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Analyzing warehouse cost structures and pricing models

A case study approach

School of Technology and Innovations
Master's thesis in industrial management
Master of Science in Economics and Business Administration

Vaasa 2025

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Title of the thesis: Analyzing warehouse cost structures and pricing models: A case study approach
Degree: Master of Science in Economics and Business Administration
Programme: Industrial management
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Year: 2025 **Pages:** 87

TIIVISTELMÄ:
This thesis analyzes warehouse cost structures and pricing models through a third-party logistics company. The case company operates in Northern Europe and this study handles one of their warehouses located in Finland. The aim is to answer research questions concerning the formation of warehouse cost structures, evaluate existing pricing models for the case company and assess the billing units in warehousing.

Multiple studies have been conducted concerning the inventory optimization of retailers. This thesis focuses on the warehousing providers' aspect fulfilling the study gap in third-party logistics outsourcing and provides information and solutions concerning optimization of space and profit maximization for storing services. A cost analysis is conducted to calculate the costs for storing customer goods and the factors impacting these costs. In addition, the existing pricing models' suitability for the case company is assessed continuing to the examination of best suiting billing units considering warehousing.

The thesis is conducted as a mixed method case study. The data is collected through primary sources such as interviews and case company warehouse management system and secondary sources as supporting literature. The supporting literature consists of 51 articles, 12 books, 3 conference papers, 5 surveys, 7 public sector sources. In addition, 10 consulting sources are also used in handling the pricing models.

The research presents the cost structure of the warehouse by breaking down the premise expenses from fiscal year 2024. The mandatory costs are analyzed and the entity assessed. Concerning the pricing models, both internal and external factors have been taken into account to pursue a warehousing contract that serves and benefits both parties. For the case warehouse the suggested pricing models are closed and hybrid models as they enable flexibility and contract customization while enabling profit maximization by utilizing economies of scale. The suitability of billing methods is approached by the goods attributes since the dimensions and weight play an essential role in the storing possibilities. It can be argued that the company should bill goods in shelves by pallets and the goods on mass storage area by area (m^2), volume (m^3) or weight (kg) depending on the attributes of the goods. Then, it must be acknowledged that the pricing models are influenced by the company strategy and the pricing is always contract specific.

AVAINSANAT: (Third-party logistics, cost structure, pricing model, billing unit, optimization).

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TIIVISTELMÄ:
Tässä tutkielmassa analysoidaan kolmannen osapuolen logistiikkayrityksen varaston kustannusrakenteita ja hinnoittelumalleja. Kyseinen yritys toimii Pohjois-Euroopassa ja tämä tutkielma keskittyy yrityksen varastoon, joka sijaitsee Suomessa. Tutkielman tarkoituksena on vastata tutkimuskysymyksiin, jotka käsittelevät varaston omien kustannusten muodostumista, olemassa olevien hinnoittelumallien sopivuuden analysoimista sekä arvioida yksikköhintoja varastoinnissa.

Jälleenmyyjien varastoinnin optimointia on tutkittu aikaisemmin useissa eri tutkimuksissa. Tämä tutkielma keskittyy logistiikan palveluntarjoajan näkökulmaan täyttäen tutkimusaukon ja luo ratkaisuja tilankäytön optimointiin sekä varastoinnin tuottavuuden maksimointiin. Varaston välttämättömiä kustannuksia ja niihin vaikuttavia tekijöitä havainnoidaan kustannusanalyysin avulla. Lisäksi olemassa olevien hinnoittelumallien avulla lähestytään tuotteiden yksikköhinnoittelua, joista ehdotetaan yrityksen tilanteeseen sopivimmat vaihtoehdot.

Tutkielma on toteutettu monimenetelmätutkimuksena hyödyntäen kvalitatiivisia ja kvantitatiivisia menetelmiä. Tutkimuksessa hyödynnetty aineisto on kerätty primäärisistä ja sekundäärisistä lähteistä. Primäärisiä lähteitä ovat haastattelut ja case yrityksen varastonhallintajärjestelmä. Sekundäärinen lähde on aiheesta olemassa oleva kirjallisuus. Tutkimuksessa käytetty kirjallisuus koostuu 51 artikkelista, 12 kirjasta, kolmesta konferenssipaperista, viidestä tutkimuksesta sekä seitsemästä eri julkisen tahon tiedonlähteistä. Lisäksi kymmenen konsultointisivuston lähdettä on hyödynnetty työn käytännöllisen luonteen vuoksi.

Tutkielma käsittelee varaston kustannusrakenteita käsittelemällä case yhtiön vuoden 2024 tilikauden kustannuksia. Välttämättömiä kustannuksia analysoidaan ja sekä niiden suhteita kokonaisuuksiin arvioidaan. Hinnoittelumallien käsittelyssä otetaan huomioon sekä sisäiset, että ulkoiset vaikutustekijät kun pyritään luomaan kokonaisuutta, joka palvelee sekä asiakasta, että palvelun tarjoajaa. Kyseessä olevalle varastolle suositellaan joko suljettua tai hybridi-hinnoittelumallia, sillä kyseiset mallit mahdollistavat joustavan ja sopimuskohtaisen hinnoittelun samalla mahdollistaen case yrityksen tuoton maksimoinnin mittakaavaedun avulla. Yksikköhinnoittelu on vahvasti riippuvainen tuotteen ominaisuuksista. Tutkimuksen avulla pystytään perustelemaan, että yhtiön kannattaisi laskuttaa hyllyssä varastoitavia tuotteita lavaperusteisesti ja massa-alueella säilöttäviä tuotteita pinta-alan (m^2), tilavuuden (m^3) tai painon (kg) perusteella. Pitää kuitenkin ymmärtää, että hinnoittelumallien toteuttamiseen vaikuttaa yhtiön strategia ja hinnoittelu on aina sopimuskohtaista.

AVAINSANAT: (Third-party logistics, cost structure, pricing model, billing unit, optimization).

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Abbreviations

3PL – Third-party logistics
WMS – Warehouse management system
SSCM – Sustainable supply chain management
EOQ – Economic order quantity
ERP – Enterprise resource planning

Acknowledgement

I acknowledge the usage of ChatGPT (OpenAI, 2024) for generating ideas and finding sources for this thesis.

1 Introduction

The introduction covers the presentation of the research topic and gives the needed context and justification for conducting this study. It consists of study background, aim of the study, research question, justification of the study and structure of the thesis. In addition, the case company is introduced.

1.1 Study Background

Logistics are an essential part of supply chains. According to Fahimnia et al. (2011) logistics are the network of organizations, activities, information, people and resources involved in the physical flow of products from supplier to customer. When handling physical goods there is always a need for logistics. Regardless of the necessity of logistics it is becoming more common to outsource logistical activities (Abbasi et al., 2024). This is due to the complex nature of logistics and to companies being able to focus on their own strengths. As globalization enables even larger supply chains across the world it becomes even more demanding to manage supply chains (Vidrova, 2020). This has led to the growing need for third-party logistics.

Third-party logistics can be described to possess the following characteristics: Integrated or multi-modal logistics service provider, contract-based service provider and consulting service providers (Tezuka, 2011). Tezuka (2011) also divides 3PL providers into “asset-type” and ”non-asset-type” service providers where the former type of company owns the assets such as warehouses and transport vehicles as the latter does not. As 3PL companies possess expertise concerning logistical attributes among transportation, storing and coordinating it eases the burden of the customer company, and they can focus on their own needs.

Inventory optimization is a common target for research, especially for retailers. As retailers handle multiple goods, they have to estimate the need for them and analyze markets

to have the right amount of stock while minimizing costs and maximizing sales (Theodorou et al., 2023). This study focuses on the service providers' aspect of warehouse cost structures and pricing models. As 3PL companies' storage and manage goods for their customers the investments to provide these services generate costs. This study uses real-life data as the thesis is conducted to a 3PL company operating in the Northern Europe and focuses to one of their warehouses in Finland.

1.2 Aim of the study

The aim of this study is to investigate the costs and income generated by the case company's warehouse through storing service. In addition to adducing cost structures the optimal pricing model is analyzed. This addresses the nature of the pricing model and continuing to deeper details of pricing methods. From the wish of the case company the main focus is to analyze only the warehouse premises and its possibilities to be profitable. This is approached by a cost analysis of the expenses that the premises cause along with the income through storing goods. Here the aim is to sort expenses into detail and provide a clear image of where and in what relation costs are originated. Thus, enabling us to consider and analyze the necessity of the expenses and ponder on possible savings in expenditures. These costs are reflected in the income generated by the storing service. Here the profitability of the current contracts is analyzed giving valuable information of the current state of sources of income.

As the cost analysis provides detailed and precise information concerning the costs and profits of warehouse storing operations, the pricing models can be assessed. On top of the data collected and generated in the cost analysis the pricing model selection is affected by multiple factors. Here the utilization rate of storage space and turnover are key factors.

Among these themes the study aims to provide clear entity to further scientific research among logistics fields, especially warehousing. Not only to meet the expectations and

needs of the case company but to contribute to the research in the field of logistics pursuing solutions.

These factors constitute the entity for providing information from the aspect of the 3PL constructing the study gap. Often researches handle economic order quantity (EOQ) and carrying costs when considering warehouse optimization. These are the factors from the retailer's side. This study concentrates on the warehousing service providers aspect of optimizing usage of space and assessing pricing models and methods to maximize profitability.

1.3 Research questions

The research questions are formed to target existing objectives provided by the case company. The research concentrates on warehouse premises cost structures and the pricing models for customers using the warehousing services. The questions must be formed so that the cost structures must be clearly defined and that the existing pricing models should be evaluated and possibly provide alternative options and present their possibilities in the company environment. Taking these attributions into account the research questions are formed as follows:

Q1: What are the factors and components that contribute to the formation of warehousing costs in the case company's warehouse?

Q2: What is the most optimal warehouse pricing model for the case company to maximize profitability?

Q3: What are the best billing units?

1.4 Justification for the study

This thesis is conducted as an assignment for a Northern Europe third-party logistics company. In this environment it is worth justifying the execution of this study on a scientific basis. As a case study it is typical to be conducted due to its interest or theoretical reason (Ridder, 2017). This covers the first factors as this study meets the interest of the author and the case company. Case study research is also described to be able to include any issue which the researcher finds worth studying (Gummesson, 2017). The worthiness can be argued as the third-party logistics market domain is growing which can be seen as the revenue of third-party logistics companies globally doubled from 2010 to 2021 (Statista, 2024).

As exploiting the case theory, it includes dual goals as to provide a solution to problems and contribute to science and can be adopted as the objective to particularize and generalize (Gummesson, 2017). This ties the aim of this thesis. It examines a growing field in vast industry to enable generalizable data of cost structures and using different pricing models. Similarly, it uses a case company to put the theories into practice to analyze them in a real-world environment creating information of the possibilities of the pricing models and to provide possible solutions to the case company.

The examination of the research gap is also present when justifying the research. Logistics is a vast entity that is inevitably part of supply chains. Taksin et al., (2018) conducted a literature review on 77 supply chains optimization studies and concluded that 49 of the 77 papers handled minimizing costs. They also made a proposition for future research concerning supply chain costs such as holding cost could be added as classification criteria. On the other hand, Davarzani & Norrman (2015) state that more case and action research studies must be done concerning warehousing research since the lack of empirical research in the area can be considered as a warning to academia. To influence and address real-life problems the case research is needed to enable information that can be utilized in reality. Majority of reviewed papers have methods of mathematical modeling even though practitioners prefer the logic of solutions rather simple to ensure

their functionality in reality (Davarzani & Norrman, 2015). This is rooted in the problems of the warehousing management system (WMS) not always being advanced enough to have complex algorithms implemented.

1.5 Structure of the thesis

This thesis consists of seven main parts which are introduction, literature review, methodology, problem with the case company, results, discussion and conclusion. Section 1 handles the basics to familiarize the reader with the research topic with the research questions and objectives. Section 2 proceeds to give the reader an understanding of the research area and the field of study. Recent acknowledgements and findings regarding the research problem are addressed and the theoretical frameworks are brought to the attention of the reader. Section 3 contains the methodology of the study as information on how the study is conducted when it comes to data, tools, methods and the overall process of conducting the thesis work. In section 4 the challenges of the case company are addressed.

The main part of this study is section 5 where the theoretical frameworks presented in the literature review are used in practice. The research problems are addressed, and the results are presented giving the case company valuable data addressing the research problems. The section 6 sums up the findings in this study and the reader is informed of the limitations to enhance the rigor of the study. Lastly section 7 handles the entity of the research and the propositions to the case company are expressed.

1.6 Case company

This thesis is conducted as an assignment to a case company. The case company is a multinational company providing operations in contract logistics in Northern Europe. As a service provider their aim is to generate optimal logistics solutions for the customer

enhancing customer performance. They are a non-asset-type 3PL company as they do not have their own infrastructure. The company has a revenue of 190 million euros and over 3000 employees.

One of the justifications for this study is the interests of the case company. This thesis pursuits to assess the profitability of the current contracts with their clients in the current state of the warehouse. The research is limited to the warehouse storing operations since the aim is to analyze the premise costs for its productivity.

2 Literature review

In this section a literature review is conducted to familiarize recent studies and acknowledgements among storing and logistics. The main purpose is to bring forth literature concerning the research topic and problem (Helo et al., 2019). Here the main theories and theoretical frameworks are handled to be able to make justified and rational conclusions. Thus, it is essential to provide rigor entity of literature to enable in-depth understanding concerning the research topic, problems and objectives.

The literature review handles five sections as warehouses in supply chains and logistics, economies of scale in logistics, cost structure dimensions, available warehouse pricing models and lastly the study gap is addressed. First the framework of warehouses in supply chains is analyzed as their role and challenges are assessed. Next the theoretical framework for applying economies of scale in logistics is handled. Here the economy of scale is used to explain phenomena and as a factor enabling possibilities among warehousing. The cost structure dimensions handle the various expenditures to enable the storing services. This section brings forth information about the factors enabling the warehousing business. Lastly the pricing models are analyzed and the study gap expressed.

This literature review constitutes an entity which allows the reader to approach warehousing optimization problems from the aspects of pricing models. It enables to understand the cost structure components and the advantages and disadvantages of different pricing models

2.1 Warehouses in supply chains and logistics

To enable rational and justified methods to converge warehouse pricing models' framework the bigger picture is crucial to understand. When providing the storing services, it

is essential to keep up with the markets and be able to network in the segment. In addition, the role of warehouses in supply chains needs to be understood. As supply chains cover all the sequences for a product or service from its conception to consumption (Pardo et al., 2023) warehouses are a key factor in optimizing schedules. To comprehend these entities the warehouses' role in the supply chains are examined more along with providing deeper understanding of the expectations of the customer in the markets and the challenges concerning them.

2.1.1 Typical Warehouse functions

Warehouses should be designed to meet the requirements of the supply chain that it is a part of, but certain operations are common to most warehouses (Rushton et al., 2022). These can be seen in the figure below.

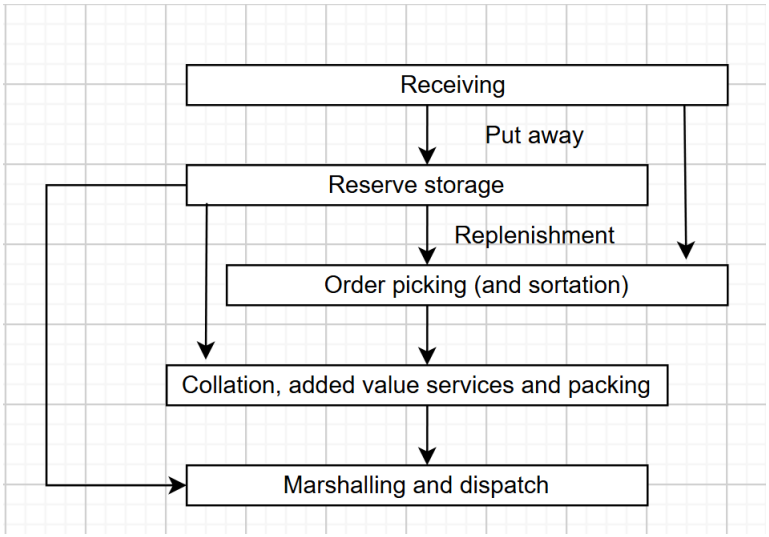

Figure 1. Authors illustration of typical warehouse functions adapted from Rushton et al. (2022)

Receiving the goods is the starting point to the warehousing process. This typically involves physical unloading from the transportation vehicle. Here the quality check takes

place and if necessary, goods can be unpacked or repacked. Then the goods are recorded to the WMS and then they can be put away to the storage area.

Reserve storage is considered the storage area which holds the bulk of warehouse storage. Here the goods are stored in identifiable locations enabling warehouse management. When needed the required amount of the goods can be picked up from the location for the next processes.

Order picking is the process that follows when the client sets an order for goods. This has requirements for a certain amount of certain product delivered in a certain time period. The picking is the process of collecting these ordered goods from the reserve storage. This is a key warehouse operation that requires a significant proportion of warehouse staff.

Collation, added value services and packing contain the actions before dispatching. If the picking request includes, for example, individual goods they could need own cartons or certain packing methods. These can be portrayed as value-adding services since the goods are handled into a form suitable for transportation and set together by certain standards.

Marshalling and dispatch concerns the final activities as goods are set to transportation. Goods are marshalled to form the loads in the dispatching area ready for the transportation vehicles.

The actions discussed above are the most common ones in a typical inventory holding warehouse (Rushton et al., 2022). This thesis focuses on the phase of reserve storage and storing the goods.

2.1.2 3PL in current supply chains

Globalization has changed the field of trade drastically, as it has enabled offshore manufacturing and market coverage across borders, resulting in a larger customer base (Kazancoglu et al., 2024). As customer bases expand the challenges in supply chains increase as there a more factors to be considered. In today's market individual customers appreciate fast service (Diefenbach et al., 2024). To enable rapid service and fulfill customer needs companies need warehousing. Thus, warehousing has become one of the key factors in functional global supply chain network (Singh et al., 2019). As the demands of customers have become more challenging to fulfill it has led to advancements in the supply chain segments to be able to satisfy the needs. This has also led to developments in logistics and warehousing. Warehouses are not only premises to store goods but have developed into technology-enriched factories to satisfy cost-efficient, time-critical and reliable deliveries (Boysen & Koster, 2024). Boysen and Koster (2024) elaborate that the industry has changed especially due to e-commerce, same-day deliveries, omnichannel retailing and global supply chain disruptions.

As logistics management has become more complex it has become more common to outsource it to 3PL companies. As the global markets are so competitive it is lucrative for companies to outsource activities that are outside their core expertise (Aktas et al., 2011). The outsourcing of logistics can be also argued by the savings in costs. As stated before, globalization has enabled the growth of customer bases across borders. Still the demand and expectations of fast deliveries maintain. This leads to the need for warehousing across the borders. Not only do these actions require large investments but may cause challenges when operating in another country such as language barriers. The phenomenon of logistic outsourcing can also be seen in the rising revenue of 3PL companies globally. This is illustrated in Figure 2.

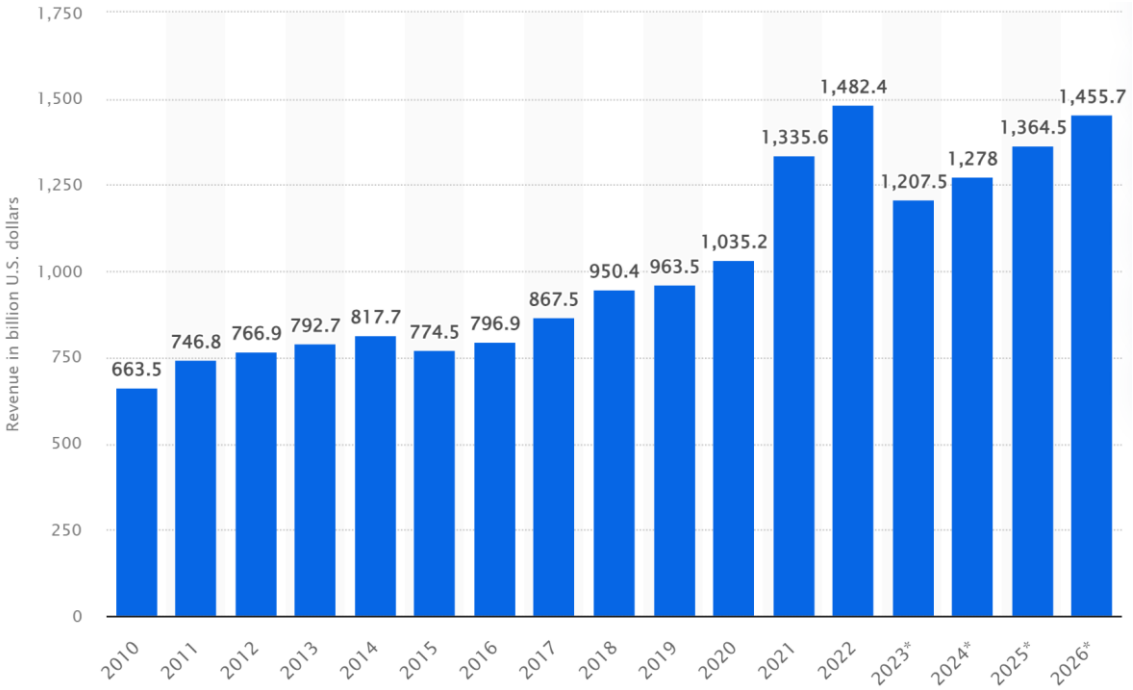

Figure 2. Revenue of the global third-party logistics (3PL) industry from 2010 to 2022, with forecasts until 2026. Source: *Statista* (2024).

Figure 2 illustrates the revenue growth among 3PL companies globally from 2010 to 2022 with predictions until 2026. When investigating the growth of 3PL companies in more recent history it is worth noting that it is not only a recent phenomenon. According to Dr. Robert Lieb and Steven Kendrick (2002) the US fortune 500 manufacturers used 3PL services outside the United States as 70% in Canada, 67% in Western Europe, 61% in Asia, 58% in Mexico, 52% in Latin America, and 44% in Eastern Europe in 2002. Nowadays 90% of the Fortune 500 companies use 3PL. (Langley, 2024).

Warehouses have always had an essential role in between producing goods and their consumption. (Boysen & Koster, 2024). Because of new innovations and demands the services have come a long way. 3PL companies are not only lenders of storage space but offer various services on top of storing goods and their handling such as freight bill auditing and customs brokerage. (Langley, 2024). Still warehousing is the most outsourced activity among shippers. (Langley, 2024). As the industry is developing and going through

changes the need for basic warehousing services and management are still present. Thus, it can be acknowledged that there is a need for warehousing on the markets.

To meet the needs of the markets 3PL companies need to perform well enough for them to be profitable for the client companies. According to Langley (2024) 89% of shippers reported that 3PL improved their service and 80% reported it enabled cutting costs. This indicates that the expertise and actions of the 3PL companies can produce cost efficient services for their customers. Next the focus attaches to the clients' expectations and other possible needs that lead to the selection of 3PL company.

2.1.3 The expectations from clients

3PL companies face various demands when it comes to the selection criteria for clients. According to Aguezzoul (2014) cost is the most used criteria in the process of deciding 3PL companies to work with. The ones to follow in order are relationship, services, quality, information & equipment system, flexibility, delivery, professionalism, financial position, location and reputation. Zarbakhshnia & Karimi (2024) also state that costs and services constitute the most significant criteria for 3PL evaluation. This highlights the importance of pricing in the 3PL markets. But one should not only rely on the price. Due to climate change the role of sustainability and responsibility among corporate actions have advanced into a more effective and expressive state. This can be seen as sustainability plays an increasingly important role for investors and analysists evaluating companies (Thun et al., 2024). In sustainable supply chain management (SSCM) social and environmental activities can improve economic performance (Tavana et al., 2017). Setyawan & Rizkyah (2024) provided a systematic literature review where 3PL providers are divided into categories such as traditional, sustainable, sustainable-resilient, green, gresilient, traditional reverse and sustainable reverse. Due to the literature review it can be noticed that the demands and expectations for the 3PL companies vary by nature and classification. This enables the conclusion that the expectations vary by different sectors and strategies. Although several features are sought after the price is still among the

ones in essence. So as pursuing the optimal economic models the price is crucial but simultaneously the social and environmental aspects cannot be ignored.

2.1.4 Challenges of 3PL

Although 3PL companies are experts in their field they are not perfect either. According to Bulgurcu & Nakiboglu (2018) problems concerning 3PL failures create challenges such as:

- higher costs
- late shipments
- loss of reputation

This enhances the importance of choice for the 3PL partnership. The failures in logistics operations root from the challenges that 3PL companies face. A study focused on China conducted by Rahman et al., (2019) concluded that four most critical challenges for multinational 3PL in order are:

- Guanxi
- Price pressure
- Government regulations
- High transportation cost

The first three are more extensive topics which affect the operations of warehousing so they are handled more in detail.

Rahman et al., (2019) elaborate that guanxi is a term in China which refers to a relationship carrying long-term social obligations. This enforces the value of networking. The importance of relationships is becoming crucial as not only non-core actions are being outsourced but also value creating actions (Darko & Vlachos, 2022). This leads to more of partnerships rather than outsourcing. This contributes to the situation where communication is in essence since it is the enabling factor for partnerships. Similar development

can be seen through the third-party logistics studies since the study conducted in 2020 acknowledged the need for development among relationships and the 2024 study states that relationships, collaboration and customer service are in essence of nowadays supply chains. (Langley, 2020;2024). So, the responsibility presented to 3PL companies is rising contributing to the requisite of communications and trust among parties involved.

When considering the market segment for 3PL the price pressures reach each of their business aspects since the goal of 3PL is to increase the profits of the customer company via logistical efficiency. If the operations are not effective enough or are expensive price-wise it is not worthy for a company to use 3PL services. The appropriate pricing of logistics services has become a critical issue in the field (Kong, et al 2022). This also affects the customer selection from the 3PL company's aspect as well since other industries have higher margins than others possibly indicating better incomes by customized cooperation.

Government regulations are essential for 3PL companies to be aware of since regulation frameworks concerning supply chains have direct and indirect effects on logistics entities activities such as document flow and logistic operations (Grabara et al. 2020). Especially if having cross border operations the local laws must be acknowledged. This demands continuing awareness concerning the regulatory frameworks as they can see changes. This can be seen in regulations concerning transportation. The rising need for logistic services has increased the transportational activities that contribute to climate change. There are regulatory frameworks concerning this matter, but more comprehensive approach is needed to effectively address the logistics operations impact towards environmental challenges (Maji et al. 2024). Both national and international legislation, frameworks and policies share the goal of a more sustainable future (Chakwizira, J. 2022). As legislation must be obeyed at the same time green actions can be beneficial to company brand and image.

2.2 Economies of scale in logistics

Economies of scale are a microeconomics term referring to the phenomena of increasing benefits through the reduction of costs by expanding and increasing output. (CICC Research, 2024). Possibilities for the decrease in costs can derive from high fixed costs, lower input prices enabled by high volume or bulk orders or learning economies. (Linden, 2016). The theory is common in production industries when optimizing the output of facility. It is often used in mass production where the goods manufactured are almost identical to each other. This theoretical framework can be adapted and applied to different fields as well.

This can also be approached by logistics point of view. The advantages of using 3PL root to the utilization of economies of scale and economies of scope. (Tezuka, 2011). Baumgartner et al. (2011) researched the economies of scale concerning warehousing and transportation and developed a supply chain design model exhibiting these factors. The paper concluded that failing to consider economies of scale in transport frequencies leads to higher costs. In addition, the theory is acknowledged in warehousing. Birgit Schildt (1994) states that there are number of solutions to minimizing warehouse total costs as warehouses have limited capacity and exhibit economies of scale. These points indicate that the economies of scale in logistics are affected by transport frequencies and spatial capacity. This pattern can be observed as Jiang & Chen (2010) states that the economies of scale in logistics are complicated but can be divided into existing patterns as density economies of network and size economies of network. They define economies of scale in logistics as the phenomenon when average logistics cost decreases when logistics production rises. To apply this theory in storing the spatial capacity optimization is in essence.

2.3 Cost structure dimensions

When companies have inventory, they can follow key numbers such as carrying costs which are an expenditure handled in percentage where the carrying costs are divided by the value of inventory. This can be used as the baseline when addressing the formulation of the costs of 3PL services. The carrying costs consist of capital costs, storage space costs and inventory risk costs. (Logistiikan maailma, 2024). Lambert & La Londe (1976) also mention the inventory service costs separately. Since the company in question is a 3PL company the carrying costs for another company reflect the prices of the 3PL services.

To analyze the cost structures for 3PL services the limitations must be made clear what factors are included and what is excluded. Since this thesis focuses on the premise costs, the cost structures in examination are land and premise costs.

According to Rushton et al. (2022) the warehousing costs can be broken down into parts as follows: staff, building, building services, equipment and information technology.

Staff – Covers 45-50% of the costs.
Building – Covers 25% of the costs including rent or depreciation of the building.
Building services – Covers 15% of the costs such as light, heating, building maintenance etc.
Equipment – Covers 10-15% of the costs including rental or depreciation, equipment maintenance and running costs.
Information technology – Covers 5-10% of the costs including systems and data terminals.

Gwynne Richards (2011) demonstrates the costs as warehouse cost tree that can be seen in figure 3 below.

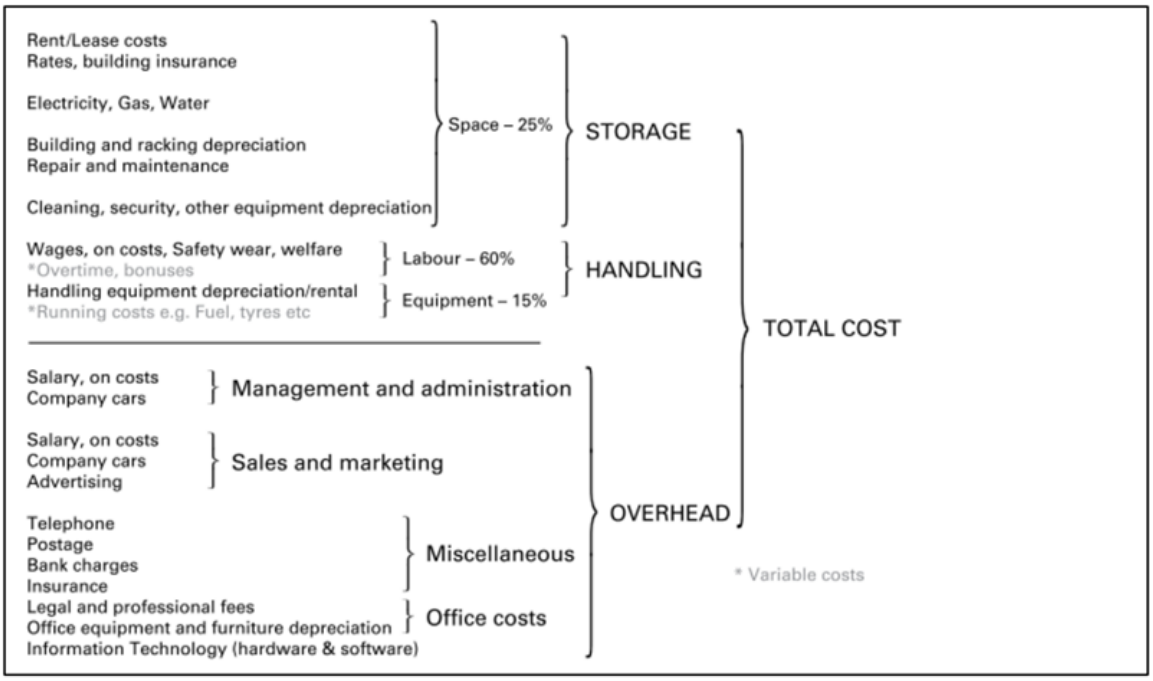

Figure 3. Simple warehouse cost tree (Richards, 2011)

According to Rushton et al. (2022) and Richards (2011) the land and premise costs should be around 25-40% of the whole warehouse costs. It can be observed that there are multiple mandatory costs that are included in the expenditure. When considering the possible variable costs, it can be analyzed whether it would be more profitable to own the premises or rent it. These factors concerning the mode of ownership can vary between strategies and business models. To clarify it can be argued that the price of commodities varies by usage, which is true, but their optimal usage is out of this thesis' scope.

Thomas Merril (2020) categorized the pros of leasing into three main subjects as i) an alternative way of financing assets while having a limited capacity for funds or wish to save capital into other purposes, ii) risk decreasing factor concerning owning the premise as the leasing enables residual rights for a certain duration of time allowing to test the assets without full ownership commitment and iii) customization as lease enables the lessor and lessee divide the rights to assets allowing functions helping to overcome collective action problems. The lucrativeness of owning or leasing is affected by multiple factors such as size, taxation, nature of assets, financial constraints and management

compensation (Morais, 2013). Businesses also must take cash flow, long-term goals and industry trends into account (Alex et al., 2024).

Considering the cost structures by Rushton et al (2022) and Richards (2011) it must be acknowledged that there are many types of warehouses. To improve warehouse operations companies have invested in automated material, handling technology including logistics service providers (Kemro & Norrman, 2022). This is also acknowledged by Rushton et al. (2022) who state that the automation of warehousing requires costly systems which affect the cost relations within the warehouse cost structures. Thus, the cost structures vary by company and are dependent on the systems and operating model of the warehouse.

2.4 Available warehouse pricing models

This section focuses on the possible pricing models for the storing of goods. Gwynne Richards (2011) presents four different models for logistics charging methods as:

- Open book
- Cost-plus
- Closed book
- Hybrid

These models are taken into further examination and will be used as a source in finding the optimal pricing model. Because of the case handles service industry, the customer perspective must be taken into account as well since the deal won't be done if both parties are not satisfied. Since this topic is very practical to ensure full understanding on top of theoretical aspects, other 3PL companies and consultants' companies have been used in sourcing data.

2.4.1 Open book

The open book contracts are based on total transparency (Richards, 2011). As the name states, the contracts are open between parties where the 3PL shows the exact costs for logistic operations to the client. Here the client will pay for the service costs and the reward fee on top. Richards (2011) continues that for these kinds of contracts it is common for the reward fee to be determined by performance. On the other hand, the contracts can be customized with agreed margin (Davies&Robson, 2022). Since the contract is based on transparency, trust and cooperation are in essence. This arises in the development of operations as both parties are committed to pursuit opportunities to reduce costs and sharing the profits of cost savings. (Di & Wang, 2017). As interdependence is an issue among companies in industrial markets it can be observed that the open book pricing model does not only affect this by influencing direct but more importantly indirect relationships (Alenius et al. 2015). Since it has an impact on relationships it can be used for networking purposes. This can create long-lasting partnerships.

Considering the utilization of a pricing method the pros and cons must be analyzed. These can be categorized from the aspects of the client and the service provider. When considering from the aspect of the client the key pros are:

- Transparency
- Being involved in processes
- Easy contracting

Transparency enables and demands trust and confidentiality. This allows the client to see the costs and thus enables discussion of potential cost-reduction strategies. (Richards, 2011). Transparency does not always guarantee value for money spent. (Davies & Robson, 2021). Through transparency the client is enabled to be engaged and involved in the logistics processes. (Richards, 2011). This provides more information to the client. The open book contract can be set up without detailed specification of services. (Davies & Robson, 2022). This is dependent on the occasion but since the client will be covering

the expenses the overall negotiations can be assumed to be more simple than other contracts including specific details.

Cons:

- Demanded expertise
- Additional workload
- Paying for inefficiencies

When using the open book pricing model, the client must have expertise concerning the logistic activities and put effort into managing the contract. (Davies & Robson, 2022). This demands resources leading to costs. Then, this can also lead to the situation where clients use too many resources in monitoring the 3PL decreasing the financial benefits. Also, if not tied to the fee of performance the shipper might have to pay due to the inefficiency of the 3PL. (Davies&Robson, 2022).

For the service provider the pros and cons can be categorized as follows:

Pros:

- Low financial risks
- Defense against scope creep

From the aspect of the service provider this is the model contains low financial risk (Kenco, 2018). Since the client is the one paying the overall costs, it is a safe option for the 3PL provider. Similarly, if a customer asks for additional tasks to be carried out the provider can just charge for the extra work done. (Kenco, 2018). This enables safe option to avoid scope creep.

Cons:

- Low margins
- Risk of spreading confidential information
- Not encouraging cost savings

Due to the lower financial risks the margins tend to be low for the provider. (Kenco, 2018). In addition, the transparency is not always riskless since sharing information can be harmful for the supplier as the client may use this information in price negotiations, making the supplier more vulnerable. (Fehr & Rocha, 2018). It also appeases the risk of spreading confidential information. These power asymmetries may negatively influence collaborations concerning open book models since the supplier may be afraid of exploitation. (Fehr & Rocha, 2018). In these models it can be also challenging to require cost control and improve productivity of the provider. (Davies & Robson, 2022). Since the provider can bill the client for costs it does not encourage the savings.

The open book pricing model has its pros and cons for both customers and providers. Usually, it is more desirable among the customers. (Kaur, 2024). It provides detailed information on how costs are generated and how much. This enables involvement in the processes and gives power to make decisions. Still, it can be observed that in this model the 3PL service provider does not necessarily have the ambition to maximize effectiveness in their actions. It also demands investment from the client to have expertise and causes work to manage these contracts.

In the light of this data, it can be analyzed what kind circumstances this pricing model fits. This model suits new shipper-3PL relationships. (Kenco, 2018). Especially in new fields where there is limited amount of data, this is a safe way to start cooperation. This also enables the 3PL to gain information about various prices which can be utilized later if switching to a closed book model. (Kenco, 2018). The model is useful in circumstances where the needed resources are hard to determine or forecast. (Davies & Robson, 2022). This suits complex projects and other individual entities. Also, in these situations the

contractor needs the information and authority to manage the entities. So, the best scenario to use open book pricing is in the start of new cooperations and uncertain situations where the occurring costs are not certain.

2.4.2 Cost-plus

The cost-plus contracts are similar to open book but here the service fee is rather a percentage increase to the costs. (Richards, G., 2011). Since the fee is tied to the costs by percentages it indicates that the profits of the provider grow along with the costs generated for the client. On the contrary it works vice versa as the costs decrease and so do the providers' profits. This model does not encourage the provider to improve efficiency or cost control. (Davies&Robson, 2022). Thus, these contracts need stringent targets and commitment to reduce costs. (Richards, 2011). Li et al. (2015) researched the cost-plus pricing strategy in transport services and concluded that shorter due time or lack of capacity may create a situation for increasing the price since needing more resources. This can be applied in warehousing services as the orders for warehouses might come in short notice. These situations may cause conflicts among parties due to the possible misunderstandings and assumptions regarding operational capabilities. For these situations the collaboration and the client's expertise for understanding warehouse management should be enhanced.

2.4.3 Closed book

In the closed book model, the charges are based on the activities carried out by the 3PL company as the customers get fixed prices on given volumes. (Richards, 2011). The main difference between open and closed book contracts is the transparency. In the closed book model, the cost structures are not elaborated to the client but only the fee of negotiated activities. This creates advantages and disadvantages.

Considering the clients' aspects, the closed booked deals bring consistency and eases budget forecasting. In addition, they don't need such expertise as in open book models since they only need to inspect the invoices without getting into detailed cost elements. (SCCG, n.d.).

At the same time, they need to consider the prices in detail to avoid paying high margins. This can be approached by competition in the markets and analyzing the service quality. On the other hand, this encourages the provider to find more efficient ways in warehousing management as it enables more profits. The closed book models also decrease the risks of leaks of confidential material as they don't have the obligation of showing their books to the clients. Even though it increases the risks it enables freedom for pricing methods.

As for the provider, the closed book model increases risks but also enables higher profits. Richards (2011) states that the main disadvantage is the difficulty to budget as the costs vary by month and are dependent on the warehouse activities. This makes the pricing in closed booked contracts critical. The 3PL companies should hardwire some cushion into the prices to reduce the impacts of demand fluctuations. Another possibility is to have specific terms in terms of contracts for minimal usage of storage space to ease the fluctuations to reduce financial risks. It is also critical to cover the overhead costs and other possible financial needs.

There are different models to enable closed book contracting as they can be customized and negotiated and they are taken into examination next.

2.4.3.1 Fixed prices

The fixed pricing is one of the simpler contract types. Here the shipper contracts for a fixed fee of warehousing including services such as storing, picking, packing, kitting and assembling. (WSI, 2024). It can also be customized by collaboration by determining what

to exclude and include as variable and fixed expenses. (Kaur, 2024). Next the pros and cons are taken into consideration first by the customers and later from the aspect of the service provider.

Pros:

- Stable costs
- Balancing risk
- Collaboration

The advantage of fixed prices model for the shipper is the financial stability and visibility. (Daguer logistics, 2025). As the costs are stable and predictable it balances the risk in day-to-day operations. (Kenco, 2018). Since the collaboration by this model enables to customize the fixed expenses (Kaur, 2024) it enables flexibility along with the cooperation.

Cons:

- Accuracy of forecasting

The fixed price model demands accurate forecasting (Kenco, 2018). Since the fixed costs are constant the utilization of the contract should be maximized constantly if possible. During low volume times the costs don't change mut the income is lower, which decreases profits.

Next the pros and cons of the fixed pricing model are analyzed from the providers' point of view.

Pros:

- Steady cash flow
- Balancing risk

Likewise, the costs are stable for the customer and so is the cash flow for the 3PL. In addition, this balances the risks also for the 3PL and covers from fluctuations. (Kenco, 2018). In low volume times the fixed prices still remain enabling cash flow for the provider.

Cons:

- Not maximizing profits
- Accuracy of forecasting

When the model protects profitability at low volume times, on the contrary it does not maximize profitability at high volume times. The forecasting accuracy applies to the 3PL as well. It is important to match the labor needed to the volume (Kenco, 2018).

Overall, the fixed price modeling enables stable cash flow as costs for customers and income for providers. In addition, it balances risks by easy predictions for costs. Then it does demand accurate forecasting from both parties. If the customer does not utilize the maximum capacity they are paying for unnecessary costs. Similarly, the provider has to forecast the necessary resources for the actions in question. In addition, this model does not maximize profits for the provider during high volume times but then protects on low volume times. This model could be used in complex projects to ease the logistics operations through collaboration of companies.

2.4.3.2 Transaction based

Transaction based pricing models are used when outsourcing logistic activities where the prices depend on the volume. (Logistiikan Maailma, 2025). The transactions-based model is an entity where the whole process is priced by individual activities from receiving the goods to shipping them.

The pros and cons of this model for the customer are as follows:

Pros:

- Pay only what is needed
- Predictability
- See the root of costs from invoices

Using the transaction-based model it does not contain similar risks for paying extra for unutilized space or activities like in fixed pricing. Here all the actions are priced individually, which enables the customer predictability over the actions. (Daguer logistics, 2025). Since the actions are billable this provides easy billing reviews, and the customer can examine the roots of billings. (Kaur, 2024).

Cons:

- Accuracy of forecasting
- Budgeting challenges

Even though this model enables possibilities in forecasting its importance rises. (Kenco, 2018). If the forecasts are not accurate it can lead to service failures and extra costs. A similar problem concerns the budgeting. If the forecasts are wrong or supply chains experience problems the distribution costs need adjustments. (Kenco, 2018).

Next the pros and cons of this model are addressed from the providers' perspective:

Pros:

- Maximizing profits
- Simple invoicing
- Scope creep defense
- Efficiency improvements for own interest

This model often enables higher margins and easy invoicing. (Kenco, 2018). When it is defined what to expect to be done for certain transaction possible extra actions can be adjusted in pricing. (Kenco, 2018). Since there are no guaranteed costs in this model it is fully on the providers responsibility and interest to improve efficiency.

Cons:

- Risky
- Unstable flow of income
- Price negotiations

The volumes may fluctuate month to month and this model moves the risk from shipper to the 3PL (Kenco, 2018). As the costs are tied to the volume of products at low volume times the revenue of the 3PL decreases. In addition, it can be challenging to find a pricing matrix that is acceptable for both parties since volatile actions are difficult to resource and cost. (Davies & Robson, 2022). Since the flow of goods can be volatile the cash flow can also experience fluctuations leading to more challenging budgeting.

This model enables better margins for the 3PL and simple invoicing, but the risks are also increased. Since the pricing is based on volume it can bring higher income, especially among seasonal products. The disadvantages are the unstable flow of income, and it is challenging to keep up with rate reviews to improve performance. (Richards, 2011). Nevertheless, these challenges can be addressed internally as in the closed book models the warehouse improvements serve the service provider since the prices are fixed without the necessity of showing books. This model provides possibilities to the customer as well by straight billing, predictability and sources of costs. This model still requires high-accuracy forecasting (Kenco, 2018). It must be noted that the utilized models are contract specific and can be customized for suiting the cooperation.

2.4.4 Hybrid

The pricing models have been divided into open book and closed book contracts and their subcontracts. In addition to these two options, the hybrid can be presented as the third option that includes mixes of open and closed book models. It must be noted that a contract is an agreement of two parties to do or abstain from doing some act (Purpura, 2008) so agreements and contracts can be customized. There can be multiple pricing models as long as both parties accept the terms. The hybrid model contracts can utilize characteristics from the different pricing models and combine them. (Richards, 2011).

2.5 Study gap

Inventory control is important to companies and thus research often analyzes the optimization problems from the retailer's point of view. At the same time Davarzani & Norrman (2015) state that there is a lack of empirical research of warehousing. This literature review addresses the market from the 3PL providers aspect without neglecting the needs of clients. Both customers and 3PL providers' interests are considered since it is a part of the service industry.

The literature review provides vast knowledge of the situation of nowadays logistics and acknowledges the possibility to exploit economies of scale in logistics. It addresses the study gap by addressing information concerning warehouse management and the expectations of clients. This provides valuable information concerning the business domain of outsourced logistics by taking the clients' needs into account while analyzing the profit maximization for service providers.

3 Study methodology

In any academic research the research methodology must be justified to ensure validity and reliability. In this section the academic framework for conducting this study is presented. First the research method is handled and the usage justified. Next the data and its collection are presented to provide detailed information on the data sources to ensure transparency. Lastly the reliability is expressed to finalize acknowledging the characteristics for academic work.

3.1 Method

The research problem limits suitable methods for the research (Helo et al., 2019). To approach a problem, it can be analyzed by its characteristics to choose the right method. The two main types of research problems are nomothetical where the current situation is analyzed and normative where it is analyzed how things should be (Helo et al., 2019). When analyzing warehouse cost structures and pricing models the characteristics of both can be seen. This enables various methods to be used.

The chosen method to approach this research is mixed method case study. Since the research problems are vast by nature the methodological characteristics must enable flexibility and take various aspects into account. This indicates the usage of a case study since it is the most flexible research design where the researcher is enabled to retain holistic characteristics of real-life events in the examination of empirical incidents (Schell, 1992).

The research problem defines the needs for the method suitable for it (Helo et al., 2019). To justify the usage of mixed methods case study both quantitative and qualitative characteristics have to be present. Since the aim is to understand and optimize costs and pricing models the data sources are numerical indicating quantitative study methods. A

quantitative study focuses on answering questions about how much and how many (Research & Doctoral services, 2015). Qualitative research on the other hand focuses on non-numerical data used to subjectively approach phenomena (Taha et al., 2024). Here subjectivity could cause distortion since the aim is to provide information to the industry that would be rather objective. However qualitative research is complex as it is used as cover-all term that covers research strategies, paradigms, parent disciplines, sources of data and methods of analysis for them (Parry et al., 2013). The qualitative characteristics can be seen in semi-structured interviews and evaluation of pricing models as holistic views are used to assess their viability and in assessing the fields of cost structures.

As researching a specific warehouse and its cost structures and pricing models it can be defined as nonexperimental. Then it must be acknowledged that this study focuses on one case company and aims to provide scientific research utilizing detailed information about a real-life company. Concerning the problems of case company observations take place. Observations are used in studies of organizations trying new business models (Gummesson, 2017). As the research is nonexperimental that focuses on providing information by applying theory in a real-life example it can be characterized as illustrative research. An illustrative case study is descriptive in character which adds realism with in-depth examples to other information about policies or programs (Baškarada, 2014)

In the light of this supporting literature, it can be justified to use an illustrative mixed method case study as the rightful method. Mixed methods research combines and integrates qualitative and quantitative methods in the same research (Molina-Azorin, 2016). This enables deeper understanding of the research problem by utilizing both research methods to provide an informative entity.

3.2 Data collection

The data used in this research can be divided into supporting literature, semi-structured interviews and the data collected from the case company WMS. The supporting literature consists of 51 articles, 12 books, 3 conference papers, 5 surveys, 7 public sector sources. Due to the practical nature of the topic, 10 consulting sources are also used in handling the pricing models. The main focus is on the theoretical framework provided by scientific literature; however, the consulting sources also bring practical insight that can be taken into account when analyzing the models.

Six people were interviewed in the semi-structured interviews. Semi-structured interviews are a blend of open- and close-ended questions for one respondent at a time, often with follow-up questions why or how questions (Adams, 2015). According to Guest et al. (2006) 6-12 interviews are enough for qualitative research projects. Thus, it justifies applying this method in the study with the correct number of respondents. The people interviewed are professionals currently working or have worked among logistics. To increase generalizability people outside the case company were also interviewed in addition from the customer side as well. This decreases the homogeneity of the study and enables more perspectives. The interviewees A-E have experience from the service providers aspect when interviewee F has experience from outsourcing the logistics activities. Information concerning the interviews is stated in table 1. The interviews were conducted in Finnish and later carefully transferred into English.

ID	Title	Method	Date	Duration
A	Sales Manager	Teams	1.4.2025	48min
B	Site manager	Teams	2.4.2025	41min
C	Site manager	Teams	2.4.2025	38min
D	Site manager	Teams	3.4.2025	46min
E	Development manager	Teams	7.4.2025	46min

F	Former Deputy head of logistics department	Teams	8.4.2025	55min

Table 1. Research interview details.

The case data used in this study is from the case company's warehouse management system and a contact person among the staff who is a site manager. The cost structures are received from the financial report of 2024. These were provided by the contact person from the staff. Data concerning the pricing models were received from both the contact person and the warehouse management system. This enabled a systematic entity to understand the modeling. In addition, a series of questions that emerged during the research process have been documented and answered by the contact person. These were gathered by small time periods and presented to the contact person for the answers.

3.3 Data analysis

Since conducting mixed methods research the selected topic can be approached by mixed analysis. Onwuegbuzie & Combs (2011) conducted a methodological article where they presented purposes for mixed analysis by Greene et al. (1989) that are triangulation, complementarity, development, initiation and expansion. Mixed analysis expansion enables the expansion concerning study's scope and focus by using both qualitative and quantitative analyzing. (Onwuegbuzie & Combs, 2011). According to Creswell & Inoue (2024) mixed methods evaluation study has the intention of completing an evaluation of a program by examining personal qualitative experiences as well as qualitative outcomes and the procedures are to collect qualitative and quantitative data in different stages. This method is utilized as it covers personal experiences via interviews and quantitative data through the calculations and analysis of the pricing methods.

This approach is used in research to provide information on a broader level but also in detail. As the analyzation of cost structures and pricing models handle larger entities the case company enables the research to extend real-life examples of pricing and billing of the warehouse storage space. When providing numerical evidence of pricing model profitability, the acknowledgements can be reflected to the larger entities concerning the analyzation of market situations tied with the constitution of the prices.

In the analysis a certain time period is used to analyze the customer base of the warehouse in a time frame of 13.1 – 18.2. 2025. The usage of this exact time period can be justified. Before this timeframe an update was made within the WMS to certain affecting factors that had an impact on the number of pallets for certain customers. To rule out confusion from the numbers the data collection had to be done after this update. To enable in-depth understanding of the data the data analysis was started at the end of February to keep up with the research schedule which determined the exact dates for the time period for the collected data.

3.4 Reliability

To create trustworthy research, it must have rigor and validity. Rigor can be described as the standards for investigators to evaluate the quality, value and trustworthiness of research. (Liu, 2017). Liu (2017) continues that the first step to attain rigor is to choose appropriate methodology. This can be evaluated in section 3.1 where the methodology used in this thesis is justified by supporting literature.

According to Zohrabi (2013) possible procedures to validate research can be conducted through content validity, internal validity, external validity and utility criterion. Zohrabi (2013) continues that reliability deals with consistency, dependability and replicability of the results obtained from a piece of research.

The content validity addresses the degree to which an assessment instrument is relevant and representative of the targeted construct it is meant to measure. (Rusticus, 2014). This is achieved through vast supporting literature and reviews also outside the case company and primary data inside the company. In addition, this thesis is supervised to ensure validity of the content. Internal validity concerns the congruence of research findings with reality which can be addressed by numerous ways such as triangulation. (Zohrabi, 2013). Triangulation is reached by collecting data from various sources by primary data form case company, live interviews and secondary data via supporting literature. External validity examines the generalizability of the research. (Andrade, 2018). This is addressed by covering both the providers and customers' aspects of the pricing models. They are handled in universal matters that can be put into different contexts and be analyzed to provide conclusions. The utility criterion refers to the usefulness and proper information for the decision makers. (Zohrabi, 2013).

Reliability concerns the consistency of the results obtained (Andrade, 2018). In quantitative aspect this is straightforward since they are numerical however the qualitative data can be challenging to get consistently identical results. (Zohrabi, 2013). Reliability can be addressed through the content validity by analyzing the supporting literature and interviews of experts from the field. When it comes to replicability the reliability is handled by the ability to conduct the same study elsewhere and could be referred as replicability. (Laher, 2016). This is approach by providing clear information regarding the supporting literature and appropriate references. In addition, interview questions can be found in the appendix to conduct similar interviews. Dependability concerns the stability of findings over time involving the evaluation of findings, interpretation and recommendations of the study. (Korstjens & Moser, 2017). The findings in this study are justified and the methods, techniques and procedures are presented. This audit trail allows the reproduction of the study guaranteeing the dependability. (Ahmed, 2024).

4 Problem with the case company

The case company is a third-party logistics service provider in Northern Europe. It is a multinational company that provides customized solutions to customers in the field of logistics. This case study addresses one of their warehouses located in Finland. The company is interested in examining their own costs and comparing them to the warehousing prices. This is approached first by conducting a cost analysis to the cost structures. This way it can be broken into detail what the costs are and how much. This is followed by an analysis concerning the pricing models. This must be assessed in order to understand the possibilities concerning different pricing models. After this the actual warehousing prices can be approached by the billing methods. While providing information about possibilities among pricing models their current contracts are taken into evaluation. The current contracts' profitability is examined and evaluated if they need improvement. If changes are needed this paper gives recommendations.

The warehouse premises in question contain 24 000 euro-pallet lots divided into lots in shelves (18 000) and mass storing area (6000). The company has 23 different clients which operate in different industries leading to a variety of products. This affects storing optimization as the size and weights of the goods vary. The aim is to find an optimal pricing model for the warehouse that utilizes the characteristics of the goods. This problem is approached first by the optimization of space. When the constraints have been acknowledged the pricing models are taken into consideration in the environment of the warehouse. To enable in-depth data the units of billing in the pricing models are addressed to offer possibilities to the pricing methods. Here the four biggest clients are taken for example. In the end a summary is contrived from the findings.

5 Results

The results section is the core of the thesis. The aim is to provide objectively accurate results to the case company concerning the research questions and objectives. The data collected in this research is used in practice and analyzed to enable alternative options and solutions when it comes to the cost structures and warehouse pricing models.

The empirical study is divided into six sections which are handled in detail with their sub sections. The sections are cost structures, suitability of different pricing models, pricing units, capacity limitations and optimization of space, frameworks for warehousing pricing methods and analysis of present pricing methods. In the cost structures the company's fiscal year of 2024 is used and targeted at the land and premises costs. Then the pricing models are analyzed by the aspect of the case company. Next the pricing unit handles the methods of billing by the billing unit generating income. The capacity limitations and optimization of space handles the factors contributing to the decisions concerning the storage placements of the goods. Frameworks for billing methods handle the formulas generated to pursue optimal pricing by storage placement. Lastly the analysis of present pricing methods assesses the present pricing model reflected in the findings. With these six sections the research questions and objectives are assessed.

5.1 Cost structures

The cost structures handled in this section are from the case company's fiscal year report 2024. This ensures that the data is recent and is an applicable source to analyze costs on a yearly level. The aim is to answer the first research question stated as:

Q1 What are the factors and components that contribute to the formation of warehousing costs in the case company's warehouse?

When focusing on the factors that form the cost of warehousing it is directly related to the costs that originate from the premises themselves. This leads to the analyzation of land and premises costs. According to the information provided by the staff of the company the costs concerning land and promises are as follows:

- Property rent
- Other space-related fees
- Rent of other fixed assets
- Property tax
- Land rent
- Electricity
- Heating and water
- Cleaning expenses
- Fixed maintenance fees
- Security
- Garbage collection
- Facility repairs
- Snow removal
- Liability insurance

These key figures are presented in figure 4 below.

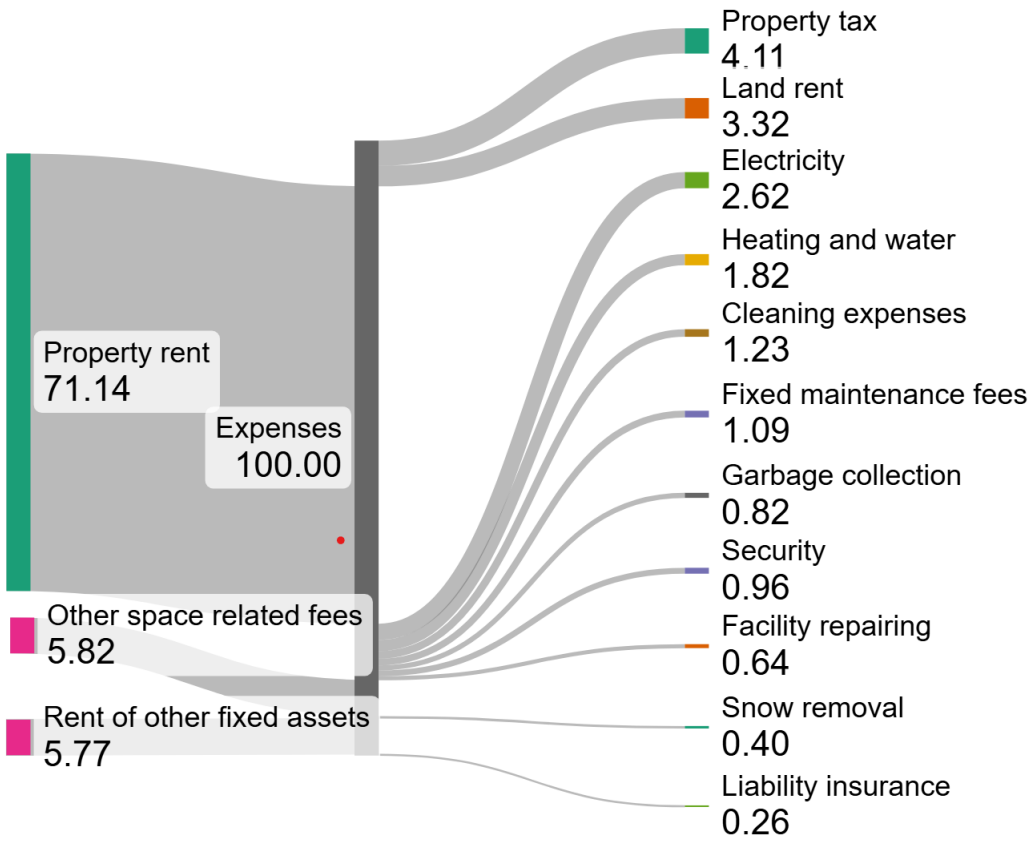

Figure 4. Land and premises costs individually in relation to the entity by percentage (%) from 2024

Figure 4 demonstrates the relation between the individual costs contributing to the whole cost of land and premises. Here it can be declared that the property rent is the most striving factor as it uses 71,14% of the costs on land and premises. After that the next costly expenses are other space-related fees and rent of other fixed assets. These are also the only factors along with property rent that individually cover 5% or more of the total land and premises costs. After these three most costly expenses the remaining costs split 17,27% among eleven different factors. To enable in-depth understanding about the costs all of them are handled and the relative amount of costs is examined.

5.1.1 Property rent and space related fees

The property rent is significantly the highest expense, covering 71,14% of the total costs. Due to confidential matters these factors can't be totally transparently handled so the other space-related fees are taken into consideration in this section. Together they combine 76,96% of the total costs. The warehouse in question provides 24 000 pallet lots. The rent and space-related fees' high proportion of the costs is reasonable due to the size of premises. Such a high-capacity warehouse needs also a great amount of space which leads to land rental. The land rental covers 3,32% of the total fees lifting these three expenses into a combined result of 80,28%.

As for handling space-related fees the fixed assets are taking into account here as well. Fixed assets concern subsets of produced assets mostly machinery, equipment, buildings or other structures. (Eurostat, nd). Since the topic discussed is the premise costs the fees of machinery and equipment are ruled out from this. This covers 5,77% and increases the combined costs to 86,05%.

The notable factor in these costs is that none of them are constant. Their amount varies throughout the months of 2024. Since these expenses have variation through the year it indicates that these fluctuations are not uncommon. This leads to the importance of taking these factors into consideration when customizing the warehouse storing prices. These fluctuations can also originate from certain projects that need space around the warehouse premises. These changes must be noted as they appear in the costs that generate 86,05% of the total land and premises costs.

5.1.2 Property tax

Property tax is an unusual factor in the land and premises costs as they are rental premises. According to Finland's ministry of finance (n.d.) it is an annually paid tax based on the ownership of the property. This is included in the case company's costs since their

contract with the property's owner states that they will pay the annual property tax fees. In Finland the property tax varies by municipality. According to Finland tax administration (2025) the municipalities can decide the exact tax rate concerning general real estate tax between 0,93-2%. The exact tax rate will not be handled in order to keep the exact location concealed.

This property tax covers 4,11% and is the fourth largest individual expense included in the land and premises costs. This is an important factor regarding the expenses since it is an uncommon expenditure and must be taken into account when managing the overall cost of the warehouse.

5.1.3 Electricity

Electricity formed 2,62% from the overall costs in 2024. Electricity handles many potential factors that not only impact on the cost but can affect in other ways like company image and its brand. Electricity is a good way to impact climate neutrality by using environmentally friendly power. This is already addressed since the electricity used in the case company is 99.99% renewable.

The consumption of electricity is not stable and varies throughout the year. It can be observed that the electricity expenses are higher during winter months than in the summer. This indicates either higher usage in wintertime, higher price of electricity or both. The case company has an exchange electricity contract so this can be evaluated from historical data.

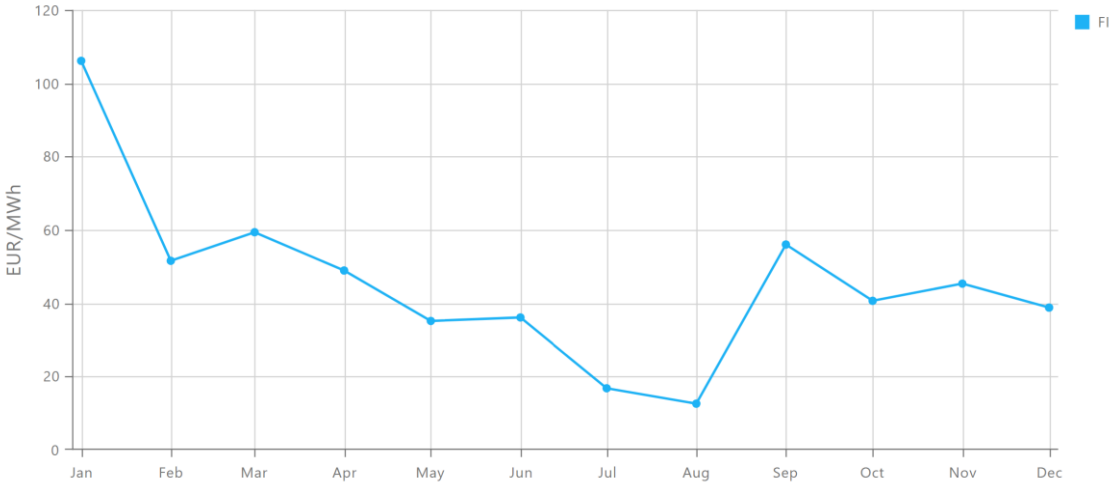

Figure 5. Electricity prices in Finland in 2024. Source: Nordpool

From the figure above it can be observed that the electricity prices in Finland are pricier in wintertime than summertime. This explains the higher costs of electricity during wintertime. The electricity consumption is optimized through lights equipped with motion detectors. This enables the automation of the light's usage, ensuring that they are used only when needed.

5.1.4 Heating and water

Heating and water expenses combine 1,82% of the costs. This includes similar attributes to electricity since the cost is higher during the winter months. The warehouse optimizes its usage of heating as a part of the warehouse operates without external heating. This part stores goods that are not sensitive to changes in temperature.

Like with electricity the source for the heating is a valuable choice for the company. Not only is it a way to fight climate change and enhance sustainability but the challenges in different fields of heating affect their prices significantly. Global challenges create different circumstances that adjust risks among the sources for heating. These factors are important to take into account and inspect periodically to avoid peaks in prices due to phenomena that are not controllable by the company.

5.1.5 Cleaning expenses

The cleaning expenses cover 1,23 % of the land and premises costs. Cleaning services are outsourced. Cleaning has an impact since it affects the workers' perceived productivity (Horrevorts et al., 2018). This is linked to work efficiency and atmosphere in the company. Large warehouses generate dust over time and if cleaning is neglected, it can cause hazards to the health of the staff. Additionally, the influence of clean environment is not limited internally. As goods are sent to clients their condition should be as good as they were when they entered the warehouse. If the quality of products is affected negatively by the storage environment it leads to reclamations and disruptions. This implies that cleaning is a factor that impacts many fields not only internally but externally as well. If these deeds are not managed and carried out good enough it might cause higher expenses.

5.1.6 Fixed maintenance fees

The fixed maintenance fees include predictable costs from actions that have to be carried out to maintain the functionality of the premises. It includes, for example, scheduled maintenance audits and checks of the premises. These cover 1,09% of the overall premise costs.

5.1.7 Security

Security is a mandatory factor when it comes to off hours formulating 0,96% of the costs. The safety of the clients' goods must be ensured to be able to provide trusting services. If security is not managed well it might lead to losses among clients and hurt the company brand and image. It is important to understand that security concerns the safety of the physical goods, but the term also includes the safety of non-physical goods such as information. It has similar attributes as cleaning in the sense that it can become more costly if not executed well enough.

5.1.8 Garbage collection

Garbage collection is a mandatory act that covers 0,82% of the costs. The only way to address this cost is to reduce the amount of garbage generated which leads to the reduced amounts of garbage collection. This is highly linked to the profile of operational activities tied to the momentary workload. One way to address the generation of garbage is the company culture regarding consumption. The optimization in consumption of goods requires cautiousness and professionalism along with understanding the bigger picture when a substance becomes trash and that it cannot be exploited in any activities.

5.1.9 Facility repairs

The wear and tear of premises are unavoidable, and this causes 0,64% of the costs. This expenditure is not stable as it comes up only when premises must be repaired. Although wear and tears are unavoidable, to some extent they can still be minimized. To minimize possible repairs the flow of goods must be treated which caution. Facility maintenance can be monitored and the reasons behind possible repairs can be solved. Here preventive maintenance is also an essential role. This can be addressed by proper training of staff and emphasizes safety in operations, especially concerning the use of machinery. Regular inspections are worth conducting as well to prevent escalations of possible issues.

5.1.10 Snow removal

Snow removal is a seasonal cost that causes 0,40% of the total costs. The problematic part of snow removal is that it is hard to predict due to changes in weather. This way it can cause unexpected amount of costs, so the company must be prepared to different scenarios caused by unstable weather. With the overall costs it is the second cheapest expense, but it holds a lot of accountabilities. In the wintertime the weather can cause hazardous environments due to the amount of snow and ice. If the maintenance of the

surroundings is poor, it can create risks for the workers. This can lead to injuries and this way to sick leaves. Also, operational effectiveness can suffer delays if the warehouse is not accessible, or the movement is slowed down due to the environmental conditions. Thus, it has dependability and holds the status that it can create costs if not executed well enough.

5.1.11 Liability insurance

The smallest expenditure on land and premises cost is liability insurance which covers 0,26% of the total costs. In Finland there are mandatory insurances for companies such as occupational accident and disease insurances (Sosiaali- ja terveysministeriö, n.d.) but liability insurances such as general business liability insurance and product liability insurance are not mandatory but voluntary (Suomi.fi, 2022). Although they are not mandatory, they enable and create safety for the working conditions and for the company. They protect from unpredictable accidents and enable stability.

5.1.12 Summarizing the cost structures

The cost analysis enables us to approach the warehouse cost structures by a real-life example of the case company. Here it can be observed in detail how the costs are distributed and in what shares. This answers the first research question of

Q1: What are the factors and components that contribute to the formation of warehousing costs in the case company's warehouse?

5.2 Suitability of different pricing models

Now the first research question has been handled providing information on the cost structures. Next the aim is to assess the pricing models and to consider the best one for the needs of the case company. In this section the aim is to answer the second research question which is:

Q2 What is the most optimal warehouse pricing model for the case company to maximize profitability?

It has to be acknowledged that the clients' needs have to be taken into account in the pricing model. Since operating in the service industry, it is unlikely to have contracts that would be one-sided. So, when maximizing their own profits, the client must benefit from the contract as well.

First the nature of the models is handled pursuing the best suiting pricing model. The open book pricing model suits the new shipper-3PL relationships (Kenco, 2018) and circumstances where the needed resources are hard to determine or forecast (Davies & Robson, 2022). This is also noticed in the interviews. Interviewees A, B, C, D and E also stated that the open book model suits new contracts especially if there is no history from the field. This lowers the risk of mispricing the services and enables a good start to the cooperation. In addition, the low risks are noticed in the literature (Kenco, 2018) and by interviewees (A, B, C and D). Interviewee D still notes that the transparency alone does not guarantee a good contract since cost efficiency is the top priority.

The problems with open book pricing are that it requires expertise and additional work from the customer along with the risk of paying for inefficiency (Davies & Robson, 2022). For the provider the margins are often lower, and it does not encourage the provider to make processes more efficient (Davies & Robson, 2022; Kenco, 2018). This was also noted by interviewees A, B and C. In addition, interviewee D mentioned that the open

model enables easier competitive tendering for larger companies. Similar notifications were stated by interviewee E. This can be noticed by Fehr & Rocha (2018) as well since they state that the open model creates risks concerning the spread of confidential information and that the information can be used against the provider in price negotiations. This makes the service provider more vulnerable.

The closed book model takes an opposite stance concerning transparency than the open book model. The closed book model is handled by fixed and transaction based in this thesis. The fixed model enables stability for customers as the price stays constant along with collaboration as the contract can be customized to include and exclude certain actions (Kaur, 2025). According to interviewee A this model suits the provider since the income is stable without risk. Interviewees B and E also described a scenario where a certain amount of space is rented to the customer which transfers the risk to the customer for utilizing the space. This is also noted by interviewee F who states that when goods are not always stored on pallets the leasing of whole premises is easier than pricing by individual units. This model also encourages the provider to improve internal effectiveness since it is a closed book model it benefits mainly the provider.

Similarly, the cost is constant and the risk of optimization for the services is transferred to the customer. Due to this factor the customers' forecast must be accurate for this model to be profitable (Kenco, 2018). For the provider this model contains challenges concerning the pricing (interviewee D) and problematic situations in negotiating terms about what transaction to include and exclude to the contract (Interviewees B and C).

The transactional model is based on the pricing for individual activities through the logistic processes. This model ensures that the customer pays only what their need is and with successful forecasting concerning volume the costs can be predicted (Daguer logistics, 2025). Similarly, the service provider can maximize their profits since this model tends to have higher margins (Kenco, 2018) and the efficiency improvements serve provider's interest. The profit maximization is noticed by interviewee A and interviewees A,

B, C and D argue on that the volume-oriented nature serves the customer because of the scalability as they pay for the individual actions. Interviewees A, B, C and E also prefer this model since it encourages the provider to find more efficient solutions. Even though this mainly improves the provider financially it also serves the customer in the sense that the actions are effective and the fluent operations decrease the margin for errors for them as well.

In the transactions-based model the accuracy of forecasting becomes more important and raises the risk and can cause budgeting challenges in forecasting failures for the customer (Kenco, 2018). Interviewee F notes that to fight challenging forecasting the fixed monthly contracts are a good and simple choice if the price is satisfying for both parties. In these situations, the customer does not have to use resources to check billings. It also covers from large costs from back-and-forth transportation of goods due to complex and challenging logistics.

The risks rise for the provider as well since the volumes fluctuate (Kenco, 2018) leading to unstable income. This enhances the importance of the prices given to the customer. In addition, the price negotiations can be challenging (Davies & Robson, 2022). Interviewee A also notifies the higher risks and interviewee C mentions that the customer can calculate their costs and transfer the risks to the provider in the form of optimization for actions. Interviewee E points out that the pricing might not be equal among goods when their attributes are taken into account. Certain pallets can create the same amount of revenue, but they are not equally easy to handle. This can create situations where pallets can have cheaper prices than others considering the resources needed for their handling through the warehousing processes. When comparing the transactions based pricing and fixed pricing, the transaction based one was the preferred option by all of the respondents except respondent F. Interviewee F has experience from the customer side and states that when operations are challenging to forecast, and the nature is very hectic the fixed monthly contracts relieve the complexity of carrying out these operations.

The hybrid pricing model contains characteristics from both open and closed book pricing (Richards, 2011). This opens possibilities and flexibility since the contracts can be customized with a wider range of arrangements. Like other models this also has its pros and cons. Interviewee A points out that when certain activities are handled by open booking and others by closed booking it could lead to a situation where the customer compares the prices among themselves and might question the prices. So, it can be challenging to form a functioning price entity when both models are utilized. At the same time, interviewee C and D pointed out that the hybrid model enables flexibility. Respondent D also continues that the hybrid model could be utilized in new partnerships to fight the drawbacks of the open book model which is popular in those cases. Interviewee B also states that the characteristics of both models can be utilized and for different occasions the better suiting characteristics can be used.

In the light of the information gathered through supporting literature and interviews it can be concluded that all of the models have their pros and cons, and the chosen pricing model depends on the situation. Interviewee D concluded that the company strategy is the deciding factor when choosing the pricing model. It can be observed that the open book pricing model carries lower risk but has similarly lower margins. Then the closed book model carries higher risk enabling higher profits. So, the company stance on risk management is in essence. At the same time the case warehouse carries capacity for 24 000 pallets, indicating large size which could utilize the economies of scale. Because the contract customization is dependent on the needs of the customer the hybrid model enables flexibility and possibilities concerning the customization of the contract. It must be acknowledged that the decision process is impacted by internal and external factors. Overall, the hybrid model offers the largest variety of possibilities concerning the customization of contracts, which can be one of the greatest assets for the service provider. So, depending on the company strategy the case warehouse could utilize closed or hybrid pricing model to enable higher profits while managing the risks and enabling contract customization in mature contracts. In newer contracts the open book can be a good starting point.

5.3 Pricing units

Now the general level of pricing models is handled by their nature. Pricing models have an influence on the way of conducting business and how the cooperation is constructed. For deeper examination the actual source of income of warehousing must be studied. This addresses the third research question which is

Q3: What are the best billing units?

This can be approached by examples of storage charges by Richards (2011). Richards (2011) presents four examples as follows: rate per pallet per week, rate per square foot per week, rate per shelf location per week and fixed rental cost per week/month. It can be observed that the charging is based on two factors that concern the usage of space and the timespan for storing. So, it can be concluded that the root source of income can roughly be divided into the unit of billing and timespan of the storing.

5.3.1 The unit of billing

When analyzing pricing models in detail the root source of income is the billing for the storing service. Since there is a limited capacity for space in a warehouse the unit billing should be customized for the usage of space. Pallet-based pricing might not always be the most profitable option as the unit of billing can be customized. Instead of pallets the unit of billing could be cubicles (m^3), squares (m^2) or by weight in kilograms (kg). It is crucial to understand the customization in the contracts.

Before considering the profitability aspect of the unit of billing the compatibility of the unit and WHS has to be observed. The unit that the billing will be based on has to be supported by the billing system (Interviewees A and C). Similarly, it has be supported by the customers' ERP system.

The idea in the billing unit is to maximize profits by the attributes of the goods and using the finite capacity as effectively as possible. It has been acknowledged that the capacity is limited to 24 000 lots. Other limiting factors are the weight limit which is 3400kg for a row in shelf that enables lots for four euro-pallets (max 850kg) and three FIN pallets (max 1133). In addition, the volume by cubical is limited in a shelf lot as well. With these limitations the best options can be pursued via customized billing units.

When the weight of a euro-pallet rises over 850kg it starts to become too heavy to be stored on a shelf except on the floor row. This narrows the possible lots where it can be stored and forces it to be stored in the mass storage area. In the case mentioned the billing could be customized for the weight of the pallet (Interviewee D and E). This is due to its attribute to exceeding the price that would be charged by one pallet and for its restrictive factors concerning lot selection. Since the limit of the possibility to choose the lot freely is 850kg for euro-pallets and 1133kg for FIN-pallets these are the intersection points where the price of the pallet should exceed the standard pallet price when comparing to standard pallets. The increase in price can be formed by various factors but the most important one is to customize it into a form where it is acceptable and cost-effective to the customer as well.

Volume is also an option to be the unit of billing. It is sensible especially in the case where goods are stored in the mass storage area. In these situations, goods are not always on a euro- or FIN-pallet so the usage of volume as billing unit is rational (Interviewee E). Volume based billing has the advantage that here the customer is billed from the actual usage of space (Interviewee C and E). Interviewee A states that the volume-based billing is a good option if the goods are stackable. To deepen the knowledge of lucrativeness of billing by volume or pallet their relation by usage of space must be examined. When storing goods in shelves it must be acknowledged that the lot is then occupied for the one pallet. Shelf lots are not always perfectly matched with the volume of the pallet stored. So, for example, height-wise space can be left unutilized. This is in essence in space and lot size optimization. The ideal situation would be to have standard-sized

goods with standard-sized shelves to optimize the usage of space. Since this is not always possible it is challenging to utilize all the space available.

Pricing-wise similar ideology can be utilized as with weight. The volume-based billing unit is lucrative when the volume of the pallet exceeds the space in a shelf lot. This forces it to be stored in the mass storage area. When the volume exceeds the limit that it cannot be stored on a shelf the price should exceed the pallets price similarly as in billing by weight.

When comparing area (m^2) and volume (m^3) based billing the height aspect causes challenges and possibilities. Interviewee D points that the area is easy to price and argue the price by comparing it to the area price of the premises. Interviewee B prefers area pricing when all the premises are leased to the customer. On the other hand, interviewees C, D and E note that the volume-based billing takes height into account possibly enabling more profits. Then, interviewee D notes that it can be challenging to find suiting prices for the height. When pondering these pricing methods, it is worth discussing with the customer what kind of goods are in question and what their attributes are, whether they are stackable or not. This way a contract can be customized to serve both parties.

It can be concluded that goods stored on shelves should be billed by pallets because this model transfers the optimization in space utilization to the customer. When a lot is occupied, the place is taken regardless of the volume of the pallet. So, the pallet-based pricing eliminates the variance in income by volume or weight. According to interviewee E this model is also easy to operate with.

When goods are stored in the mass storage area it is often due to their attribute of too high volume (m^3), weight (kg) or area (m^2) when assuming that there is lots available in shelves. This indicates that the billing method should be based on the factor that forces it to be stored in the mass storage area. If more than one attribute forces the pallet to be stored in the mass storage area the most profitable one should be elected.

5.3.2 Timeframe of billing

In the examples by Richards (2011) the time periods used are weeks and months. It can't be stated to have explicitly one best method that could be used universally. It must be remembered that these are contract varied subjects, and the best option can be reached through the cooperation of the parties involved. The timeframe of billing affects the company cashflow by the frequency of payments.

5.4 Capacity limitations and optimization of space

To maximize profitability in storing services the capacity must be maximized. To construct the framework and the possibilities within the scope, limitations must be acknowledged. The main constraint is the amount of space. The capacity is 24 000 pallet lots divided among lots is shelves (18 000) and mass storing areas (6000). Other limiting factors in the warehouse storing lots are weight and volume in cubicles. The weight limit in shelf row is 3400kg which fits four euro-pallets or three FIN-pallets. This indicates that the maximum amount of goods stored in a shelf row is four euro-pallets that weigh 850kg or 3 FIN-pallets that weigh 1133kg each. The volume is dependent on the structure of the shelf and the case company does not have individualized data of each row's volumes. This creates challenges in space optimization since it is difficult to follow lot specific usage of space when there is no detailed data available. Also, the volumes of the rows are adapted by the need, so the structure of the shelves vary by time.

Since the warehouse consists of lots in shelves and mass storage areas these must be analyzed. When considering the maximization of profitability in storing services the economies of scale should be utilized. This ideology can be affined to the research gap of this thesis and assist in reaching the objectives concerning maximizing profitability of storing services. The profit maximization can be approached by the economies of scale when the logistical average costs decrease and average production rises. When analyzing this from the perspective of storing it derives to the ideology where the average cost of

a storage lot decreases when higher amounts of lots are enabled to usage when the amount of space is constant. So, the average cost of providing a lot decreases and similarly profits increase due to higher capacity. Here the data on the volume of the lots would be crucial. The ideal situation would be to have lots for different sizes as standard where the full capacity would be utilized. This could be achieved by cooperation and collaboration with the clients where the volume would be tracked, and certain shelves could be customized to certain clients. This way the volume for individual goods by clients could be forecasted or separately agreed on. This way the lots could match the volume of the goods better, enabling more lots by number.

To assess the maximization of mass storage area capacity should be taken into consideration. To formulate fluent entity in mass storage areas the placement of the pallets and the piling attributes are in essence. The capacity of pallets should be maximized without the risk of making warehouse actions such as picking more challenging. This is enabled by using enough space for machinery to proceed in the area and piling the pallets within possibilities. If the goods are not stackable, they demand more space of their own and the full capacity is not reached. In these cases, the prices should be higher as well since they limit the full capacity and take up more space than stackable goods. These situations indicate that the pricing is not always optimized if the unit of billing is always the number of pallets. This indicates that there are scenarios when the billing should be done other way such as by area, volume or weight. To be able to choose the right billing methods in the pricing models these have to be examined in detail.

5.5 Frameworks for warehouse pricing methods

To be able to negotiate suitable contracts the specific prices for lots should be found by the billing unit. Since the price for a lot is dependent on the utilization rate of the warehouse it must be taken into account. Another factor that has to be considered is the mass storage area. It is stated to have 6000 lots when considering lots used for euro-pallets. This means that if the mass storage area would be filled with shelves it could enable

6000 lots as in reality it is just an empty space of 2000m^2. The shelves utilize height of the space efficiently indicating that the mass storage areas capacity is in reality less than 6000 lots. This indicates that a lot from the mass storage area is more expensive than one on the shelf. Because the stacking ability of goods cannot always be predicted the capacity for mass storage area has to be assumed to minimum number of pallets fitting the area. The minimum capacity can be derived from the floor capacity. This thesis focuses on pricing to reach the breakeven point and leaves profit considerations to the case company.

Since the number of profits is left for the case company to decide the price for breakeven point can be assessed. The factors impacting the price are premise costs, capacity, and the utilization rate of the warehouse. In addition, the time period adjusts the costs for the timespan in question. In the light of the supporting literature, interviews and observations the author developed formulas to illustrate the formation of warehousing lot prices.

5.5.1 Price for a lot in shelf

First the formula for deriving the price for a lot on shelf is handled. Here the capacity can be stated since the number of lots in shelves is reported and the space is limited. The formula for euro-pallets is as follows:

f($Price_S$) =

$$\frac{\left(\frac{C(t)}{L}\right)}{U} + p \qquad (1)$$

Where,

C = Costs

t = Time

L = Lot amount/capacity

U = Utilization rate of warehouse

p = Profit

This formula takes into consideration the costs tied to the time period, number of possible lots and utilization rate of the warehouse. The formula generates the answer to the price for a lot excluding the externally added profit (p). If the price would be calculated for FIN-pallets the ratio would be adapted by ¾.

5.5.2 Prices for mass storage area

When calculating the price for a contract that does not use shelf lots the mass area has to be taken into consideration. If a product that is stored on the shelf utilizes a billing unit other than pallet-based billing the pricing can be compared to the lot specific prices. When a product is placed in a lot on a shelf it takes the lot to itself regardless of the weight or height. Thus, it is worthy to use pallet-based billing on goods stored on shelves. This indicates that other billing units than pallet-based could be utilized for goods that are stored in the mass storage area

To reach profitability with the mass storage area it must generate income for at least equal to 6000 pallet lots since that is the possible capacity if the area had shelves instead of free space. Basically, the mass storage area is for products that cannot be stored on shelves. This indicates that the mass storage area is meant for products that i) have too high volume, ii) are too heavy to be stored on shelves. Here it must be acknowledged that the goods might not fit the shelf lots just because of their height but their wideness when the goods surpass the pallets borders. In these cases, the goods usage of space should be taken into account by square roots.

5.5.2.1 Area and volume-based pricing

The mass storage area pricing can be approached first by billing of square root which can then be used in pricing volume. The mass storage area cannot be filled completely because this would obstruct the picking order for products. Thus, space must be left for aisles as well. The case company has stated that 20% of space must be left for the aisles which means that the storage space is 80% of the mass storage area. In addition, the upcoming formula has the assumption that goods are not stackable. This has to be the assumption to ensure profitability. Once again it can be noted that anything can be negotiated when forming contracts so the price can be adjusted if it can be ensured that the goods are stackable. The formula for pricing by area is as follows:

$f(price_A)$

$$\frac{\left(\frac{C(t)}{0{,}8m}\right)}{U} + p \qquad (2)$$

Where,

C = Costs

t = Time

m = Space of mass storage area (m^2)

U = Utilization rate of warehouse

p = Profit

When calculating the prices for the mass storage area the costs are ¼ from the whole warehouse costs since the mass storage area is 25% from the whole warehouse capacity.

Since the company does not have accurate data on each shelf lot it is challenging to track the optimal price for volume if it would be stored on the shelf. This would demand detailed data and standardized volume for lots to fit smaller volume pallets to optimize the usage of space. In the current state it is easier to use pallet-based billing when storing

goods in shelves lots. Due to these reasons the volume-based billing is focused on the mass storage area.

It is challenging to price goods by their volume since it cannot always be known if the majority of the volume consists by the width, depth or height of the product. If it consists mainly form width or depth it takes more area horizontally indicating the area-based billing. When the height increases the volume rises without the bottom area rising. In this scenario the increase in volume should be taken into account in the price indicating volume-based pricing. It is challenging to provide a universal price for the volume due to the different attributes of the goods. To ensure profitability the pallets pricing must always reach at least the breakeven point. Thus, the volume-based pricing could be approached by the area-based pricing and add the price for height separately. This can be taken into consideration in contract negotiations when the attributes of the goods can be investigated in more detail. This would also make the area billing by square meters alone unnecessary since it fails to add price for the height.

5.5.2.2 Weight based billing

When considering weight as billing unit the verge of pricing is the point when the pallet cannot be stored on a shelf anymore. This point is 850kg for euro-pallets and 1133kg for FIN-pallets. It cannot be universally stated what is the optimal price per kg, but it is possible to create a formula that calculates the minimum price. The formula can be formatted as follows:

f($Price_w$) =

$$\frac{\left(\frac{C(t)}{\sum_{i=1}^{n}(W_i * L_i)}\right)}{U} + p \qquad (3)$$

Where,

C = Costs

t = Time

L_i = Lot_i

W_i = $Weight_i$

U = Warehouse utilization rate

p = Profit

Here it must be noted as storage capacity is always dependent on space usage. Thus, as goods are upon pallets the pallets size is the minimum area that will be used in the storing process. This must be taken into account when examining the price for weight-based billing. In addition, it has to be taken into account that the weight stored in a lot (*L*W* in equation) is pallet specific and the pallets have to be assessed individually as in the formula. When less weight takes one lot the price in kilograms rises to meet the breakeven point. This must be considered if the amount of the product varies during the storage time and is not handled as an entity.

5.5.3 Limitations of the formulas

The formulas generated above enable a baseline framework for pricing lots but there are limitations that have to be acknowledged. First the utilization rate must be forecasted. This could be addressed by implementing minimum utilization rates for contracts which would ease the forecasting process.

The second limitation is profit. The profit is shown as an external factor added to the body of the formula which constitutes the breakeven point. The profit factor is left for the company to decide how they want to determine the profit. It is contract specific and cannot be determined universally.

Third are the assumptions. All of the formulas concerning the mass storage area have to have capacity assumptions for the minimum amount of capacity to ensure profitability.

The formulas are tools to approach new contracts and give a lead in how to price new contracts. They enable calculations to reach breakeven point and pursuit profits. They can and should be adjusted by new detailed information enabled in contract negotiations.

5.6 Analysis of present pricing methods

To provide justified improvements the current situation must be observed. Here the four biggest clients pricing models have been taken into detailed analysis. To justify the selection of these four clients the figure 6 can be observed below. It demonstrates the number of pallets per customer for the time period of 13.1.2025-18.2.2025. It can be observed that the clients 1, 3, 4 and 22 are the largest users of the storing space by the amount of pallets.

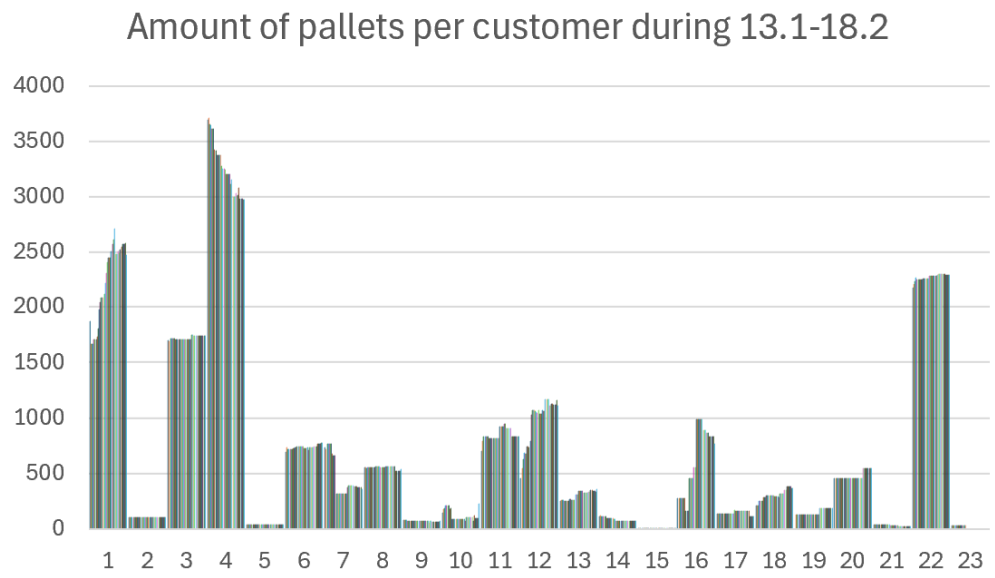

Figure 6. Number of pallets per client

The pricing models are mainly closed-booked contracts so due to confidentiality reasons no exact prices will be handled.

5.6.1 Client 1

The client number one is the third largest client by number of pallets in storage and has a closed-booked pricing model using the average amount of pallets within a month as a unit of billing tied to the time period.

By using the formulas above, it can be concluded that the current contract demands a utilization rate of over 83,35% to be profitable.

5.6.2 Client 3

Client number 3 is the fourth largest client by the number of pallets in storage. The contract is a closed-booked model with billing tied to the highest number of pallets within a week.

This client has three different prices which are tied to the size of the goods on the pallets by height so this pricing model utilizes partly a volume-based pricing. It categorizes the price for pallets by their height. Under 70cm is the cheapest one, 70-120cm is in the middle and the priciest is over 120cm. Here it must be noted that the average height of a lot in shelf is 120cm so the largest category does not fit in shelves so they must be stored in the mass storage area.

It can be observed that the contract concerning under 70cm products would need the utilization rate to be over 93,71% to be profitable and the 70-120cm contract needs over 58,52% to be profitable.

The key factor in comparing these two contracts is the optimization of space. When a pallet is set to the shelves it takes the lot for itself. Since the average height is 120cm under 70cm contract does not utilize the whole space of the lot. Because the volume is smaller it also costs less for the customer. So, to make smaller pallets more profitable the lots in shelves could be more standardized by size so in this case the capacity would rise when enabling more lots for smaller pallets. The 70-120cm contract utilizes space better and provides better margins as well compared to the under 70cm contract.

When analyzing the last category of over 120cm goods the limits in the capacity must be taken into account. Since they do not fit shelves, they must be stored in the mass storage area. The presented capacity for mass storage is 6000 but this is the theoretical amount the area could fit if it had shelves in the area whereas it could utilize the height of the warehouse better. So, in reality the capacity is lower, indicating that the costs should be higher than for pallets that fit shelves.

The calculations show that in the situation of non-stackable goods the utilization rate of capacity should be over 116,63% for this contract to be profitable. With the assumption that the goods are not stackable this contract is unprofitable since the breakeven point is over the capacity of 100%.

To summarize, the contract for pallets sizing 70-120cm is most profitable. It can utilize capacity well and has breakeven point in utilization rate of 58,52%. The under 70cm goods contract has the breakeven point in utilization rate of 93,71%. The contract would be more profitable if shelf lots could benefit space better and thus enable more lots and capacity. The contract for over 120cm goods is unprofitable because the breakeven point lies in 116,63% exceeding the possible capacity.

5.6.3 Client 4

Client number 4 is the largest in number of pallets in storage and has a closed-book contract where the billing is tied to the highest amount of product within a week. This contract uses weight as a unit of billing. So, the number of pallets naturally indicates the amount of goods stored but the actual profiting factors come via weight in kilograms (kg).

Using the formula concerning weight as the unit of billing it can be calculated that the breakeven point sits in 220,15% utilization rate. This enables the conclusion to state that the contract is not profitable. Since the breakeven point is over double the capacity, it is highly unlikely that space optimization could alone improve the profitability enough so it can be concluded that the price is too cheap.

5.6.4 Client 22

Client number 22 is the second largest client and has a closed-book pricing model where the billing is tied to the highest number of pallets within a week. Using the formulas above it can be calculated that the utilization rate is 38,99% to reach breakeven point. This contract can be considered profitable as it leaves well room for profit considering the overall utilization of storage space.

6 Discussion

Now the theoretical frameworks and empirical studies have been conducted, and they can be interpretated. The discussion section is divided into sub-sections handling the answers to the research questions, limitations of the study and suggestions for future research. The research questions are addressed with the knowledge gathered in the empirical section enabling the detailed results. To provide rigor the limitations have to be acknowledged and stated. This leads to the recommended future research where the limitations could be addressed and the drawbacks concerning the literature gap being filled.

6.1 Answers to the research questions

To summarize the main findings of this study the research questions are presented as well with the answers for them. The first research question was as follows:

Q1: What are the factors and components that contribute to the formation of warehousing costs in the case company's warehouse?

This question was addressed through the case company's fiscal year report 2024. The contributing factors with the proportion of the costs are as follows:

- Property rent – 71,14%
- Other space related fees – 5,82%
- Rent of other fixed assets – 5,77%
- Property tax – 4,11%
- Land rent – 3,32%
- Electricity – 2,62%
- Heating and water – 1,82%
- Cleaning expenses – 1,23%

- Fixed maintenance fees – 1,09%
- Security – 0,96%
- Garbage collection – 0,82%
- Facility repairs – 0,64%
- Snow removal – 0,40%
- Liability insurance – 0,26%

Q2: What is the most optimal warehouse pricing model for the case company to maximize profitability?

All of the pricing models have their benefits and challenges. It is dependent on internal and external factors such as company strategy, risk management and customer wishes. Considering that the case warehouse has capacity for 24 000 lots it could utilize economies of scale. This indicates that it could aim to maximize profitability via closed book pricing. Then, the open book model would enable lower risk options that can suit certain activities. This leads to the possible use of hybrid models enabling both characteristics from open and closed book models.

Since pricing models suit different situations, it can't be stated that one could be universally better than others. According to the supporting literature and the interviews it can be concluded that an open book model suits new customer contracts while the closed book model could be utilized in more mature and longer customer cooperations with preliminary data from the field. In addition, the closed book model encourages continuous improvement and enables higher margins to open possibilities towards profit maximization.

Overall, the hybrid model enables flexibility and scales concerning pricing characteristics and risk. The hybrid model can be customized to contracts so that it serves both customers and providers. It can be customized by the situation where there is a need for lower risk adjustments it can utilize more open book characteristics. Similarly, when conducting business on a more mature contract where risk can be managed to enable higher profits the closed book characteristics can be applied. The goal is always to reach a contract where both parties benefit from the cooperation.

Q3: What are the best billing units?

The empirical study concluded that lots in shelves should be billed by pallets and the goods in the mass storage area that do not fit in shelves could be billed by area (m^2), volume (m^3) or weight (kg). Since the case warehouse does not have standardized lots for products on shelves there is a risk that space is left unutilized. The pallet-based billing leaves this risk to the customer and similarly eliminates decreased profits due to the ordering of goods partly from pallets. To decide the unit of billing for the goods stored in the mass storage area the attributes have to be taken into account. The more the goods weight the more it can generate by weight billing. Similarly, the growing size indicates using the area or volume-based billing. Here the challenge is to take the height of the goods into consideration and ponder if area or volume billing is a better option. Here also the attributes such as stacking ability are in essence which forms the pricing very individual. The area billing is described to be easier to handle whereas the volume based enables more detailed monitoring of space usage and takes height into consideration.

While analyzing the current billing methods the existing contracts handled in this research are mainly pallet-based and one is through weight-based billing. The client 1 contract is a pallet-based contract that needs 83,35% utilization rate to reach breakeven point and become profitable. Here forecasting plays a vital role in possibilities to pursue profits.

Client 3 has also a pallet-based billing but has divided it into three price categories by height, so it does have characteristics from volume-based billing. The height categories are under 70cm, 70-120cm and over 120cm. The first two can be stored on shelves and need utilization rates of 93,71% and 58,52%. The first one does not leave a lot of room for profit which could be addressed by standardizing shelf lots or adjusting price. If the price is not raised the space could be optimized better, enabling more capacity and thus more profits. As the maximum height on a shelf lot is 120cm the second category cannot utilize much more space optimization but here the profit is already on a more satisfying level. The last category is forced to be stored in mass storage area. This contract needs a utilization rate of 116,63% to reach breakeven point with the assumption that pallets are not stackable. It can be concluded that this contract is unprofitable as the needed utilization rate exceeds 100%. Here the rise in prices or changing the billing method to area (m^2), volume (m^3) or weight (kg) should be considered.

Client 4 is the one utilizing weight-based billing. Since the average weight of a pallet is 1000kg it can be stored on shelves enabling capacity of 18 000. The needed utilization rate is 220,15% so the contract can be considered unprofitable. The company should consider raising prices or switching to pallet-based billing. Since the unprofitability is so clear there might be some more variables considering other forms of income that are beyond this research scope. The company should re-evaluate the contract and even consider utilizing more open book pricing to ensure profitability with lower risks.

Client 22 uses pallet base billing and needs a utilization rate of 38,99% to reach breakeven point. Of the contracts handled this is the most profitable one. Even though there are not necessarily exact aspects to enhancement, the company should always drive towards continuous improvement.

As already mentioned in the case of client 4 it is crucial to acknowledge that these calculations do not take the whole warehouse costs and income into account. These calculations are limited to the income by storing and costs of the warehouse premises. According to the interviews, transaction-based models in closed book pricing environment are popular. These include income from value-added actions which are not considered in these calculations. So, the profitability of the contracts applies only to the warehousing aspect and not the whole chain of logistic processes in the warehouse.

6.2 Limitations and future research

To provide reliable and rigor research the limitations of the study must be acknowledged. Since this thesis is a case study executed for the case company replicability and generalizability can be challenging. This is assessed by providing transparent research process and handling topics on a broader scale to enable the usage of findings in various industries concerning warehousing. Still the contract profitability is related to the current situation in the warehouse, so the replication is challenging.

The time constraint is a factor to be noted. Due to the updates in case company WMS and research progress the data analyzation time period is 37 days. Longer timespan for data analyzation could enable more detailed number among the amounts of pallets stored and utilization rates. In addition, it is worth noting that concerning the profitability of warehousing contracts only take the costs of warehouse premises and income from storing operations into account. This excludes the income from value-added actions along with the costs of labor.

The future research should address the study gaps emerging in the progress of this research. The field of warehousing lacks research concerning the warehousing service providers aspect. This should be taken into account in the future and research the pricing models in various industries. In addition, the formulas used in this research are devel-

oped by the author for this case study. These could be developed further to provide formulas concerning warehouse billing optimization. For the case company to provide a larger understanding of profitability the pricing models should be researched by the aspect of all the logistics processes and not only warehousing. In addition, the WMS could be developed to provide detailed information concerning the volume of shelf lots. This would benefit space optimization and enhance cost efficiency.

7 Conclusion

This research was conducted as a mixed method case study. The aim was to examine the case company warehouse costs structures providing information on mandatory expenses for warehousing premises. In addition, the warehouse pricing models were assessed analyzing the environment suiting each model. This was examined in depth continuing to the analyzations concerning units of billing. This enabled an informative entity concerning warehouse business models from the aspect of the warehousing service provider.

The research presents the cost structure by breaking down the premise expenses from fiscal year 2024. The mandatory costs are analyzed and the entity assessed. Concerning the pricing models, both internal and external factors have to taken into account to pursue a warehousing contract that serves and benefits both parties. For the case warehouse the suggested pricing models are closed and hybrid models as they enable flexibility and contract customization while enabling profit maximization by utilizing economies of scale. The suitability of billing methods depends on the goods and their attributes specify the best option. Overall, it can be argued that the company should bill goods in shelves by pallets and the goods on mass storage area by area (m^2), volume (m^3) or weight (kg) depending on the attributes of the goods.

The research can be assessed as successful as it was able to answer the research questions and provide an informative entity concerning warehousing as business. This thesis can be considered rigor and trustworthy as the chosen methodology and methods are justified. In addition, primary and secondary sources were utilized to constitute reliable entity of data. Most importantly the case company enabled the primary source for real life data by its WMS. This enabled us to handle research topics in real life environment providing reliable findings.

8 Sources

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Appendices

Appendix 1. Interview outline

Introduction

Q1. Please introduce yourself by describing your title, area of responsibilities and background.

Questions related to pricing models

Q2. Have you worked with an open book pricing model contract/project in warehousing?

Q3. If you have, please describe the pros and cons of the modeling.

Q4. If you have not, what would you consider possible pros and cons to be?

Q5. What kind of 3PL company could utilize this model or are there certain situations where you can see this model fitting best?

Q6. Have you worked with a closed book pricing model contract/project in warehousing?

Q7. If you have, please describe the pros and cons of the modeling.

Q8. If you have not, what would you consider possible pros and cons to be?

Q9. Would you prefer a model where a fixed fee is given for all warehousing services such as storing, picking, packing, kitting and assembling or a transaction specific model where individual pallets have their own storage prices and value-added services such as picking, packing, kitting and assembling are also priced individually? And why so?

Q10. What kind of 3PL company could utilize a closed book model or are there certain situations where you can see this model fit best?

Q11. Have you worked with a hybrid (mix of open and closed book) pricing model contract/project in warehousing?

Q12. If you have, please describe the pros and cons of the modeling.

Q13. If you have not, what would you consider possible pros and cons to be?

Q14. What kind of 3PL company could utilize this model or are there certain situations where you can see this model fitting best?

Questions related to pricing units

Consider the closed book model from the aspect of 3PL. When do you see the pricing should be based on

Q15. by pallet?

Q16. by weight (kg)?

Q17. by area (m^2)?

Q18. by volume (m^3)?