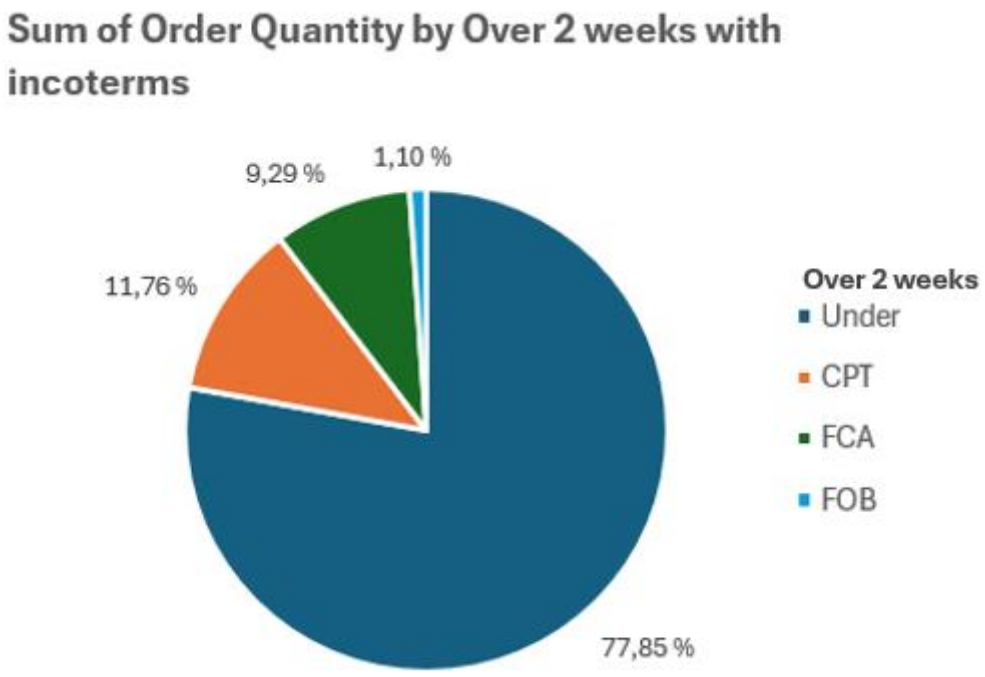

Figure 22. Sum of order quantity by over 2 weeks with incoterms.

When looking at the value distribution of late pick-ups filtered by incoterms, it is essential to compare these shares with the total value of orders with delayed delivery due to the late pick-up. The total value of late pick-ups represents 24,85% of the total dataset. For CPT, late pick-ups orders make for 49,41% of the value of late orders which means that 12,28% of entire data's order backlog from last five years is late due to CPT pick-up issues. This phenomenon was to be expected as CPT is by far the most common of the three incoterms, making for 73,5% of this data sample. In contrast, FCA makes for only 24,37% of total orders, but 42,46% of the value of delayed pick-up, indicating that delayed FCA orders have a more significant financial implication compared to quantity of products. The share of total value is 10,55%. Although FOB orders represent the smallest share of total orders (2,13%), they make up 8,13% of the value of delayed collections, further highlighting the high impact of high-value FOB orders on delayed

pick-ups. However, this may be due to the fact that the share of late FOBs in this sample is so small that single delivery cases are more likely to increase the value. The total share of the value is for FOB 2,02%. This variation in the distribution of value across different incoterms suggests that the financial impact of late pick-ups is significant for CPT and FCA orders, highlighting the importance of adjusting storage cost invoicing practices. These shares are grouped in the figure 23 below:

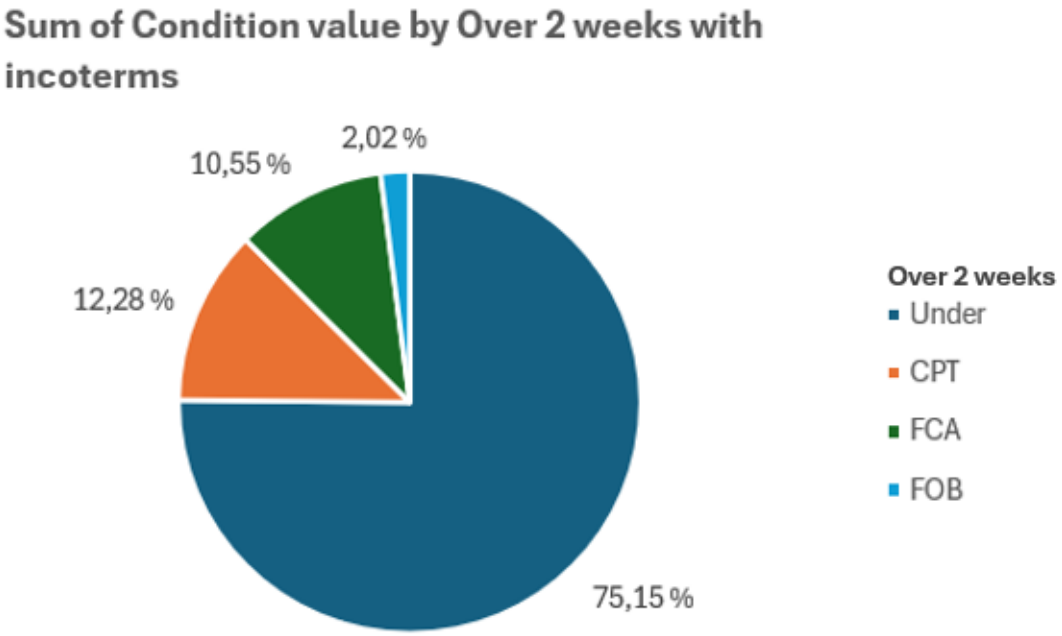

Figure 23. Sum of condition value by over 2 weeks with incoterms.

Analysis of the data collected from May 2019 to May 2024 highlights several key trends related to delayed pick-ups and their financial impact. The lower volumes recorded in 2019 and 2024 are explained by incomplete data sets, which need to be taken into account when analysing the data trends. The majority of orders are picked up during the two week free storage period but a significant share of delayed pick-ups, 22,15% of orders, which significantly increases storage costs. Delays were particularly significant in 2020 and 2021, which may be due to external disruptions in the supply chain but since then the trend has been in decline. In the incoterms, CPT makes for 53,09% of delayed

orders, while FCA accounted for 41,95% of delayed orders, with a higher share of delays compared to its total order volume, suggesting that customer-side delays occur even when transport responsibility is transferred earlier in the process. Both CPT and FCA delays have a significant financial impact, with CPT delays making up 49,41% and FCA 42,46% of the value of the delayed orders. Although FOB accounts for a smaller share of orders, delays still occur in all incoterms, indicating that the specific characteristics of each incoterm contribute to the rate of late pick-ups and their financial implications.

Reflecting the qualitative results on the whole dataset without limitations reveals the impact of customer delays on overall manufacturing performance highlighting the operational implications of these findings for top management. When the data is analysed holistically, it becomes clear how delays in customer pick-ups impact production scheduling efficiency, increase inventory costs and misallocation of resources. These inefficiencies not only affect the direct production result, but also have a multiplier effect on inventory management, space utilization and the ability to complete new orders. Demonstrating these impacts in terms of the number of units delayed and the associated value provides a clear indicator that can be used to guide strategic decision-making. Such insights are beneficial to identifying bottlenecks, optimizing the MTO process and ensuring that operational workflow remains aligned with organizational goals, eventually improving overall productivity and profitability. The delay due to customers compared to the overall operational performance is shown in the figure 24 below:

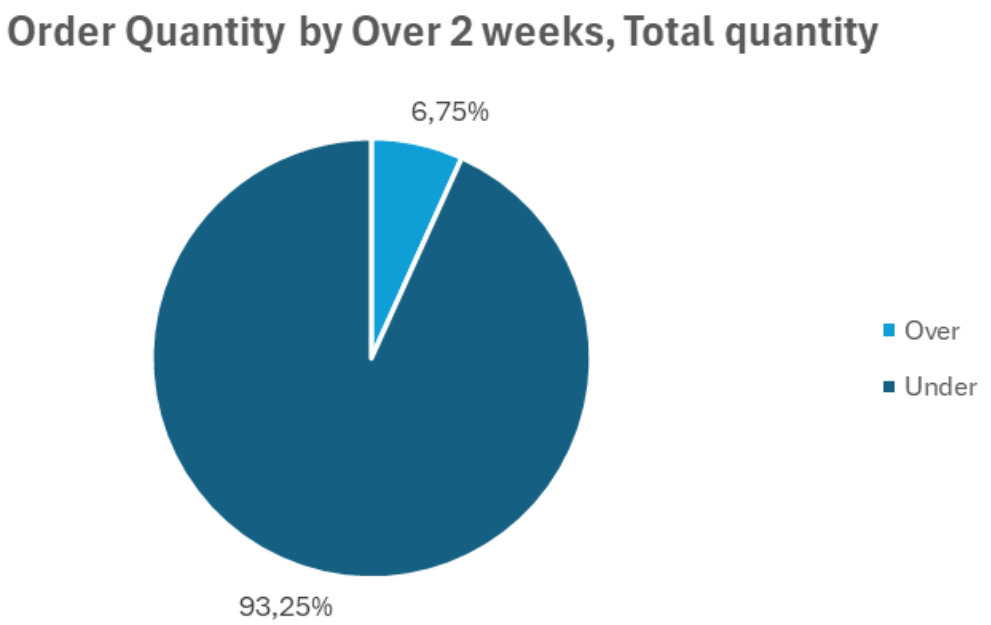

Figure 24. Order quantity by over 2 weeks compared to the total quantity.

The figure 24 presents the distribution of delayed collections by customers of goods ready for delivery over the entire five years in terms of the quantity delivered to customers. It shows that 6,75% of all delivered items were delayed by more than 2 weeks due to the customer. From this graph it cannot be said that 93,25% were on time as that share includes other delivery terms where the manufacturing company is responsible for organizing delivery to customer's site. However, it can be stated that 6,75% of the total five years of deliveries delayed by more than two weeks due to the customer has a significant impact on operational and financial performance. The distinction between on-time and delayed orders also highlights opportunities for process improvement supporting the organisation's efforts to optimize logistics and reduce the frequency of delays. From a contractual perspective, these findings highlight the importance of clearly defining the customer's responsibility for collection schedules and related costs, as a significant share of delays can impact on the use of warehouse space and create additional costs that an organisation would prefer not to take on. Additionally, delays caused by customers also mean that the realisation of the order revenue will be delayed

until the responsibility for the order has been transferred to the customer. This share is shown in figure 25 below:

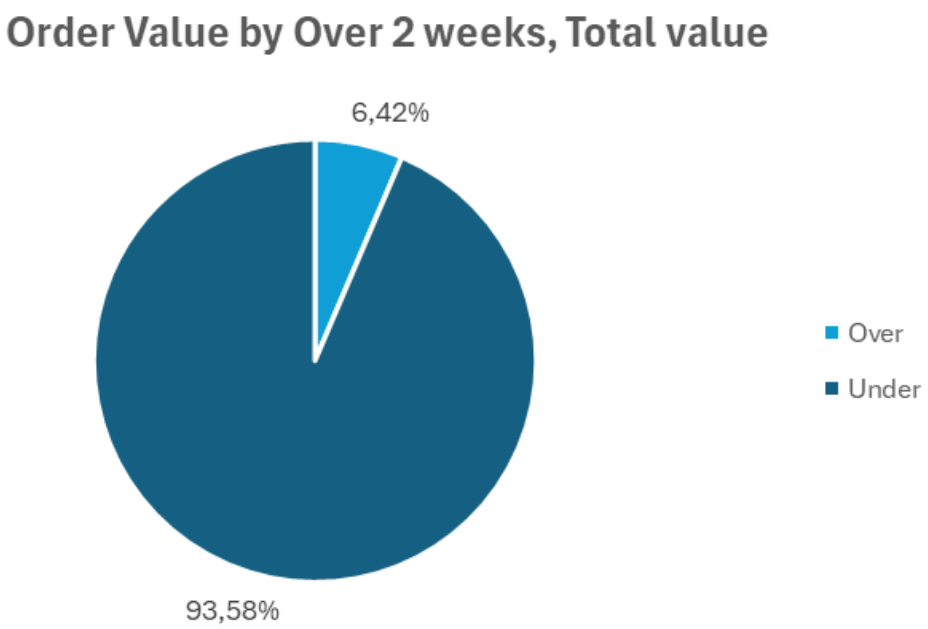

Figure 25. Order value by over 2 weeks compared to the total quantity.

Figure 25 demonstrates the impact of customer delays of more than two weeks on recovery as 6,42% of the total value of orders was delayed due to a delay in customer collection. This chart shows a similar trend to the previous analysis in figure 24 where 6,75% of the quantities delivered were affected by delays. While the previous chart highlighted the number of delayed items, this chart highlights the financial implications, as it shows that delays represent a noticeable share of the total value of goods delivered over the whole period analysed. As the value of the orders have delayed 6,42% over two weeks, it directly affects the manufacturing company's cash flow and financial planning. This only benefits the customer as they receive more time to pay for the order until they arrange a collection for their order. Additionally, these findings highlight the need to coordinate contractual conditions and invoicing strategies for customer pick-up responsibilities in order to effectively manage the disruptions in the operative processes. Comparing the two charts, it might be thought that an impact of less than 10% sounds

small, but when these proportions of total activity are taken into account, the impact is significant.

5 Conclusions

The final chapter of the study presents the main findings and contributes to the current scientific literature. It also discusses theoretical implications, practical implications for management applications, in particular for improving operational efficiency, financial performance and logistics management. It also acknowledges the limitations of the research and makes recommendations for future research directions to further explore the topic.

5.1 Main findings and results

The purpose of the study is to investigate the organizational impact of integrating storage cost invoicing into business processes focusing on delayed pick-ups. The study presents the main results of a mixed-methods approach that includes both quantitative data analysis and qualitative insights into contract and storage cost management. One of the key findings is that the introduction of storage cost invoicing has effects on operational efficiency, financial management and customer behaviour. By encouraging customers more for the on-time pick-up of ready-to-deliver goods, companies can manage storage capacity more effectively and reduce unnecessary storage costs. Collected data indicates that while a high share of orders is picked within the two-week free storage period, a considerable share of high value orders are delayed leading to an increase in overall storage costs and financial instability.

The first key factor in integrating the contract is to create clear and legal contractual conditions, defining the roles and responsibilities of both the manufacturer and the customer in terms of pick-up schedules and processing delays. A clear and legally approved contract ensures that the conditions, in particular those relating to late collections and storage costs, are transparent and executable, reducing the probability of disagreements. Another key factor is the sharing of responsibility, in particular through the use of incoterms such as CPT, FCA and FOB clauses, which specify at which stage the customer takes responsibility for the goods. This makes sure that both parties

are aligned in terms of logistical processes and that customers are responsible for their responsibilities to arrange pick-up on time. In addition, customer communication is one of the key factors to effectively integrate the contract into business processes. Providing customers with clear and consistent information about their responsibilities for collection and the potential financial implications of delays helps to improve transparency, strengthen relationships and reduce the risk of misunderstandings. These three key factors should be considered when integrating the contract into business processes.

In integrating the invoicing of storage costs into business processes, operational and financial monitoring plays key role, as it allows the company to accurately monitor and invoice storage costs, particularly when products have been finished from production and remain in stock after the agreed free period. By monitoring these processes, the company can prevent late collections from leading to uncovered costs and therefore secure its operational and financial interests. Resource planning is another important factor as the effective use of storage space and internal logistics is key to avoiding bottlenecks and ensuring that storage facilities are not overloaded by extended delays in customer pick-ups. The introduction of storage cost invoicing will encourage customers to meet agreed schedules, freeing up storage space for new orders and improving overall operational efficiency. In addition, aligning responsibilities and consequences between the company and its customers will help to promote on-time pick-ups. By clearly communicating the financial consequences of delayed pick-ups, the company aligns customer behaviour with its own logistical and operational objectives, creating a beneficial arrangement that increases supply chain efficiency. These factors ensure that the integration of both contract and invoicing mechanisms supports the company's wider strategic objectives while focusing on operational and financial efficiency and together answer to research question 1.

One of the main implications, of integrating the contract and implementation of storage cost invoicing, is improved cash flow and revenue generation as the introduction of

storage cost invoicing ensures that the company is compensated for the extended use of its storage facilities and that the orders are recognised as revenue when they are handed to the customer. By formalizing this process in contracts, the company reduces the financial impact of long-term storage when customers do not pick up goods on time. Another significant implication is improved logistical efficiency. As empirical evidence from the dataset shows, delayed pick-ups take up valuable storage space and also disrupt the flow of goods and resource allocation within the company. When customers are financially responsible for delays, they are encouraged to collect their products on time reducing supply chain bottlenecks and improving overall inventory management. In addition, integrating the invoicing of storage costs into business processes improves the robustness and transparency of the organization. With clear contractual conditions for storage costs, all departments involved from sales to logistics, are aligned in managing storage costs and meeting customer requirements. This structured approach to contract management and invoicing supports better coordination between internal teams and streamlines decision-making processes, especially in balancing customer service and operational cost recovery. These effects demonstrate how integrating such mechanisms into business processes not only helps to protect the company's financial interests but also promotes more efficient and streamlined operations throughout the organization. These implications answer research question 2 and together with the key factors of integration create an understanding of the benefits that a company can bring to its business processes. These factors and implications are summarised in the figure 26 below:

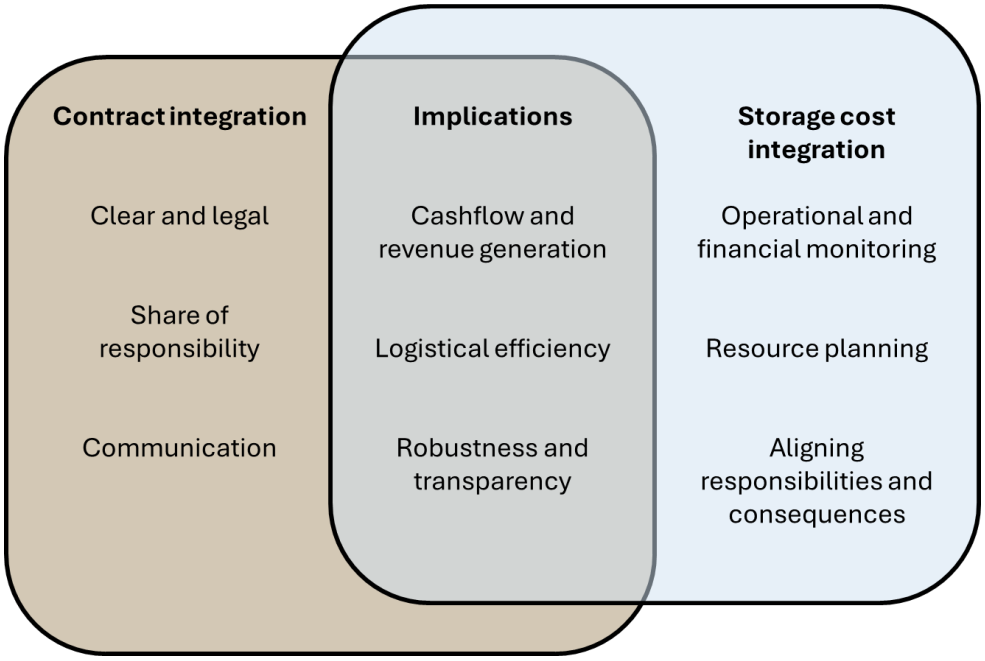

Figure 26. Key factors and implications of integration.

The quantitative results of the study provide detailed evidence of the implications of integrating the invoicing of storage costs due to delays in customer pick-ups into the business process. One of the main findings concerns the number of delays that exceed the two-week free storage period. The data shows that 6,75% of all orders are delayed by more than two weeks between May 2019 and May 2024 and therefore should be charged storage costs. When considering only the CPT, FCA and FOB incoterms, which are the only incoterms used in the case company for which it is the customer's responsibility to arrange the pick-up at some point in the process, the delay is 22,15% of the delimited dataset. This figure 16 is significant as it reflects the frequency of delays caused by customers requiring additional storage costs to be charged and delays from the factory's perspective. A breakdown of these delays by incoterms shows that CPT accounts for the largest share, 73,5% of all orders, while FCA and FOB account for 24,37% and 2,13% respectively. Although CPT is the most common term, it should be noted that delays occur in all three incoterms, indicating that customer behaviour with pick-up arrangements is a systemic problem regardless of contractual responsibilities. This quantifiable delay suggests the possibility of recoveries through efficient invoicing

mechanisms, especially for high value orders where delays significantly increase inventory management costs.

In addition to the frequency of delays, the quantitative analysis also revealed the financial impact of delayed collections which amounted to 6,42% of the total value of orders was due to orders more than two weeks late. When applying the same delimitation as for the total, the share of value delayed by more than 2 weeks is 24,85%. This percentage is higher than the percentage of delayed quantities (22,15%) indicating that delayed orders are among high-value products. This difference means that delays are not evenly distributed across all orders, but tend to affect the more financially significant orders, with a further negative impact on revenue recognition and financial planning. The annual analysis also reveals a historical trend of increased delays in 2020 and 2021, likely driven by external factors such as the COVID-19 pandemic, which caused supply chain disruptions. The reduction in delays after 2021 suggests an improvement, but the cumulative impact of these disruptions has still a financial effect which highlights the need for better contractual and operational compliance to manage customer delays more effectively.

When looking at the overall business implications, operational impacts due to delays are discovered, which could be reduced through strategic actions. A holistic analysis shows how delays in customer collections disrupt production scheduling, lead to increased inventory costs and cause inappropriate allocation of resources. These identified inefficiencies extend beyond direct production results and create a multiplier effect that reduces inventory management, space utilization and the ability to produce new orders quickly. The results highlight the need for strategic action to counteract these implications, as delays in customer collection affect cash flow and delay revenue recognition. Delays primarily benefit customers by allowing them to extend their payment commitments, but also have a negative impact on the financial and operational performance of the manufacturer. Therefore, clearly defining customer responsibility for collection schedules and integrating invoicing strategies to cover excess inventory costs

are needed measures to minimize disruptions, optimize logistics and eventually increase productivity and profitability across the entire manufacturing operation.

5.2 Theoretical implications

The number of different frameworks in the literature on supply chain management has been rising while the has been little attempt to further stress the existing inconsistencies. Usually, the reason behind these inconsistencies falls to the fact that these frameworks are constructed, for instance, without the participation of practitioners (Soni and Kodali, 2011). A similar trend is seen in other disciplines of supply chain management research where the focus has been much on purely product flows, while Enz and Lambert (2023) highlight that the two most cited supply chain management frameworks for services lack sufficient conceptual rigor and methodological clarity. To build upon these pitfalls, this paper presents an approach to bridging theoretical gaps with practical insights by focusing on the often overlooked problem of storage cost invoicing for delayed customer pick-ups. By integrating contract management theory with supply chain principles, this study brings clarity to the cost dynamics of delayed supply chains and seeks to create a coherent, practical framework that better harmonizes operational and financial responsibilities.

The study contributes to the field of supply chain management as well as the management of the contractual costs, which contributes to an understanding of the impact of late collections on both operational efficiency and financial results. By focusing on specific contract terms and their financial implications, this study highlights the importance of contract clarity and shared responsibility in complex supply chains, particularly in situations involving ready-to-deliver goods.

The results of this research can also be expanded to the field of service-dominant logic, whereas Enz and Lambert (2023) point out that the management of processes is the main focus compared to the products and materials. Storage for ready-to-delivery goods in case of delayed pick-ups can also be considered as a service. It involves providing a

specific service to a customer, for which additional value capture could be redeemed. However, the service-dominant logic and supply chain management literature lacks specific guidance on identifying, combining, and leveraging underutilized resources within service supply chains. To build upon this, this research highlights how storage as a service can be effectively managed and monetized through structured invoicing and contractual relationships. By applying the principles of service-based logic to the management of storage costs, this study expands the view of storage services as an integral part of supply chain management and advocates a framework to better account for the financial impact of extended storage services in delayed customer incidents.

The proposed conceptual framework (figure 9) encourages researchers to collaborate in validating and refining supply chain management pillars and constructs to unify the supply chain management discipline whilst taking into account the main factors. The integration of contractual and operational aspects into the supply chain framework not only addresses traditional gaps in operationally focused research, but also supports the development of a more holistic and comprehensive view of supply chain responsibility. The proposed framework requires further statistical validation and generalisation. Once its reliability and validity are established in the greater matter, the refined constructs can serve as a definitive set of measures for supply chain management excellence in strategy, planning, and operations.

5.3 Managerial implications

The case company can use the framework (figure 9) developed in this study to effectively define and implement a storage cost invoicing contract and ensure a structured and efficient approach to managing delayed customer pick-ups for ready-to-deliver goods. By clearly defining the terms and conditions of storage cost invoicing in the contract, a company can define the responsibility of customers for on-time pick-up of goods and create financial responsibility for extended use of storage space. This integration into the business process would not only streamline the invoicing process but also promote a proactive approach to manage customer’s logistical arrangements and minimise delays.

The introduction of storage cost invoicing would further align the company's operational objectives and financial management by linking storage costs directly to customer behaviour. This would allow the company to recover the costs associated with delayed pick-ups, improve cash flow and optimise the use of warehouse space. The integration of contract and invoicing will ensure that internal processes are aligned, leading to better resource planning, more predictable operations and better overall financial performance. Eventually, this framework will provide the case company with a strategic advantage in reducing additional costs and risks associated with storage, improving customer responsiveness and increasing operational efficiency.

From a managerial perspective, addressing the impact of customer delays on manufacturing performance is relevant to improving overall business processes. The company should recognize that customer pick-up delays disrupt production scheduling, increase inventory costs and cause misallocation of resources, eventually affecting both operational efficiency and profitability. To reduce these problems, it is useful to clearly define the customer's responsibility for pick-up schedules and to include invoicing strategies to cover additional storage costs and encourage the customer to arrange the pick-up on time. These measures can help to minimize disruptions, optimize logistics, and improve productivity and profitability across the organization.

Managers should use the analysis of empirical data to gain insights into customer behaviour and performance. By analysing trends in customer pick-up delays under different delivery terms, such as CPT, FCA and FOB, the company can identify recurring patterns that cause bottlenecks in the processes. This data-driven approach enables proactive decision-making to resolve bottlenecks and improve logistical processes. In addition, analysing trends in late pick-ups or extended inventory usage helps to more accurately forecast future storage needs improving efficient management of storage capacity and reducing unnecessary costs. Managers can also use this information to adjust pricing strategies, review contract terms and conditions, and introduce customer-

specific incentives or penalties for on-time collections, thereby improving operational efficiency and customer relations.

To reduce the financial and operational impact of delayed pick-ups, the companies should consider taking a number of actions. First, introducing stricter contractual terms for late collections can encourage customers to manage their logistics more efficiently, thereby reducing additional costs and improving revenue recognition. Better communication with customers is also important to ensure that they understand their pick-up responsibilities and schedules, which will help prevent delays before they occur. Continuous monitoring of trends, especially for high-value orders, and the use of proactive analytics can help predict potential logistical disruptions, allowing managers to take preventative action. In addition, developing a risk management strategy focused on high-value orders will help reduce the financial and operational risks associated with late pick-ups which will eventually support a more efficient and profitable business process.

5.4 Limitations and future research

The limitations of this study are mainly due to its focus on a single case study company and its specific order process and data, which limits the generality of the results. The study considers only three incoterms as defined by the case company so the conclusions drawn may not be applicable to other delivery terms or to companies using different contractual frameworks. Although the qualitative data were collected from external sources, the analysis is largely influenced by the internal processes of the case company and the findings may therefore not be fully representative of wider industry practices. The empirical data analysed only cover the last five years, of which only four are full years, limiting the ability to identify long-term trends or to evaluate current developments as a whole. While these limitations provide valuable information for the case study, the results of the study may not be generally applicable without further research in other contexts and over longer time periods. In addition, other limitations of the study include the fact that certain factors, such as external market conditions,

economic fluctuations or supply chain disruptions, which may affect the invoicing process for storage costs, are not fully taken into account in this study. The study also focuses primarily on the operational and financial implications of integrating storage cost invoicing without examining in depth the possible cultural and social implications.

Future research could explore the possibility of including the invoicing of storage costs in a wider range of incoterms, such as Delivered at Place. This would offer a valuable understanding of how storage cost invoicing could work for different contractual conditions and transport responsibilities. By studying incoterms, researchers could evaluate how increased manufacturer responsibility in the transportation process affects storage costs, customer behaviour and overall profitability. In addition, future studies could investigate how different customer segments respond to invoicing mechanisms in different industries providing a more complete understanding of how storage costs are managed in different environments. Additionally, the study could explore how new technologies such as blockchain, AI or real-time monitoring systems can improve the efficiency of storage cost invoicing and increase the transparency of the logistics process. Prior studies have already shown prominent opportunities for growth in areas like resilience and sustainability that are seen as vital points for organizations' value network and operational landscape while further studies in this regard are needed.

References

Abdollahpour, S., & Rezaian, J. (2017). Two new meta-heuristics for no-wait flexible flow shop scheduling problem with capacitated machines, mixed make-to-order and make-to-stock policy. Soft computing (Berlin, Germany), 21(12), 3147-3165. https://doi.org/10.1007/s00500-016-2185-z

Aboolian, R., Berman, O., & Wang, J. (2021). Responsive make-to-order supply chain network design. *Naval research logistics, 68*(2), 241-258. https://doi.org/10.1002/nav.21940

Adeniran, I. A., Efunniyi, C. P., Osundare, O. S., & Abhulimen, A. O. (2024). Optimizing logistics and supply chain management through advanced analytics: Insights from industries. *Engineering Science & Technology Journal*, *5*(8)

Ahmad, H., Hanandeh, R., Mustafa, H., Alzagheer, H., & Barakat, S. (2021). The effects of ERP system implementation on the integration of Supply Chain. *Uncertain supply chain management, 9*(4), 1099-1106. https://doi.org/10.5267/j.uscm.2021.x.009

Akkermans, H. A., Bogerd, P., Yücesan, E., & van Wassenhove, L. N. (2003). The impact of ERP on supply chain management: Exploratory findings from a European Delphi study. *European journal of operational research, 146*(2), 284-301. https://doi.org/10.1016/S0377-2217(02)00550-7

Alrjoub, A. M. S., & Ahmad, M. A. (2017). Inventory management, cost of capital and firm performance: Evidence from manufacturing firms in Jordan. *Investment management & financial innovations, 14*(3), 4-14. https://doi.org/10.21511/imfi.14(3).2017.01

Anantadjaya, S. P., Nawangwulan, I. M., Irhamsyah, M., & Carmelita, P. W. (2021). Supply chain management, inventory management & financial performance: evidence from

manufacturing firms. Linguistics and Culture Review, 5(S1), 781-794. https://doi.org/10.21744/lingcure.v5nS1.1463

Arslan, H., & Yildiz, M. (2022). The financial impact of supply chain disruptions on manufacturing firms.

Aspers, P., & Corte, U. (2019). What is Qualitative in Qualitative Research. Qualitative Sociology, 42(2), 139-160. https://doi.org/10.1007/s11133-019-9413-7

Baena Rojas, J. J., López Cadavid, D. A., & Vanegas López, J. G. (2024). Interrelations between logistics, trade, and law in the Incoterms® context: A bibliometric analysis of academic literature. Pomorstvo (Rijeka : 1999), 38(1), 82-95. https://doi.org/10.31217/p.38.1.7

Bah, A., Duramany Lakkoh, E., & Daboh, F. (2023). An Empirical Evidence of The Impact Of Inventory Management On The Profitability of Manufacturing Companies.

Belderbos, A., Delarue, E., Kessels, K., & D'haeseleer, W. (2017). Levelized cost of storage — Introducing novel metrics. Energy Economics, 67, 287-299. https://doi.org/10.1016/j.eneco.2017.08.022

Bergami, R. (2013). Managing Incoterms 2010 risks: Tension with trade and banking practices. *International Journal of Economics and Business Research, 6(3), 324-338*.

Bond, P. L., Green, K. W., & Inman, R. A. (2020). Relationships among JIT practices: An interpretive modeling approach. Production Planning & Control, 31(5), 400-411. https://doi.org/10.1080/09537287.2019.1640405

Brunaud, B., Bassett, M. H., Agarwal, A., Wassick, J. M., & Grossmann, I. E. (2018). Efficient formulations for dynamic warehouse location under discrete transportation

costs. *Computers & chemical engineering, 111*, 311-323. https://doi.org/10.1016/j.compchemeng.2017.05.011

Bulula, N., Mwiru, D. P., Swalehe, O., & Thomas Mori, A. (2020). Vaccine storage and distribution between expanded program on immunization and medical store department in Tanzania: A cost-minimization analysis. Vaccine, 38(51), 8130-8135. https://doi.org/10.1016/j.vaccine.2020.10.088

Burda, A. (2015). LOGISTICS ROLE IN THE ECONOMY. *Knowledge horizons : economics, 7*(1), 170.

Cai, J., Hu, X., Han, Y., Cheng, H., & Huang, W. (2016). Supply chain coordination with an option contract under vendor-managed inventory.

Chakraborty, A., Verma, N. K., & Chatterjee, A. K. (2022). A Single Supplier Multi Buyer Supply Chain Coordination under Vendor-managed Inventory: Ensuring Buyers' Interests in a Decentralized Setting.

Chen, L. (2013). Dynamic supply chain coordination under consignment and vendor-managed inventory in retailer-centric B2B electronic markets. *Industrial marketing management, 42*(4), 518-531. https://doi.org/10.1016/j.indmarman.2013.03.004

Chen, L., & Kang, F. (2007). Integrated vendor–buyer cooperative inventory models with variant permissible delay in payments. *European journal of operational research, 183*(2), 658-673. https://doi.org/10.1016/j.ejor.2006.10.035

Chen, X., Tai, A. H., & Yang, Y. (2014). Optimal production and pricing policies in a combined make-to-order/make-to-stock system. *International journal of production research, 52*(23), 7027-7045. https://doi.org/10.1080/00207543.2014.932930

Cheng, L. C. (2010). Evaluating the role and integration of contract manufacturing strategy in supply chain management: An empirical study. *International journal of manufacturing technology and management, 19*(1-2), 27-46. https://doi.org/10.1504/ijmtm.2010.029449

Ceyhun, G. C. & Keser, H. Y. (2020). Introduction to International Transportation and Logistics. In G. Ceyhun (Ed.), *Handbook of Research on the Applications of International Transportation and Logistics for World Trade* (pp. 1-17). IGI Global. https://doi.org/10.4018/978-1-7998-1397-2.ch001

Christopher, M. (2016). Logistics & supply chain management (5th ed.). FT Press.

Cooper, M. C., Lambert, D. M., & Pagh, J. D. (1997). Supply Chain Management: More Than a New Name for Logistics. *The international journal of logistics management, 8*(1), 1-14. https://doi.org/10.1108/09574099710805556

Dai, T., Cho, S. H., & Zhang, F. (2016). Contracting for On-Time Delivery in the U.S. Influenza Vaccine Supply Chain. Manufacturing & service operations management, 18(3), 332-346. https://doi.org/10.1287/msom.2015.0574

Davis, J., & Vogt, J. (2021). Hidden supply chain risk and Incoterms®: Analysis and mitigation strategies. Journal of Risk and Financial Management, 14(12), 1-16. https://doi.org/10.3390/jrfm14120619

Davis, J., & Vogt, J. (2022). Incoterms® 2020 and the missed opportunities for the next version. International Journal of Logistics, 25(9), 1263-1286. https://doi.org/10.1080/13675567.2021.1897974

De Vries, J., & van der Laan, E. (2020). Managing warehouse efficiency: The role of technical and organizational factors.

Di Giannatale, P., & Passarelli, F. (2018). Integration contracts and asset complementarity: Theory and evidence from US data. International Journal of Industrial Organization, 61, 192-222. https://doi.org/10.1016/j.ijindorg.2018.09.002

Dohale, V., Ambilkar, P., Gunasekaran, A., & Verma, P. (2022). Supply chain risk mitigation strategies during COVID-19: Exploratory cases of “make-to-order” handloom saree apparel industries. International Journal of Physical Distribution & Logistics Management, 52(2), 109-129. https://doi.org/10.1108/IJPDLM-12-2020-0450

Enz, M. G., & Lambert, D. M. (2023). A supply chain management framework for services. *Journal of business logistics, 44*(1), 11-36. https://doi.org/10.1111/jbl.12323

Faccio, M., & Gamberi, M. (2021). New methodologies for warehouse layout design and storage allocation: A literature review.

Fan, J., & Wang, G. (2018). Joint optimization of dynamic lot and warehouse sizing problems. *European journal of operational research, 267*(3), 849-854. https://doi.org/10.1016/j.ejor.2017.12.019

Farhad, Billimoria, Paul, & Simshauser (2023). CAMBRIDGE WORKING PAPERS IN ECONOMICS Contract design for storage in hybrid electricity markets.

Feng, L. (2019). Design and Implementation of ERP Management System for Manufacturing Enterprise. *Journal of Physics: Conference Series, 1345*(6). https://doi.org/10.1088/1742-6596/1345/6/062018

Feng, Y., Martel, A., D'Amours, S., & Beauregard, R. (2013). Coordinated Contract Decisions in a Make-to-Order Manufacturing Supply Chain: A Stochastic Programming

Approach. *Production and operations management, 22*(3), 642-660. https://doi.org/10.1111/j.1937-5956.2012.01385.x

Freeman, S. L., Cameron, A., & Burrell, K. (2024). Qualitative versus quantitative research—Moving beyond the numbers. Equine Veterinary Journal. https://doi.org/10.1111/evj.14210

Frazier, G. L., Spekman, R. E., & O'Neal, C. R. (1988). Just-In-Time Exchange Relationships in Industrial Markets. *Journal of marketing, 52*(4), 52. https://doi.org/10.2307/1251633

Gallego-García, S., Gejo-García, J., & García-García, M. (2021). Development of a maintenance and spare parts distribution model for increasing aircraft efficiency. Applied sciences, 11(3), 1-21. https://doi.org/10.3390/app11031333

Gholami, A., Nezamoddini, N., & Khasawneh, M. T. (2023). Customized orders management in connected make-to-order supply chains. Operations management research, 16(3), 1428-1443. https://doi.org/10.1007/s12063-023-00364-1

Grâu-Panțureac, M. (2023). The importance of contracts in business relationships. Competitiveness and Innovation in the Knowledge Economy. http://dx.doi.org/10.53486/cike2022.55

Green, G., Kennedy, P., & McGown, A. (2002). Management of multi-method engineering design research: A case study. Journal of Engineering and Technology Management, 19(2), 131-140. https://doi.org/10.1016/S0923-4748(02)00006-1

Groten, M., & Gallego-García, S. (2021). A systematic improvement model to optimize production systems within industry 4.0 environments: A simulation case study. Applied sciences, 11(23), 11112. https://doi.org/10.3390/app112311112

Gupta, S., Kumar, S., Singh, S. K., Foropon, C., & Chandra, C. (2018). Role of cloud ERP on the performance of an organization: Contingent resource-based view perspective. *The international journal of logistics management, 29*(2), 659-675. https://doi.org/10.1108/IJLM-07-2017-0192

Hariga, M., As'ad, R., & Ben-Daya, M. (2022). Vendor Managed Inventory Coordination Under Contractual Storage Agreement and Carbon Regulation Policies. IEEE Access, 10, 66098-66112. https://doi.org/10.1109/ACCESS.2022.3183988

Hasan, M. S., Ebrahim, Z., Mahmood, W. H. W., & Rahman, M. N. A. (2017). An insight into enterprise resource planning system (ERP-S) research trend. *Jurnal ILMI*, *7*(1).

Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. Evidence-Based Nursing, 18(3), 66-67. https://doi.org/10.1136/eb-2015-102129

Hoque, M. (2011). An optimal solution technique to the single-vendor multi-buyer integrated inventory supply chain by incorporating some realistic factors.

Hossain, M. S. J., Chabada, M. M., & Sarker, B. R. (2012). An optimal vendor-buyer cooperative policy under generalized lead-time distribution with penalty cost for delivery lateness.

Hu, B., Meng, C., Xu, D., & Son, Y. (2018). Supply chain coordination under vendor managed inventory-consignment stocking contracts with wholesale price constraint and fairness. *International journal of production economics, 202*, 21-31. https://doi.org/10.1016/j.ijpe.2018.05.009

Jing, F., & Mu, Y. (2020). Dynamic lot-sizing model under perishability, substitution, and limited storage capacity. *Computers & operations research, 122*, 104978. https://doi.org/10.1016/j.cor.2020.104978

Juan, S., & Li, E. Y. (2023). Financial performance of firms with supply chains during the COVID-19 pandemic: The roles of dynamic capability and supply chain resilience. *International journal of operations & production management, 43*(5), 712-737. https://doi.org/10.1108/IJOPM-04-2022-0249

Kapsali, M., Roehrich, J. K., & Akhtar, P. (2019). Effective contracting for high operational performance in projects. International Journal of Operations & Production Management, 39(2), 294-325. https://doi.org/10.1108/IJOPM-10-2017-0604

Kelle, P., & Akbulut, A. (2005). The role of ERP tools in supply chain information sharing, cooperation, and cost optimization. *International journal of production economics, 93-94*(1), 41-52. https://doi.org/10.1016/j.ijpe.2004.06.004

Khakdaman, M., Wong, K. Y., Zohoori, B., Tiwari, M. K., & Merkert, R. (2015). Tactical production planning in a hybrid Make-to-Stock-Make-to-Order environment under supply, process and demand uncertainties: A robust optimisation model. *International journal of production research, 53*(5), 1358-1386. https://doi.org/10.1080/00207543.2014.935828

Kim, D., Park, Y., Kim, H., Park, K., & Moon, I. (2022). Inventory policy for postponement strategy in the semiconductor industry with a die bank. Simulation Modelling Practice and Theory, 117, 102498. https://doi.org/10.1016/j.simpat.2022.102498

Kizil, M. (2010). A holistic approach for the problem of storage space allocation in cellular manufacturing. International journal of advanced manufacturing technology, 48(9-12), 1031-1043. https://doi.org/10.1007/s00170-009-2334-y

Klein, B., Crawford, R., & Alchian, A. (2012). Vertical integration, appropriable rents, and the competitive contracting process. https://doi.org/10.1017/CBO9780511817410.010

L. T., & Gould, E. M. (2019). Microsoft Power BI: Extending Excel to Manipulate, Analyze, and Visualize Diverse Data. Serials review, 45(3), 184-188. https://doi.org/10.1080/00987913.2019.1644891

Lee, J., Cho, R. K., & Paik, S. (2016). Supply chain coordination in vendor-managed inventory systems with stockout-cost sharing under limited storage capacity.

López, J. G. V., Rojas, J. J. B., & Cadavid, D. A. L. (2024). Interrelations between logistics, trade, and law in the Incoterms® context. Pomorstvo (Rijeka : 1999), 38(1), 82. https://doi.org/10.31217/p.38.1.7

Lorenc, A., & Szkoda, M. (2015). *Customer logistic service in the automotive industry with the use of the SAP ERP system*. https://doi.org/10.1109/ICAdLT.2015.7136584

Lummus, R. R., Krumwiede, D. W., & Vokurka, R. J. (2001). The relationship of logistics to supply chain management developing a common industry definition. *Industrial management + data systems, 101*(8), 426-432. https://doi.org/10.1108/02635570110406730

Mahajan, P. S., Raut, R. D., Priyadarshinee, P., & Kamble, S. (2024). Inventory management and TQM practices for better firm performance: A systematic and bibliometric review.

Maheshwari, S., Gautam, P., & Jaggi, C. K. (2021). Role of Big Data Analytics in supply chain management: Current trends and future perspectives. *International journal of production research, 59*(6), 1875-1900. https://doi.org/10.1080/00207543.2020.1793011

Mapanga, A. (2024). Rethinking competency requirements in South African supply chain management. Journal of transport and supply chain management, 18(5), e1-e9. https://doi.org/10.4102/jtscm.v18i0.990

Melega, G. M., Xu, C., Jans, R., & Paquette, J. (2025). An integrated approach for lot-sizing and storage assignment. *Omega (Oxford), 131*, 103183. https://doi.org/10.1016/j.omega.2024.103183

Miguel, F. M., Frutos, M., Méndez, M., & Tohmé, F. (2022). Order batching and order picking with 3D positioning of the articles: Solution through a hybrid evolutionary algorithm. *Mathematical biosciences and engineering : MBE, 19*(6), 5546-5563. https://doi.org/10.3934/mbe.2022259

Mohajan, H. K. (2017). TWO CRITERIA FOR GOOD MEASUREMENTS IN RESEARCH: VALIDITY AND RELIABILITY. Annals of "Spiru Haret" University. Economic Series (English ed.), 17(4), 59-82. https://doi.org/10.26458/1746

Nickell, E. B., Schwebke, J., & Goldwater, P. (2023). An introductory audit data analytics case study: Using Microsoft Power BI and Benford's Law to detect accounting irregularities. Journal of accounting education, 64, 100855. https://doi.org/10.1016/j.jaccedu.2023.100855

Njihia, E., & Mwirigi, F. M. (2014). The effects of enterprise resource planning systems on firm's performance: A survey of commercial banks in Kenya. *International journal of business and commerce*, *3*(8), 120-129.

Odedairo, B. O. (2021). Managing Spare Parts Inventory by Incorporating Holding Costs and Storage Constraints. *Journal of Engineering, Project, and Production Management, 11*(2), 139-144. https://doi.org/10.2478/jeppm-2021-0014

Pathak, K., Yadav, A. S., & Agarwal, P. (2024). An Inventory Model for Deteriorating Goods with Exponential Demand, Variable Holding Costs, and Partial Backlogging Across Two-Warehouses in an Inflationary Environment. IAENG International Journal of Applied Mathematics, 54(5), 950-960.

Peiqiang, Z. (2018). The design and implementation of enterprises financial management system. *Journal of advanced oxidation technologies, 21*(2), . https://doi.org/10.26802/jaots.2018.09187

Penttinen, E., Hallikainen, P., & Salomäki, T. (2010). Implementing electronic invoicing in a textile and cleanliness company - Impacts on buyer-seller relationships.

Pfaff, D., Skiera, B., & Weitzel, T. (2004). Financial chain management. *Wirtschaftsinformatik, 46*(2), 107-117. https://doi.org/10.1007/BF03250930

Phan, A. C., Nguyen, H. T., Nguyen, H. A., & Matsui, Y. (2019). Effect of total quality management practices and JIT production practices on flexibility performance: Empirical evidence from international manufacturing plants. Sustainability, 11(11), 3093. https://doi.org/10.3390/su11113093

Quan-bin, W. (2009). Design and Implementation of Invoicing Management System of Storage Enterprises.

Rathor, K., Mandawat, A., Pandya, K. A., Teja, B., Khan, F., & Khan, Z. T. (2022). *Management of Shipment Content using Novel Practices of Supply Chain Management and Big Data Analytics*. https://doi.org/10.1109/ICAISS55157.2022.10011003

Richey, R. G., Roath, A. S., Adams, F. G., & Wieland, A. (2022). A Responsiveness View of logistics and supply chain management. *Journal of business logistics, 43*(1), 62-91. https://doi.org/10.1111/jbl.12290

Roehrich, J., Tyler, B. B., Kalra, J., & Squire, B. (2019). The Decision Process of Contracting in Supply Chain Management. Oxford Handbook on Supply Chain Management.

Routroy, S., & Kodali, R. (2005). Differential evolution algorithm for supply chain inventory planning. Journal of Manufacturing Technology Management, 16(1), 7-17. https://doi.org/10.1108/17410380510574059

Saleh Shatat, A., & Mohamed Udin, Z. (2012). The relationship between ERP system and supply chain management performance in Malaysian manufacturing companies. *Journal of enterprise information management, 25*(6), 576-604. https://doi.org/10.1108/17410391211272847

Saunders. (2023). Research methods for business students. Pearson Education.

Schuhmann, R., & Eichhorn, B. (2019). Contractual Management—A Holistic Approach to a Diverse Issue. Contractual Management.

Sharma, S., Abouee‐Mehrizi, H., & Sartor, G. (2020). Inventory Management under Storage and Order Restrictions. Production and operations management, 29(1), 101-117. https://doi.org/10.1111/poms.13097

Singh, G., & Ahuja, I. S. (2012). Just-in-time manufacturing: literature review and directions. *International Journal of Business Continuity and Risk Management*, *3*(1), 57-98.

Soni, G., & Kodali, R. (2013). A critical review of supply chain management frameworks: Proposed framework. *Benchmarking : an international journal, 20*(2), 263-298. https://doi.org/10.1108/14635771311307713

Stojanovic, D., & Ivetic, J. (2020). Possibilities of using Incoterms clauses in a country logistics performance assessment and benchmarking. *Transport policy, 98*, 217-228. https://doi.org/10.1016/j.tranpol.2020.03.012

Sugiono, A., Rahayu, A., Wibowo, L. A., & Hurriyati, R. (2024). Developing models of environment uncertainty, incoterms on strategic alliance and competitive advantage. Uncertain Supply Chain Management, 12(2), 1083-1096. https://doi.org/10.5267/j.uscm.2023.12.001

Tarn, J. M., Yen, D. C., & Beaumont, M. (2002). Exploring the rationales for ERP and SCM integration. *Industrial management + data systems, 102*(1), 26-34. https://doi.org/10.1108/02635570210414631

Tortorella, G. L., Fogliatto, F. S., & Vergara, L. G. (2021). The impact of lean practices on operational performance: A multi-group analysis.

Tufan, C., Çiğdem, Ş., Kılıç, Y., & Sayar, G. (2024). Agility and Resilience in Supply Chains: Investigating Their Roles in Enhancing Financial Performance. Sustainability, 16(17), 7842. https://doi.org/10.3390/su16177842

Ufua, D. E., Ibidunni, A. S., Papadopoulos, T., Matthew, O. A., Khatoon, R., & Agboola, M. G. (2022). Implementing just-in-time inventory management to address contextual operational issues: A case study of a commercial livestock farm in southern Nigeria. TQM Journal, 34(6), 1752-1771. https://doi.org/10.1108/TQM-09-2021-0268

Ullah, A., Baharun, R. B., Nor, K., Siddique, M., & Bhatti, M. N. (2017). Enterprise Resource Planning (ERP) Systems and ERP Quality Factors: A Literature Review. *Journal of Managerial Sciences*, *11*.

Vandana & Das, A. K. (2022). Two-warehouse supply chain model under preservation technology and stochastic demand with shortages. Opsearch, 59(4), 1587-1612. https://doi.org/10.1007/s12597-022-00600-5

Vuppalapati, K., Ahire, S. L., & Gupta, T. (1995). JIT and TQM: A case for joint implementation. *International journal of operations & production management, 15*(5), 84-94. https://doi.org/10.1108/01443579510083686

Zacharia, Z. G., Sanders, N. R., & Fugate, B. S. (2021). The impact of contractual governance on supply chain performance.

Östlund, U., Kidd, L., Wengström, Y., & Rowa-Dewar, N. (2011). Combining qualitative and quantitative research within mixed method research designs: A methodological review. International Journal of Nursing Studies, 48(3), 369-383. https://doi.org/10.1016/j.ijnurstu.2010.10.005

Appendices

Appendix 1. Table of closed orders from May 2019 to May 2024

Excluded from the public version.

Appendix 2. Power BI dashboard

Excluded from the public version.