



“Master Degree Program in Supply Chain Management”

Postgraduate Dissertation

“Inventory Management in Retail Market and How It Is
Affected By New Technologies”

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Patras, Greece, “June” “2024”

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Abstract

This thesis explores inventory management strategies within the retail sector, emphasizing the importance of efficient stock control, order management, and technology integration. The study analyzes methods such as Economic Order Quantity (EOQ), Reorder Point (ROP), Safety Stock, Material Requirements Planning (MRP), and Just-In-Time (JIT) management. Through a detailed case study of XYZ Retail Company, the research examines current practices and evaluates their effectiveness using quantitative methodologies. The findings reveal significant discrepancies between current and calculated inventory levels, highlighting opportunities for cost reduction and efficiency improvements. Recommendations for optimizing reorder points, safety stock, and adopting a hybrid inventory management approach are provided, aiming to enhance operational efficiency and profitability.

Keywords: Inventory Management, Retail Sector, Economic Order Quantity (EOQ), Reorder Point (ROP), Safety Stock, Material Requirements Planning (MRP), Just-In-Time (JIT), Inventory Control

Introduction

Inventory management in the retail sector involves the systematic administration of stock levels, orders, sales, and deliveries which ensure that the right quantity of products is available at the right time and place. This process is important for meeting customer demand, minimizing costs, and maximizing profitability (Radăşanu, 2016). Effective inventory management integrates various strategies, technologies, and methodologies to track and control inventory across multiple locations and channels (Ravinder & Misra, 2016).

In the retail industry, inventory management encompasses several key activities. Stock level optimization ensures that there is enough stock to meet customer demand without overstocking, which ties up capital and increases holding costs (Silver, Pyke, & Peterson, 1998). Order management involves placing orders with suppliers based on accurate demand forecasts and lead times to maintain optimal inventory levels (Chopra & Meindl, 2016). Inventory tracking uses technologies such as barcodes, RFID, and inventory management software to monitor stock levels and movements in real time (Lewis, 2019). Demand forecasting predicts future sales based on historical data, market trends, and seasonal fluctuations to make informed ordering decisions (Jacobs, 2011). Warehouse management involves efficiently organizing and managing warehouses to streamline the storage and retrieval of products (Heizer et al., 2020).

Effective inventory management can lead to several benefits, including improved customer satisfaction, reduced operational costs, and increased profitability (Amasaka, 2014; Liker, 2004; Ohno, 2019). Conversely, poor inventory management can result in stockouts, overstock situations, and significant financial losses (Ravinder & Misra, 2016; Radăşanu, 2016).

Proper inventory management is critical for several reasons. Firstly, it optimizes operations by ensuring that products are available when needed, thereby preventing delays in sales and production processes (Ravinder & Misra, 201). Secondly, it enhances customer service by maintaining optimal stock levels, allowing retailers to avoid stockouts and ensure that customers can always find the products they need, leading to higher customer satisfaction and loyalty (Radăşanu, 2016). Thirdly, it increases profitability by reducing holding costs, minimizing losses from obsolescence and spoilage, and optimizing order quantities to balance holding and ordering costs

(Amasaka, 2014). Additionally, proper inventory management helps in reducing various costs such as storage, insurance, and taxes associated with holding excess inventory. It also reduces the costs associated with rush orders and stockouts (Ravinder & Misra, 2016). Lastly, companies that manage their inventory effectively can respond more quickly to market changes and customer demands, providing them with a competitive edge in the retail sector (Radăşanu, 2016).

Objectives

The primary objectives of this thesis are to examine inventory management methods, evaluate inventory forecasting technologies, analyze case studies, provide recommendations, and identify limitations and future research. The thesis aims to analyze different methods and strategies used for inventory management in the retail sector, including Economic Order Quantity (EOQ), Reorder Point, Safety Stock, Material Requirements Planning (MRP), and Just-In-Time (JIT) management. It also explores the technologies and systems used for inventory forecasting and management, such as Relx Solutions, and assesses their effectiveness in the retail context. Additionally, the thesis conducts a case study analysis of a retail company to evaluate its current inventory management practices, productivity, and performance using methods such as EOQ, Safety Stock, and JIT .

Structure of the Thesis

The thesis is structured as follows.

- ✚ The introduction provides an overview of the research topic, the importance of inventory management in retail, and the objectives and structure of the thesis.
- ✚ The literature review chapter reviews existing literature on inventory management techniques, including EOQ, Reorder Point, Safety Stock, MRP systems, and JIT management. It also explores the role of technology in inventory management and examines previous studies on inventory management in the retail sector.
- ✚ The research methodology chapter outlines the research design, data collection methods, and quantitative research methodologies used in the study. It also

describes the case study approach and the tools and software employed for data analysis.

- ✚ The case study analysis section presents the case study analysis of a retail company, including a description of the company, its current inventory management practices, and an evaluation of its productivity using EOQ, Safety Stock, and JIT methods. Empirical data is analyzed to assess the effectiveness of these inventory management models.
- ✚ The evaluation of inventory management models chapter compares the current practices of the company with the EOQ model, analyzes safety stock management, and assesses the impact of JIT on productivity and costs.
- ✚ The findings and implications are discussed in detail. The results and discussion section summarizes the results of the case study analysis and the comparative analysis of inventory management models. It highlights the benefits and drawbacks of each model and discusses the impact on the company's competitiveness and profitability.
- ✚ In the conclusion chapter all key findings of the research are being summarized, it also provides recommendations for improving inventory management in the retail sector, identifies the limitations of the study, and suggests areas for future research.

Literature Review

Economic Order Quantity (EOQ)

The Economic Order Quantity (EOQ) model is a fundamental tool in inventory management used to determine the optimal order quantity that minimizes the total costs associated with inventory, including both ordering costs and holding costs (Silver, Pyke, & Peterson, 1998). This model is particularly valuable in helping businesses, especially retailers, maintain a balance between having sufficient inventory to meet customer demand and also to minimizing the costs associated with ordering and storing inventory.

The EOQ is calculated using the following formula:

$$EOQ = \sqrt{(2DS / H)}$$

Where:

- D represents the annual demand for the product.
- S is the ordering cost per order, which includes all costs associated with placing and receiving an order.
- H is the holding cost per unit per year, which includes costs such as storage, insurance, and obsolescence.

Components of EOQ

- ✓ **Annual Demand (D):** This is the total quantity of a product that a business expects to sell over a year. Accurate estimation of annual demand is crucial as it directly affects the EOQ calculation.
- ✓ **Ordering Cost (S):** This includes all expenses related to placing an order and receiving goods, such as administrative costs, shipping, and handling. These costs are assumed to be fixed per order, regardless of the order size.
- ✓ **Holding Cost (H):** This encompasses all costs associated with storing inventory over a period, including warehousing, insurance, depreciation, and opportunity

costs. Holding costs are basically expressed as a percentage of the inventory value.

The EOQ model provides several key benefits and applications in inventory management. By determining the optimal order quantity, EOQ minimizes the total cost of inventory, which includes both ordering and holding costs (Silver, Pyke, & Peterson, 1998). This balance ensures that the cost associated with ordering is not excessively high, and the cost of holding inventory is kept to a minimum (Radăşanu, 2016). EOQ helps businesses maintain an optimal inventory level, ensuring that there is enough stock to meet demand without overstocking, which can also tie up capital and increase holding costs (Chopra & Meindl, 2016). With EOQ, businesses can streamline their ordering processes, reducing the frequency of orders and taking advantage of bulk purchasing discounts while avoiding the pitfalls of excess inventory (Lewis, 2019).

While the EOQ model is highly beneficial, it has certain limitations. EOQ assumes that demand for the product is constant throughout the year, which may not be the case for all products, especially those with seasonal demand (Jacobs, 2011). The model assumes that ordering and holding costs are constant, which may not accurately reflect the variability in real-world scenarios (Heizer et al., 2020). EOQ also assumes that inventory is replenished instantly when an order is placed, which is not always possible due to lead times and supply chain delays (Liker, 2004). Furthermore, the EOQ model typically applies to individual products, making it less practical for businesses managing multiple products with varying demand patterns and cost structures (Ohno, 2019).

Reorder Point

The Reorder Point (ROP) is an inventory management metric that determines the specific stock level at which a new order should be placed to replenish inventory before it runs out. The primary goal of the ROP is to ensure that there is enough stock to meet customer demand during the lead time—the period between placing an order and receiving it (Grob, 2018). This helps in avoiding stockouts, which can lead to lost sales, dissatisfied customers, and disruptions in the production process.

The ROP is calculated using the following formula:

$$\text{ROP} = d \times L + \text{SS}$$

Where:

- d represents the average daily demand.
- L is the lead time in days.
- SS is the safety stock, which acts as a buffer against uncertainties in demand and lead time.

Components of Reorder Point

- ✓ **Average Daily Demand (d):** This is the average quantity of a product sold or used per day. It is typically calculated based on historical sales data and can be adjusted for seasonality and trends.
- ✓ **Lead Time (L):** The lead time is the duration between placing an order and receiving the stock. It includes the time taken for order processing, supplier lead time, and transportation. Accurate estimation of lead time is critical for determining the ROP.
- ✓ **Safety Stock (SS):** Safety stock is the extra inventory held to guard against variability in demand and lead time. It ensures that there is enough stock to meet unexpected increases in demand or delays in supply. Safety stock levels are typically determined based on the desired service level and the variability in demand and lead time.

The ROP is essential by setting an appropriate reorder point, businesses can ensure that they reorder products before they run out, thus preventing stockouts and maintaining service levels. The ROP helps in maintaining optimal inventory levels, ensuring that stock is replenished just in time to meet demand without overstocking, which can tie up capital and increase holding costs (Milewski & Wiśniewski, 2022). Consistently having the exact amount of products available when customers need them leads to higher customer satisfaction and loyalty. Stockouts can result in poor sales and damage to the business's reputation (Arani et al., 2021). Knowing when to reorder reduces the time and effort spent on emergency orders and rush shipments, leading to more efficient and cost-effective operations.

While the ROP is a powerful tool in inventory management, it has some limitations and considerations. The ROP assumes relatively stable demand and lead time. High variability in these factors can lead to inaccuracies in reorder point calculations. Reliable historical data on demand and lead time is essential for calculating an accurate ROP. Inaccurate data can lead to incorrect reorder points and inventory issues. Inventory levels and reorder points must be continuously monitored and adjusted based on changes in demand patterns, lead times, and market conditions (Sukmawati et al., 2019). For larger businesses, integrating ROP calculations with automated inventory management systems can enhance accuracy and efficiency.

Safety Stock

Safety stock is a critical component of inventory management that serves as a buffer against uncertainties in demand and lead time. It ensures that businesses can meet customer demand even when unexpected variations occur, thereby preventing stockouts and maintaining service levels (Jonsson & Mattsson, 2019). The concept of safety stock is essential for maintaining a smooth and efficient supply chain, especially in the retail sector where demand can be highly variable (Gonçalves et al., 2020).

Safety stock is the extra inventory held to mitigate the risk of stockouts caused by fluctuations in demand and supply delays. It acts as a safeguard to ensure that there is enough stock to cover any unexpected increase in demand or delay in replenishment. The primary purposes of safety stock are to prevent stockouts, which can lead to poor sales, customer dissatisfaction, and potential damage to the business's reputation (Radăşanu, 2016). By holding safety stock, businesses can ensure high service levels, meeting customer demand consistently and reliably (Ravinder & Misra, 2016). Safety stock accounts for the variability in demand, which can be unpredictable due to factors such as seasonality, market trends, and promotional activities (Silver, Pyke, & Peterson, 1998). It also provides a buffer against uncertainties in lead time, which can be affected by supplier reliability, transportation delays, and production issues (Chopra & Meindl, 2016).

The calculation of safety stock typically involves the desired service level, the standard deviation of demand, and the lead time. The formula for calculating safety stock is:

$$\text{Safety Stock} = Z \times \sigma_d \times \sqrt{L}$$

Where:

- Z is the service level factor (Z-score), which corresponds to the desired service level (e.g., 1.65 for 95% service level).
- σ_d is the standard deviation of demand, reflecting demand variability.
- L is the lead time in days.

The service level factor Z is chosen based on the level of risk a business is willing to accept. A higher service level requires more safety stock, providing greater protection against stockouts but also increasing holding costs.

Several factors influence the determination of appropriate safety stock levels. Higher variability in demand requires more safety stock to prevent stockouts (Silver et al., 1998). Uncertainty in lead time increases the need for safety stock to cover potential delays (Chopra & Meindl, 2016). Businesses aiming for higher service levels must hold more safety stock to ensure availability during peak demand periods (Radăşanu, 2016). Holding safety stock incurs additional costs, including storage, insurance, and opportunity costs. Balancing these costs with the benefits of preventing stockouts is crucial for effective inventory management (Ravinder & Misra, 2016).

While safety stock is important for inventory management, it presents several challenges. Holding safety stock increases carrying costs, which include warehousing, insurance, and potential obsolescence. Businesses must balance these costs against the benefits of preventing stockouts (Silver et al., 1998). Rapid changes in market demand and supply chain disruptions require continuous monitoring and adjustment of safety stock levels (Chopra & Meindl, 2016). Accurate demand forecasting and lead time estimation are essential for effective safety stock calculations. Inaccurate data can lead to either excessive inventory or frequent stockouts (Ravinder & Misra, 2016).

Material Requirements Planning (MRP)

Material Requirements Planning (MRP) is a system used in production and inventory management to ensure that materials and products are available for production and

delivery to customers. MRP aims to manage manufacturing processes by determining what materials are needed, in what quantities, and when they are required (Hasanati et al., 2020). This system integrates data from production schedules, inventory levels, and the bill of materials (BOM) to generate precise production and purchase schedules.

MRP systems are designed to handle three primary functions: inventory control, ensuring that materials are available for production and finished products are available for delivery; production planning, scheduling manufacturing activities to meet production targets; and scheduling, timing the delivery of materials to match production needs, thereby minimizing inventory levels and reducing carrying costs (Heisig, 2012). The MRP process involves three major steps. The first one is identifying requirements, determining the quantity and timing of finished products based on customer orders and forecasts. Then takes place the bill of materials (BOM), exploding the BOM to identify the raw materials, components, and sub-assemblies required for production and inventory status records, checking current inventory levels and on-order quantities to determine net requirements (Miclo et al., 2019).

Components of MRP

- ✓ **Master Production Schedule (MPS):** The MPS outlines the production plan for finished goods. It specifies what needs to be produced, in what quantities, and by when. The MPS is derived from customer orders and demand forecasts.
- ✓ **Bill of Materials (BOM):** The BOM is a comprehensive list of all materials, components, and sub-assemblies needed to manufacture a product. It provides a hierarchical structure of the product, detailing the relationship between finished goods and raw materials.
- ✓ **Inventory Status Records:** These records contain detailed information about current inventory levels, on-hand quantities, on-order quantities, and lead times. Accurate inventory status records are important for determining net material requirements.

The MRP process can be broken down into the following steps according to Islam et al., (2013):

1. **Demand Forecasting:** Based on the MPS, MRP systems forecast demand for finished products. This demand is then used to calculate the required quantities of raw materials and components.
2. **Net Requirements Calculation:** MRP systems calculate net requirements by considering the gross requirements (total needed materials), current inventory levels, and scheduled receipts (materials already on order). The formula for net requirements is:

$$\text{Net Requirements} = \text{Gross Requirements} - \text{On-hand Inventory} - \text{Scheduled Receipts}$$

3. **Planned Orders:** Based on net requirements, MRP systems generate planned orders for materials and components. These planned orders specify when and how much material to order or produce.
4. **Order Release:** Planned orders are reviewed and released as actual orders for production or purchase. The timing of order release is critical to ensure that materials are available when needed without holding excess inventory.
5. **Order Rescheduling:** MRP systems continuously update and reschedule orders based on changes in demand, lead times, and inventory levels. This dynamic adjustment helps in maintaining optimal inventory levels and production efficiency.

MRP systems offer several benefits to manufacturing and production management. By ensuring material availability matches production schedules, MRP systems help reduce excess inventory and minimize stockouts (Radăşanu, 2016). MRP ensures that materials are available when needed, reducing production delays and downtime, leading to more efficient use of production resources (Chopra & Meindl, 2016). Additionally, MRP helps in optimizing order quantities, reducing holding and ordering costs, and improving cash flow by avoiding overstocking and understocking (Jacobs, 2011). By ensuring timely availability of finished goods, MRP improves the ability to meet customer delivery schedules, enhancing customer satisfaction (Lewis, 2019). Furthermore, MRP systems consolidate data from various sources, providing comprehensive visibility into inventory levels, production schedules, and material requirements (Silver, Pyke, & Peterson, 1998).

Despite its benefits, MRP also presents certain challenges and limitations. MRP systems rely heavily on accurate data for demand forecasts, inventory levels, and lead times. Inaccurate data can lead to incorrect planning and scheduling (Jacobs, 2011). Implementing and maintaining an MRP system can be complex and resource-intensive, requiring significant investment in technology and training (Lewis, 2019). Variability in supplier lead times can complicate MRP planning, making it difficult to synchronize material availability with production schedules (Chopra & Meindl, 2016). MRP systems are dependent on demand forecasts, which can be uncertain and subject to change. This dependency can lead to overproduction or underproduction if forecasts are inaccurate (Silver et al., 1998). Lastly, MRP systems need to be integrated with other enterprise systems, such as ERP (Enterprise Resource Planning), for seamless data flow and operational efficiency (Radăşanu, 2016).

Just-In-Time (JIT) Management

Just-In-Time (JIT) management is an inventory strategy that aims to increase efficiency and decrease waste by receiving goods only as they are needed in the production process, thereby reducing inventory costs. This approach is part of a broader philosophy that focuses on continuous improvement and efficiency in manufacturing and operations management. JIT was popularized by the Toyota Production System and has since been adopted by various industries around the world (Mas'udin & Kamara, 2018).

JIT management is based on several core principles. Unlike traditional push systems that rely on forecasts, JIT operates on a demand-pull system where production is based on actual demand. Products are produced or ordered only when needed, reducing excess inventory (Chopra & Meindl, 2016). JIT focuses on the continuous identification and elimination of waste in all forms, including excess inventory, overproduction, waiting time, and defects. This principle is known as "muda" in the Toyota Production System (Ohno, 2019). JIT encourages ongoing efforts to improve processes, increase efficiency, and enhance product quality through continuous improvement, or Kaizen. This involves regular review and refinement of operations to identify areas for improvement (Liker, 2004). Ensuring a smooth and uninterrupted flow of materials and

products through the production process is essential in JIT. This requires efficient scheduling, coordination, and communication among all stakeholders (Heizer et al., 2020). Close collaboration with suppliers is critical in JIT. Reliable and timely delivery of materials is essential to maintain the flow of production and meet customer demand without holding excessive inventory (Chopra & Meindl, 2016).

Implementing JIT management can yield several significant benefits. By minimizing the amount of inventory held at any given time, JIT reduces holding costs, including warehousing, insurance, and obsolescence (Liker, 2004). JIT enhances operational efficiency by reducing waste and ensuring that resources are used optimally. This leads to improved productivity and lower production costs (Ohno, 2019). JIT's focus on continuous improvement and waste elimination often results in higher product quality. Defects are identified and addressed promptly, reducing rework and scrap rates (Heizer et al., 2020). With JIT, companies can respond more quickly to changes in customer demand and market conditions. This flexibility allows for better customization and faster delivery times (Chopra & Meindl, 2016). JIT fosters strong partnerships with suppliers, leading to improved communication, reliability, and collaboration. This can result in better terms, higher quality materials, and more dependable deliveries (Liker, 2004).

Despite its many advantages, JIT also presents several challenges. JIT relies heavily on suppliers for timely and accurate deliveries. Any disruption in the supply chain, such as delays or quality issues, can halt production and lead to stockouts (Chopra & Meindl, 2016). Fluctuations in customer demand can be challenging to manage with JIT, as the system relies on precise timing and coordination. Sudden spikes in demand can strain the system and cause delays (Heizer et al., 2020). Transitioning to a JIT system can involve significant initial costs, including investments in technology, training, and process reengineering (Ohno, 2019). JIT minimizes inventory levels, leaving little room for error or unexpected demand. This can increase the risk of stockouts and lost sales if demand exceeds expectations or supply chain disruptions occur (Liker, 2004). Successful JIT implementation often requires a cultural shift within the organization. Employees must embrace continuous improvement, waste reduction, and efficiency as core values (Heizer et al., 2020).

Role of Technology in Inventory Management

Technology plays a pivotal role in modern inventory management, enabling businesses to streamline operations, enhance accuracy, and improve efficiency. The integration of advanced technological tools and systems in inventory management helps companies maintain optimal stock levels, reduce costs, and respond quickly to market demands (Kithinji, 2015).

Inventory Management Software

Inventory management software is a comprehensive tool that helps businesses track and manage inventory levels, orders, sales, and deliveries. These systems offer real-time visibility into stock levels, enabling accurate forecasting and efficient inventory control. Key features of inventory management software include real-time tracking, which provides updates on inventory levels, allowing businesses to monitor stock movements and make informed decisions promptly (Chopra & Meindl, 2016). Advanced software systems can automate the reordering process by setting reorder points and generating purchase orders when stock levels fall below a predetermined threshold (Silver, Pyke, & Peterson, 1998). Inventory management software often integrates with other business systems such as ERP (Enterprise Resource Planning), accounting, and sales platforms, ensuring seamless data flow and operational efficiency (Lewis, 2019). Additionally, the software provides detailed reports and analytics on inventory performance, helping businesses identify trends, optimize stock levels, and improve decision-making (Jacobs, 2011).

Radio Frequency Identification (RFID)

RFID technology uses electromagnetic fields to automatically identify and track tags attached to objects. In inventory management, RFID offers several advantages over traditional barcode systems. Firstly, RFID tags can be read automatically and do not require line-of-sight scanning, which reduces the chances of human error and improves accuracy (Ravinder & Misra, 2016). Moreover, RFID provides real-time visibility into inventory levels and locations, allowing businesses to track items throughout the supply chain (Chopra & Meindl, 2016). Additionally, RFID streamlines inventory processes

such as receiving, picking, and shipping, thereby reducing labor costs and improving operational efficiency (Silver et al., 1998).

Barcode Systems

Barcodes are a widely used technology in inventory management for tracking and identifying products. Barcodes provide several benefits. Firstly, barcode scanning speeds up inventory processes such as counting, receiving, and shipping, thereby reducing the time and effort required for manual entry (Heizer et al., 2020). Additionally, barcodes reduce the risk of errors associated with manual data entry, ensuring accurate and reliable inventory records (Lewis, 2019). Furthermore, barcodes are relatively inexpensive to implement and can be used across various inventory management applications, making them a great cost-effective solution for businesses of all sizes (Jacobs, 2011).

Cloud Computing

Cloud computing has revolutionized inventory management by providing scalable, flexible, and accessible solutions. Cloud-based inventory management systems offer several advantages. Firstly, cloud solutions can easily scale to accommodate the needs of growing businesses, allowing for the addition of new users, locations, and features without significant infrastructure investments (Chopra & Meindl, 2016). Additionally, cloud-based systems can be accessed from anywhere with an internet connection, providing real-time visibility and control over inventory from multiple locations (Ravinder & Misra, 2016). Furthermore, cloud solutions reduce the need for on-premises hardware and IT maintenance, lowering overall costs and providing predictable pricing models (Lewis, 2019).

Data Analytics and Artificial Intelligence (AI)

Data analytics and AI are transforming inventory management by providing advanced tools for forecasting, optimization, and decision-making. AI-powered algorithms analyze historical data, market trends, and external factors to predict future demand accurately, helping businesses plan inventory levels more effectively (Ravinder &

Misra, 2016). Additionally, AI and machine learning models optimize inventory levels by balancing holding costs, ordering costs, and service levels, ensuring that businesses maintain the right amount of stock (Sharma & Jain, 2022). Furthermore, predictive analytics tools identify patterns and trends in inventory data, enabling businesses to anticipate changes and make proactive decisions to mitigate risks (Chopra & Meindl, 2016).

Internet of Things (IoT)

IoT technology connects physical objects through the internet, enabling real-time data exchange and monitoring. In inventory management, IoT offers several benefits. The IoT devices such as smart sensors and trackers provide real-time data on inventory conditions, locations, and movements, improving visibility and control (Mashayekhy et al., 2022). Additionally, IoT sensors can monitor environmental conditions such as temperature and humidity, ensuring that inventory is stored under optimal conditions and reducing the risk of spoilage or damage (Lewis, 2019). Furthermore, IoT-enabled automation streamlines inventory processes such as replenishment, ordering, and shipping, reducing manual intervention and improving efficiency (Heizer et al., 2020).

Research Methodology

The research design for this thesis encompasses a comprehensive approach to evaluate inventory management techniques in the retail sector, focusing on the implementation and impact of various strategies, including Economic Order Quantity (EOQ), Reorder Point (ROP), Safety Stock, Material Requirements Planning (MRP), and Just-In-Time (JIT) management. The study utilizes a combination of quantitative and qualitative research methodologies to provide a thorough analysis of current practices and propose improvements.

The primary objectives of this research are:

1. To analyze different inventory management methods and strategies used in the retail sector.
2. To evaluate the effectiveness of inventory forecasting technologies.
3. To conduct a case study analysis of a retail company's inventory management practices.
4. To provide recommendations for improving inventory management practices.
5. To identify limitations of the current research and suggest areas for future study.

The study employs multiple data collection methods to gather comprehensive and accurate information. Secondary data were collected extensively from a variety of sources including academic journals, industry reports, books, and existing literature on inventory management. The review focused on studies related to key inventory management concepts such as EOQ (Economic Order Quantity), ROP (Reorder Point), Safety Stock, MRP (Material Requirements Planning), and JIT (Just-In-Time) management. These sources provided valuable insights and theoretical frameworks necessary for analyzing inventory management practices in the retail sector.

Case Study Approach

A detailed case study approach will be used to analyze the inventory management practices of a selected retail company. This approach involves an in-depth examination of the company's inventory processes, starting with an overview of the company's operations, product range, and market position. It includes an analysis of the company's

existing inventory management techniques, such as stock levels, reorder points, safety stock, and use of technology. Empirical data were gathered on stock levels, sales, order frequencies, lead times, and costs associated with inventory management. Furthermore, different inventory management models (EOQ, ROP, Safety Stock, MRP, JIT) will be applied to the collected data to evaluate their effectiveness.

Quantitative Research Methodologies

The quantitative research methodologies involve calculating the Economic Order Quantity (EOQ) for various products to determine the optimal order quantity that minimizes total inventory costs. This will be followed by a reorder point analysis, where current reorder points are compared with calculated ROPs based on actual sales data and lead times. The study will also include a safety stock evaluation, assessing the adequacy of safety stock levels by considering demand variability and lead times. Additionally, a cost analysis will be conducted to compare holding costs and order costs under different inventory management models (current practices, EOQ, JIT) to identify cost-saving opportunities.

Tools and Software

Microsoft Excel will be the primary tool for data analysis, allowing for detailed calculations and modeling of inventory management techniques. Excel will be used to create data tables and perform statistical analyses.

Data Collection

The data collection process involved gathering detailed information about XYZ Retail Company's inventory management practices. The data was collected for 10 codes of frozen consumable products (pies etc), the demand of the codes is not constant, they are affected by external factors such as seasonality.

They are sensitive codes, which significantly affects their ordering and storage time, as well as their safety stock.

The following key variables were collected for each product:

- ❖ Product ID: A unique identifier for each product.
- ❖ Product Name: The name of the product.
- ❖ Stock Quantity: The current quantity of the product in stock.
- ❖ Reorder Point: The stock level at which the new order should be placed.
- ❖ Sales per Month: The average monthly sales of the product.
- ❖ Lead Time (days): The time taken for an order to be delivered after it is placed.
- ❖ Safety Stock: The extra stock maintained to prevent stockouts.
- ❖ Holding Cost per Unit: The cost to hold one unit of the product in inventory per month.
- ❖ Order Cost: The fixed cost associated with placing an order.

Data Analysis

The Economic Order Quantity (EOQ) model was applied to determine the optimal order quantity that minimizes the total cost of inventory management. The EOQ formula used was:

$$EOQ = \sqrt{(2DS) / H}$$

Where:

- 📊 D is the annual demand (calculated as sales per month multiplied by 12).
- 📊 S is the order cost.
- 📊 H is the annual holding cost per unit.

The EOQ for each product was calculated and compared with the company's current reorder points to identify potential cost savings and efficiencies. The results were presented in tables to show the EOQ values, annual demand, and the associated costs.

Safety stock levels were calculated using the standard deviation of demand and lead time, ensuring a 95% service level ($Z = 1.65$). The formula used was:

$$\text{Safety Stock} = Z \times \sigma_d \times \sqrt{LT}$$

Where:

- 📊 Z is the Z-score for the desired service level.
- 📊 σ_d is the standard deviation of daily demand.
- 📊 LT is the lead time.

The calculated safety stock was compared to the current safety stock levels to identify discrepancies and potential reductions in holding costs. Tables were used to illustrate the differences between current and calculated safety stock levels.

Reorder points were recalculated considering both average daily demand and safety stock. The formula used was:

$$\text{ROP} = (d \times \text{LT}) + \text{Safety Stock}$$

Where:

- ✚ d is the average daily demand (sales per month divided by 30).
- ✚ LT is the lead time.

These recalculated reorder points were compared with the current reorder points to highlight overestimations and suggest adjustments. The results were summarized in tables showing the current and calculated ROP values.

The impact of a Just-In-Time (JIT) system on inventory levels was assessed by calculating the daily demand and comparing it to current stock quantities. The potential for reducing inventory levels while maintaining adequate supply was evaluated. The feasibility of JIT was assessed by considering the required order frequencies and the reliability of suppliers. The analysis was presented in tables comparing current stock levels with JIT order quantities and highlighting the feasibility of implementing JIT.

Comparative Evaluation

The current inventory management practices were evaluated by examining the existing reorder points and safety stock levels. Each product's stock levels were analyzed to identify discrepancies between the current and optimal inventory levels. This analysis highlighted inefficiencies in the current system, such as overestimated reorder points and excessive safety stock.

The final step involved a comparative evaluation of the current inventory management practices, the EOQ model, and the JIT system. Key metrics considered included:

- ✚ Holding Costs: Costs associated with maintaining inventory over time.
- ✚ Order Costs: Costs associated with placing and processing orders.
- ✚ Total Costs: The sum of holding and order costs.

- ✚ Inventory Levels: Average quantity of inventory held.
- ✚ Order Frequency: Number of orders placed over a given period.
- ✚ Supplier Dependence: The reliance on suppliers for timely deliveries.
- ✚ Implementation Effort: Complexity and resources required for implementing changes.

The cost comparison between the current model, the EOQ model, and the JIT model was summarized to identify the most cost-effective approach. This was illustrated in tables comparing the costs and efficiencies of each model.

The data analysis methodology employed a systematic approach to evaluate XYZ Retail Company's inventory management practices. By applying the EOQ model, calculating safety stock and reorder points, and assessing the JIT system, the analysis identified significant inefficiencies in the current system. The findings provided clear recommendations for optimizing inventory levels, reducing costs, and improving overall competitiveness and profitability. This methodology ensures that the recommendations are data-driven and tailored to the company's specific needs, providing a solid foundation for strategic decision-making.

Limitations of the Research

The research acknowledges certain limitations. The accuracy and completeness of primary data depend on the willingness of the retail company to provide detailed information. Additionally, the findings from the case study may not be generalizable to all retail companies due to differences in product range, market conditions, and operational practices. Furthermore, the retail sector is subject to rapid changes in demand and supply chain dynamics, which may affect the applicability of the research findings over time.

Ethical Considerations

Ethical considerations are adhered to throughout the research process. Ensuring that all participants in interviews and surveys provide informed consent. Maintaining the confidentiality of the retail company's data. Regarding additional information and

regarding the identity of the company and the type of products, they cannot be mentioned by name due to data protection and ethical principles.

There is significant confidentiality in how the data is collected. There is an adaptation of the data with empirical and hypothetical elements, purely and only in achieving the purpose of the work which is the analysis of inventory management methodologies.

Providing transparent information about the research objectives, methods, and potential impacts.

Description of the Company and Industry

The case study focuses on XYZ Retail Company, a prominent player in the retail sector known for its diverse product offerings and extensive market reach. XYZ Retail operates a network of stores across various regions, catering to a broad customer base with a wide range of products, including electronics, home appliances, clothing, groceries, and health and beauty products. The company's business model is centered on providing high-quality products at competitive prices, supported by excellent customer service and a robust supply chain.

Key Aspects of XYZ Retail Company:

- ❖ **History and Background:** Established over two decades ago, XYZ Retail has grown from a single store to a multi-location retail chain. The company has a strong brand presence and is well-regarded for its commitment to customer satisfaction and innovation.
- ❖ **Product Range:** XYZ Retail offers a comprehensive selection of products across multiple categories. This diversity requires efficient inventory management to ensure that each product line is adequately stocked without overburdening storage capacities.
- ❖ **Supply Chain and Logistics:** The company's supply chain is complex, involving multiple suppliers, distribution centers, and retail outlets. We should emphasize that the company operates with external warehouses, so this helps it to have a high stock at all times (high available storage space). Efficient coordination and management of the supply chain are critical to maintaining product availability and minimizing costs.

- ❖ **Technology Integration:** XYZ Retail leverages advanced technologies such as inventory management software, RFID, and barcode systems to track and manage its inventory. The company continuously seeks to enhance its technological capabilities to improve efficiency and accuracy in inventory management.
- ❖ **Market Position:** XYZ Retail holds a significant market share in the retail industry, competing with other large retail chains and e-commerce platforms. The company differentiates itself through its product variety, pricing strategy, and customer service.

Results

Accurate data on stock levels, sales performance, and depreciation is crucial for effective inventory management. This section provides a detailed analysis of the data collected from XYZ Retail Company, focusing on these three key areas. The data offers insights into the current state of the company's inventory, the sales trends, and the depreciation of inventory items over time.

Table 1: Inventory Dataset

Product ID	Product Name	Stock Quantity	Reorder Point	Sales per Month	Lead Time (days)	Safety Stock	Holding Cost per Unit (monthly)	Order Cost
1001	Frozen Cheese pie 1kg	500	100	150	5	10	\$5	\$100
1002	Frozen Margherita pizza 2 pieces	300	50	120	7	8	\$4	\$80
1003	Frozen Special pizza 2 pieces	600	125	180	6	12	\$6	\$120
1004	Frozen Green pie 850gr	450	75	130	8	9	\$4,5	\$90
1005	Frozen Chicken pie 850gr	800	150	200	4	14	\$7	\$140
1006	Frozen Mozzarella Pizza 3 pieces	700	135	160	6	13	\$5,5	\$110
1007	Frozen Cream pie 4 pieces	400	90	110	5	10	\$5	\$100
1008	Frozen Choco pie 850gr	500	110	140	7	11	\$6	\$120
1009	Frozen Ham and cheese pie 4 pieces	350	65	125	8	9	\$4	\$90
1010	Frozen Cheese 4 pieces	900	160	190	5	15	\$6,5	\$130

Dataset includes.

- Product ID: Unique identifier for each product.
- Product Name: Name of the product.
- Stock Quantity: Current quantity (in pallets) of the product in stock.
- Reorder Point: The stock level at which a new order should be placed.
- Sales per Month: Average monthly sales of the product.
- Lead Time (days): Time taken for an order to be delivered after it is placed.
- Safety Stock: Extra stock maintained to prevent stockouts.
- Holding Cost per Unit: Cost to hold one unit of the product in inventory per month.
- Order Cost: Fixed cost associated with placing an order.

EOQ

The tables 2 and 3 provide a comprehensive overview of the inventory management calculations for various products at XYZ Retail, focusing on the Economic Order Quantity (EOQ). The EOQ helps determine the optimal order size that minimizes the total inventory costs, including holding and ordering costs. For instance, Frozen “Cheese pie 1kg”, with an annual demand of 1800 units, has an EOQ of approximately 77.46 units, meaning ordering this quantity each time will minimize costs. Similarly, other products like “Frozen Margherita pizza 2 pieces” and “Frozen Special pizza 2 pieces” have EOQs of 69.28 and 84.85 units, respectively. This variation in EOQ values across different products reflects their unique demand rates, holding costs, and order costs, ensuring that the company maintains a cost-efficient inventory level tailored to each product's specific needs.

Implementing the EOQ model allows XYZ Retail to achieve cost efficiency by balancing the costs associated with ordering and holding inventory. Larger EOQs for products with higher demand and order costs indicate the need for fewer but larger orders, optimizing resource allocation. This method not only reduces excess inventory but also ensures timely stock replenishment, maintaining high service levels and minimizing the risk of stockouts. Regularly reviewing and adjusting EOQ calculations to reflect changes in demand, costs, and other variables will help XYZ Retail maintain accuracy and efficiency. Utilizing inventory management software to automate these

processes can further enhance real-time tracking and operational effectiveness, ultimately leading to significant cost savings and improved cash flow.

The operations to calculate the EOQ per product code were done in excel

It was calculated using the following formula: $EOQ = \sqrt{(2DS) / H}$,

Where in product “1001 Frozen Cheese pie 1kg” the annual demand is 1800, the ordering cost is 100 and the annual holding cost is 60.

The EOQ was calculated in the same way for the rest of the product codes.

Table 2: Product Details and Costs

Product ID	Product Name	Sales per Month	Holding Cost per Unit	Order Cost
1001	Frozen Cheese pie 1kg	150	5	100
1002	Frozen Margherita pizza 2 pieces	120	4	80
1003	Frozen Special pizza 2 pieces	180	6	120
1004	Frozen Green pie 850gr	130	4,5	90
1005	Frozen Chicken pie 850gr	200	7	140
1006	Frozen Mozzarella Pizza 3 pieces	160	5,5	110
1007	Frozen Cream pie 4 pieces	110	5	100
1008	Frozen Choco pie 850gr	140	6	120
1009	Frozen Ham and cheese pie 4 pieces	125	4	90
1010	Frozen Cheese 4 pieces	190	6,5	130

Table 3: EOQ Calculations

Product ID	Product Name	Sales per Month	Holding Cost per Unit	Order Cost	Annual Demand (D)	Annual Holding Cost (H)	EOQ
1001	Frozen Cheese pie 1kg	150	5	100	1800	60	77,46
1002	Frozen Margherita pizza 2 pieces	120	4	80	1440	48	69,28

1003	Frozen Special pizza 2 pieces	180	6	120	2160	72	84,85
1004	Frozen Green pie 850gr	130	4,5	90	1560	54	72,11
1005	Frozen Chicken pie 850gr	200	7	140	2400	84	89,44
1006	Frozen Mozzarella Pizza 3 pieces	160	5,5	110	1920	66	80,00
1007	Frozen Cream pie 4 pieces	110	5	100	1320	60	66,33
1008	Frozen Choco pie 850gr	140	6	120	1680	72	74,83
1009	Frozen Ham and cheese pie 4 pieces	125	4	90	1500	48	75,00
1010	Frozen Cheese 4 pieces	190	6,5	130	2280	78	87,18

ROP

The analysis reveals that the current reorder points for all products are significantly higher than the calculated reorder points based on actual sales data, lead times, and safety stock. This discrepancy indicates that the company may be overestimating its reorder points, leading risk to excess inventory and higher holding costs. Adjusting the reorder points to more accurately reflect demand and lead time can help reduce inventory costs and also improve overall inventory management efficiency. To calculate the reorder point, we first need to calculate the average daily demand where the sales per month / 30, ($ROP = (d \times LT) + \text{Safety Stock}$).

Then using excel we calculate indicatively for “Frozen Cheese pie 1kg” that the reorder point is the sum of the safety stock with lead time, times the average daily demand.

For the remaining codes, the corresponding calculations were made.

Table 4: Product Details and Reorder Points

Product ID	Product Name	Stock Quantity	Reorder Point	Sales per Month	Lead Time (days)	Safety Stock	Current ROP	Average Daily Demand (d)	ROP
1001	Frozen Cheese pie 1kg	500	100	150	5	10	100	5,0	35,0
1002	Frozen Margherita pizza 2 pieces	300	50	120	7	8	50	4,0	36,0
1003	Frozen Special pizza 2 pieces	600	125	180	6	12	125	6,0	48,0
1004	Frozen Green pie 850gr	450	75	130	8	9	75	4,3	43,7
1005	Frozen Chicken pie 850gr	800	150	200	4	14	150	6,7	40,7
1006	Frozen Mozzarella Pizza 3 pieces	700	135	160	6	13	135	5,3	45,0
1007	Frozen Cream pie 4 pieces	400	90	110	5	10	90	3,7	28,3
1008	Frozen Choco pie 850gr	500	110	140	7	11	110	4,7	43,7
1009	Frozen Ham and cheese pie 4 pieces	350	65	125	8	9	65	4,2	42,3
1010	Frozen Cheese 4 pieces	900	160	190	5	15	160	6,3	46,7

Frozen Cheese pie 1kg: The current ROP is 100, whereas the calculated ROP is 35. This indicates

an overestimation by 75 units, potentially leading to higher holding costs.

Frozen Margherita pizza 2 pieces: The current ROP is 50, whereas the calculated ROP is 36. This indicates

an overestimation by 14 units.

Frozen Special pizza 2 pieces: The current ROP is 125, whereas the calculated ROP is 48. This indicates an overestimation by 77 units.

Frozen Green pie 850gr: The current ROP is 75, whereas the calculated ROP is approximately 43.7. This indicates an overestimation by about 31.3 units.

Frozen Chicken pie 850gr: The current ROP is 150, whereas the calculated ROP is approximately 40.7. This indicates an overestimation by about 109.3 units.

Frozen Mozzarella Pizza 3 pieces: The current ROP is 135, whereas the calculated ROP is approximately 45. This indicates an overestimation by about 90 units.

Frozen Cream pie 4 pieces: The current ROP is 90, whereas the calculated ROP is approximately 28.3. This indicates an overestimation by about 61.7 units.

Frozen Choco pie 850gr: The current ROP is 110, whereas the calculated ROP is approximately 43.7. This indicates an overestimation by about 66.3 units.

Frozen Ham and cheese pie 4 pieces: The current ROP is 65, whereas the calculated ROP is approximately 42.3. This indicates an overestimation by about 22.7 units.

Frozen Cheese 4 pieces: The current ROP is 160, whereas the calculated ROP is approximately 46.7. This indicates an overestimation by about 113.3 units.

Something worth emphasizing here and directly related to the uniqueness of product codes is that they are quite affected by the lead time, especially as they have a longer lead time as they are not so feared in terms of lifespan

Safety Stock

The analysis reveals that the current safety stock levels for all products are significantly higher than the calculated safety stock levels based on actual sales variability and lead times. This discrepancy indicates that the company may be maintaining excessive safety stock, leading to higher holding costs. The safety stock of this category of products remains low due to their short shelf life and the freshness that a company in this sector wishes to have. Adjusting the safety stock levels to more accurately reflect demand variability and lead time can help reduce inventory costs and improve overall inventory management efficiency. Safety stock levels were calculated using the standard deviation of demand and lead time, ensuring a 95% service level ($Z = 1.65$). The formula used was:

$$\text{Safety Stock} = Z \times \sigma_d \times \sqrt{LT}$$

For example for “Frozen Cheese pie 1kg” the safety stock is: $1,65 \times 5 \times \text{SQRT}(5)$ (it is calculated in excel).

The safety stock was calculated in the same way for the rest of the product codes.

Table 5: Safety Stock Details

Product ID	Product Name	Sales per Month	Lead Time (days)	Average Daily Demand (d)	σ_d	Safety Stock	Current Safety Stock	Discrepancy
1001	Frozen Cheese pie 1kg	150	5	5,00	0,50	1,84	10,00	-8,16
1002	Frozen Margherita pizza 2 pieces	120	7	4,00	0,40	1,75	8,00	-6,25
1003	Frozen Special pizza 2 pieces	180	6	6,00	0,60	2,42	12,00	-9,58
1004	Frozen Green pie 850gr	130	8	4,33	0,43	2,02	9,00	-6,98

1005	Frozen Chicken pie 850gr	200	4	6,67	0,67	2,20	14,00	-11,80
1006	Frozen Mozzarella Pizza 3 pieces	160	6	5,33	0,53	2,16	13,00	-10,84
1007	Frozen Cream pie 4 pieces	110	5	3,67	0,37	1,35	10,00	-8,65
1008	Frozen Choco pie 850gr	140	7	4,67	0,47	2,04	11,00	-8,96
1009	Frozen Ham and cheese pie 4 pieces	125	8	4,17	0,42	1,94	9,00	-7,06
1010	Frozen Cheese 4 pieces	190	5	6,33	0,63	2,34	15,00	-12,66

the safety stock for a 95% service level ($Z = 1.65$)

Frozen Cheese pie 1kg: The calculated safety stock is 1.84 units, while the current safety stock is 10 units, indicating an overestimation by 8.16 units.

Frozen Margherita pizza 2 pieces: The calculated safety stock is 1.75 units, while the current safety stock is 8 units, indicating an overestimation by 6.25 units.

Frozen Special pizza 2 pieces: The calculated safety stock is 2.42 units, while the current safety stock is 12 units, indicating an overestimation by 9.58 units.

Frozen Green pie 850gr: The calculated safety stock is 2.02 units, while the current safety stock is 9 units, indicating an overestimation by 6.98 units.

Frozen Chicken pie 850gr: The calculated safety stock is 2.2 units, while the current safety stock is 14 units, indicating an overestimation by 11.8 units.

Frozen Mozzarella Pizza 3 pieces: The calculated safety stock is 2.16 units, while the current safety stock is 13 units, indicating an overestimation by 10.84 units.

Frozen Cream pie 4 pieces: The calculated safety stock is 1.35 units, while the current safety stock is 10 units, indicating an overestimation by 8.65 units.

Frozen Choco pie 850gr: The calculated safety stock is 2.04 units, while the current safety stock is 11 units, indicating an overestimation by 8.96 units.

Frozen Ham and cheese pie 4 pieces: The calculated safety stock is 1.94 units, while the current safety stock is 9 units, indicating an overestimation by 7.06 units.

Frozen Cheese 4 pieces: The calculated safety stock is 2.34 units, while the current safety stock is 15 units, indicating an overestimation by 12,66 units.

JIT

Implementing a Just-In-Time (JIT) inventory management system in the current scenario would require significant adjustments in inventory levels and order frequency. The analysis indicates that all of the products' currently have excessive stock compared to their JIT order quantities, highlighting the potential for reducing stock levels to better align with actual demand and lead time requirements. For instance, "Frozen Cheese pie 1kg" has a stock quantity of 500 units, while its calculated JIT order quantity is only 25 units. This significant discrepancy underscores the need for XYZ Retail to reduce current stock levels in the rest of the products and align them more closely with actual demand and lead times.

To transition towards a JIT system, the company would need to place smaller, more frequent orders, thus maintaining lower inventory levels. Enhancing supplier relationships is determining in this process to ensure reliable and timely deliveries, thereby avoiding stockouts. Additionally, improving demand forecasting by using accurate sales data will enable the company to predict demand more precisely, further supporting the effectiveness of a JIT system. By making these changes, XYZ Retail can reduce holding costs, increase operational efficiency, and ensure that inventory levels are sufficient to meet customer demand without incurring the additional costs associated with excess inventory. However, the transition to JIT should be carefully managed to avoid disruptions in the supply chain, ensuring a smooth and efficient implementation. To calculate the JIT order quantity for the "Frozen Cheese pie 1kg" product code, the daily demand was measured with the time it takes from the order to the receipt of the goods (lead time), $JIT = Lead\ Time * Daily\ demand$. so if we consider that with the method the company wants to cover its daily needs without escaping the time limit between ordering and receiving the goods and using excel to calculate the transactions, the following table comes out.

Table 6: JIT Order Quantity and Stock Feasibility

Product ID	Product Name	Stock Quantity	Sales per Month	Lead Time (days)	Daily Demand	JIT Order Quantity	Feasibility
1001	Frozen Cheese pie 1kg	500	150	5	5,00	25	Excessive Stock
1002	Frozen Margherita pizza 2 pieces	300	120	7	4,00	28	Excessive Stock
1003	Frozen Special pizza 2 pieces	600	180	6	6,00	36	Excessive Stock
1004	Frozen Green pie 850gr	450	130	8	4,33	35	Excessive Stock
1005	Frozen Chicken pie 850gr	800	200	4	6,67	27	Excessive Stock
1006	Frozen Mozzarella Pizza 3 pieces	700	160	6	5,33	32	Excessive Stock
1007	Frozen Cream pie 4 pieces	400	110	5	3,67	18	Excessive Stock
1008	Frozen Choco pie 850gr	500	140	7	4,67	33	Excessive Stock
1009	Frozen Ham and cheese pie 4 pieces	350	125	8	4,17	33	Excessive Stock
1010	Frozen Cheese 4 pieces	900	190	5	6,33	32	Excessive Stock

Key Factors for JIT Implementation

Current Stock Levels: The existing inventory levels.

Lead Times: The time taken for orders to be delivered.

Sales per Month: The monthly demand for each product.

Order Frequency: How often orders need to be placed to meet demand without holding excess stock. The analysis shows that all products currently have significantly higher stock levels compared to what would be required under a JIT system. The current stock levels far exceed the JIT order quantities, indicating that the company is maintaining excessive inventory, which is contrary to the principles of JIT.

Cost Analysis

The current model employed by XYZ Retail maintains moderate costs, achieving a balance between holding and order costs. For instance, “Frozen Cheese pie 1kg” has an annual demand of 1800 units, and a total cost of \$2860.00. This model effectively controls inventory without overly frequent orders, keeping both holding and ordering costs within a reasonable range. However, there is room for improvement to further optimize costs and enhance inventory management efficiency.

Table 7: Current Model

CURRENT MODEL					
Product ID	Product Name	Annual Demand (D)	Holding Cost	Order Cost	Total Cost
1001	Frozen Cheese pie 1kg	1800	2500	360	2860
1002	Frozen Margherita pizza 2 pieces	1440	1200	480	1680
1003	Frozen Special pizza 2 pieces	2160	3600	360	3960
1004	Frozen Green pie 850gr	1560	2025	347	2372
1005	Frozen Chicken pie 850gr	2400	5600	300	5900
1006	Frozen Mozzarella Pizza 3 pieces	1920	3850	274	4124
1007	Frozen Cream pie 4 pieces	1320	2000	330	2330
1008	Frozen Choco pie 850gr	1680	3000	336	3336
1009	Frozen Ham and cheese pie 4 pieces	1500	1400	429	1829
1010	Frozen Cheese 4 pieces	2280	5850	253	6103

The EOQ model is designed to optimize the balance between holding and order costs, often resulting in slightly higher total costs due to the frequency of orders. For example,

“Frozen Margherita pizza 2 pieces” total cost in the EOQ model is \$2217.03, which is higher than the current model. While the EOQ model theoretically provides the optimal order size to minimize total costs, it may not fully capture the complexities and variability of real-world inventory management. Despite this, it offers a structured approach to adjusting order quantities and maintaining inventory levels, ensuring that neither excess inventory nor stockouts occur frequently.

The operations were done according to the formulas below and using the msExcel.

Holding cost = Average inventory * Holding cost per unit

Order cost = (Annual demand/EOQ)*100

Table 8: EOQ Model

EOQ MODEL						
Product ID	Product Name	EOQ	Average Inventory	Holding Cost	Order Cost	Total Cost
1001	Frozen Cheese pie 1kg	77,46	38,73	193,65	2323,79	2517,44
1002	Frozen Margherita pizza 2 pieces	69,28	34,64	138,56	2078,46	2217,03
1003	Frozen Special pizza 2 pieces	84,85	42,43	254,56	2545,58	2800,14
1004	Frozen Green pie 850gr	72,11	36,06	162,25	2163,33	2325,58
1005	Frozen Chicken pie 850gr	89,44	44,72	313,05	2683,28	2996,33
1006	Frozen Mozzarella Pizza 3 pieces	80,00	40,00	220,00	2400,00	2620,00
1007	Frozen Cream pie 4 pieces	66,33	33,17	165,83	1989,97	2155,81
1008	Frozen Choco pie 850gr	74,83	37,42	224,50	2244,99	2469,49
1009	Frozen Ham and cheese pie 4 pieces	75,00	37,50	150,00	2000,00	2150,00
1010	Frozen Cheese 4 pieces	87,18	43,59	283,33	2615,34	2898,67

The JIT model focuses on minimizing holding costs by placing smaller, more frequent orders. This approach drastically reduces the need for large storage spaces and the costs associated with maintaining high inventory levels. For instance, “**Frozen Cheese pie 1kg**” holding cost under the JIT model is only \$62.5. However, the frequent ordering

significantly increases order costs, with “**Frozen Cheese 4 pieces**” having an order cost of \$7200.00. This leads to much lower total costs compared to the EOQ model and in many products lower costs compared to the current model. The JIT model, while efficient in reducing holding costs, may increase the potential risk of supply chain disruptions.

Table 9: JIT Model

JIT MODEL					
Product ID	Product Name	JIT Order Quantity	order quantity	Holding Cost	Order Cost
1001	Frozen Cheese pie 1kg	25	12,5	62,5	7200
1002	Frozen Margherita pizza 2 pieces	28	14	56	5142,9
1003	Frozen Special pizza 2 pieces	36	18	108	6000
1004	Frozen Green pie 850gr	35	17,3	78	4500
1005	Frozen Chicken pie 850gr	27	13,3	93,3	9000
1006	Frozen Mozzarella Pizza 3 pieces	32	16	88	6000
1007	Frozen Cream pie 4 pieces	18	9,2	45,8	7200
1008	Frozen Choco pie 850gr	33	16,3	98	5142,9
1009	Frozen Ham and cheese pie 4 pieces	33	16,7	66,7	4500
1010	Frozen Cheese 4 pieces	32	15,8	102,9	7200

The cost analysis reveals that the JIT model, despite its potential for reducing holding costs, is not feasible for XYZ Retail due to the excessive increase in order costs. The current model, results in higher total costs compared to the EOQ in most cases. Therefore, the EOQ inventory management model, while not optimal but better at balancing holding and order costs, is more practical under the given conditions.

Table 10: Comparison table

Product ID	Product Name	Current Model	EOQ	JIT
1001	Frozen Cheese pie 1kg	2860	2517,44	7200
1002	Frozen Margherita pizza 2 pieces	1680	2217,03	5142,9
1003	Frozen Special pizza 2 pieces	3960	2800,14	6000
1004	Frozen Green pie 850gr	2372	2325,58	4500
1005	Frozen Chicken pie 850gr	5900	2996,33	9000
1006	Frozen Mozzarella Pizza 3 pieces	4124	2620,00	6000
1007	Frozen Cream pie 4 pieces	2330	2155,81	7200
1008	Frozen Choco pie 850gr	3336	2469,49	5142,9
1009	Frozen Ham and cheese pie 4 pieces	1829	2150,00	4500
1010	Frozen Cheese 4 pieces	6103	2898,67	7200

For XYZ Retail, adopting a hybrid approach could be beneficial. This would involve leveraging aspects of the EOQ model to fine-tune order quantities and reorder points without incurring the high costs associated with the JIT model. Adjusting safety stock and reorder points based on EOQ calculations could lead to significant cost savings. By incorporating EOQ principles, the company can improve inventory efficiency and cost-effectiveness, reducing the likelihood of overstocking and stockouts. This hybrid strategy would allow XYZ Retail to optimize its inventory management processes while avoiding the pitfalls of excessive order costs associated with JIT, ultimately leading to enhanced operational efficiency and profitability.

Evaluation of Inventory Management Models

The evaluation aims to provide a comprehensive understanding of how inventory can be managed more efficiently to reduce costs and improve overall operational effectiveness.

Comparison with the EOQ Model

The Economic Order Quantity (EOQ) model is used to determine the optimal order quantity which minimizes the total cost of inventory, which includes both holding and ordering costs. The following table provides a comparative summary of the current reorder points (ROP) and the EOQ model's ROP for each product:

Table 11: Reorder Point Comparison

Product ID	Product Name	Current ROP	Reorder Point	Discrepancy
1001	Frozen Cheese pie 1kg	100	35,0	65,0
1002	Frozen Margherita pizza 2 pieces	50	36,0	14,0
1003	Frozen Special pizza 2 pieces	125	48,0	77,0
1004	Frozen Green pie 850gr	75	43,7	31,3
1005	Frozen Chicken pie 850gr	150	40,7	109,3
1006	Frozen Mozzarella Pizza 3 pieces	135	45,0	90,0
1007	Frozen Cream pie 4 pieces	90	28,3	61,7
1008	Frozen Choco pie 850gr	110	43,7	66,3
1009	Frozen Ham and cheese pie 4 pieces	65	42,3	22,7
1010	Frozen Cheese 4 pieces	160	46,7	113,3

The table 11 provides a comparison between the current reorder points (ROP) and the calculated reorder points based on the Economic Order Quantity (EOQ) model for various products at XYZ Retail. The discrepancy in units indicates the difference between the current ROP and the calculated ROP. “**Frozen Cheese pie 1kg**” has a current ROP of 100 units, whereas the calculated ROP is 35 units, resulting in a discrepancy of 65 units. This significant difference suggests that the current reorder points are set much higher than necessary, leading to excess inventory and increased holding costs.

Similarly, “**Frozen Chicken pie 850gr**” shows a large discrepancy of 109.3 units between the current ROP (150 units) and the calculated ROP (40.7 units). This pattern is consistent across other products, such as “**Frozen Cheese 4 pieces**”, which has a current ROP of 160 units compared to a calculated ROP of 46.7 units, resulting in a discrepancy

of 113.3 units. These discrepancies indicate that XYZ Retail is potentially maintaining higher inventory levels than needed, which could tie up capital and incur unnecessary storage costs.

By adjusting the reorder points to align more closely with the calculated EOQ-based ROP, XYZ Retail can optimize inventory levels, reduce excess stock, and lower holding costs. Implementing these adjustments will lead to more efficient inventory management, freeing up resources and improving the overall cost-effectiveness of the company's operations. This realignment will help ensure that inventory levels are sufficient to meet demand without the drawbacks of overstocking.

Safety Stock Management

Safety stock is essential to protect against uncertainties in demand and lead time. The table below compares the current safety stock levels with the calculated safety stock levels based on a 95% service level (Z-score of 1.65):

Table 12: Safety Stock Comparison

Product ID	Product Name	Current Safety Stock	Safety Stock	Discrepancy
1001	Frozen Cheese pie 1kg	10,00	1,84	-8,16
1002	Frozen Margherita pizza 2 pieces	8,00	1,75	-6,25
1003	Frozen Special pizza 2 pieces	12,00	2,42	-9,58
1004	Frozen Green pie 850gr	9,00	2,02	-6,98
1005	Frozen Chicken pie 850gr	14,00	2,20	-11,80
1006	Frozen Mozzarella Pizza 3 pieces	13,00	2,16	-10,84
1007	Frozen Cream pie 4 pieces	10,00	1,35	-8,65
1008	Frozen Choco pie 850gr	11,00	2,04	-8,96
1009	Frozen Ham and cheese pie 4 pieces	9,00	1,94	-7,06
1010	Frozen Cheese 4 pieces	15,00	2,34	-12,66

The table above compares the current safety stock levels with the calculated safety stock levels based on actual demand variability and lead times for various products at XYZ

Retail. The discrepancy in units indicates the difference between the current safety stock and the calculated safety stock. “**Frozen Cheese pie 1kg**” has a current safety stock of 10 units, whereas the calculated safety stock is 1.84 units, resulting in a discrepancy of 48.16 units. This significant difference suggests that the current safety stock levels are set higher than necessary, leading to excess inventory and increased holding costs. Similarly, “**Frozen Cheese 4 pieces**” shows a large discrepancy of 12.66 units between the current safety stock (15 units) and the calculated safety stock (2.34 units). This pattern is consistent across other products, such as “**Frozen Chicken pie 850gr**”, which has a current safety stock of 14 units compared to a calculated safety stock of 2.2 units, resulting in a discrepancy of 11.8 units. These discrepancies indicate that XYZ Retail is potentially maintaining higher safety stock levels than needed, which could tie up capital and incur unnecessary storage costs.

By adjusting the safety stock levels to match the calculated values more closely, XYZ Retail can better manage inventory levels, reduce excess stock, and lower holding costs. Making these changes will result in more efficient inventory management, freeing up resources and improving the overall cost-effectiveness of the company's operations. This adjustment will ensure that inventory levels are adequate to buffer against demand variability and lead time uncertainties without the negative impacts of overstocking.

Impact of JIT on Productivity and Costs

Implementing a Just-In-Time (JIT) system requires reducing inventory levels and increasing order frequency. The following table provides a summary of the current stock levels compared to the JIT order quantities:

Table 13: Current Stock Quantity vs. JIT Order Quantity

Product ID	Product Name	Stock Quantity	JIT Order Quantity	Feasibility
1001	Frozen Cheese pie 1kg	500	25	Excessive Stock
1002	Frozen Margherita pizza 2 pieces	300	28	Excessive Stock
1003	Frozen Special pizza 2 pieces	600	36	Excessive Stock
1004	Frozen Green pie 850gr	450	35	Excessive Stock
1005	Frozen Chicken pie 850gr	800	27	Excessive Stock
1006	Frozen Mozzarella Pizza 3 pieces	700	32	Excessive Stock
1007	Frozen Cream pie 4 pieces	400	18	Excessive Stock
1008	Frozen Choco pie 850gr	500	33	Excessive Stock
1009	Frozen Ham and cheese pie 4 pieces	350	33	Excessive Stock
1010	Frozen Cheese 4 pieces	900	32	Excessive Stock

The table 13 compares the current stock quantities with the JIT (Just-In-Time) order quantities for various products at XYZ Retail. The feasibility column indicates whether the current stock is excessive compared to the JIT order quantities.

For instance, “**Frozen Green pie 850gr**” has a current stock quantity of 450 units, while the JIT order quantity is only 35 units, showing that the current stock level is excessively high. This pattern of excessive stock is consistent across all products listed, such as “**Frozen Mozzarella Pizza 3 pieces**” with a current stock quantity of 700 units versus a JIT order quantity of 32 units, and “**Frozen Special pizza 2 pieces**” with 600 units in stock compared to a JIT order quantity of 36 units.

The consistent presence of excessive stock suggests that XYZ Retail is maintaining higher inventory levels than necessary, leading to increased holding costs and potential inefficiencies. By adjusting the stock levels to match more closely with JIT order quantities, the company can reduce excess inventory, lower holding costs, and enhance overall inventory management efficiency. This adjustment would ensure that inventory levels are sufficient to meet customer demand without the drawbacks of overstocking, such as tied-up capital and increased storage costs. Implementing these changes would result in a leaner, more responsive inventory system, better suited to the dynamic demands of the retail market.

Cost Comparison

The cost comparison between the current model, the EOQ model, and the JIT model is summarized below:

Table 14: Cost Comparison of Inventory Management Models

Model	Holding Cost	Order Cost	Total Cost
Current	Moderate	Moderate	Moderate
EOQ	Lower	Higher	Slightly Lower
JIT	Significantly Lower	Significantly Higher	Highest

The table 14 compares the holding cost, order cost, and total cost associated with three different inventory management models: Current, EOQ (Economic Order Quantity), and JIT (Just-In-Time).

The current inventory management model at XYZ Retail maintains a moderate balance between holding costs, order costs, and total costs. This model effectively controls inventory without excessively high or low costs, ensuring a stable and manageable inventory system. However, there may still be room for improvement to further optimize costs and efficiency.

The EOQ model focuses on minimizing the total inventory costs by optimizing the order size. This approach results in extremely lower holding costs due to reduced inventory levels but incurs higher order costs due to the increased frequency of orders. Consequently, the total cost under the EOQ model is slightly lighter than the current model. While the EOQ model offers a more structured approach to balancing order and holding costs, it may not fully address the complexities of real-world inventory management.

The JIT model aims to minimize holding costs by placing smaller, more frequent orders. This approach significantly reduces the need for large storage spaces and the costs associated with maintaining high inventory levels. However, the frequent ordering leads to significantly higher order costs, resulting in the highest total cost among the three models. While the JIT model is effective in reducing holding costs, it may not be feasible for XYZ Retail due to the substantial increase in order processing expenses and the potential risk of supply chain disruptions.

The analysis reveals that while the JIT model can drastically reduce holding costs, it leads to the highest total costs due to increased order expenses. The EOQ model offers a balanced approach, optimizing the trade-off between holding and order costs, and also

results in slightly lighter total costs compared to the current model. The current inventory management model, although not optimal, maintains a reasonable balance between holding and order costs. From the point of view of total cost, EOQ is preferable, however, it involves risks from external factors. For XYZ Retail, a hybrid approach incorporating aspects of the EOQ model to fine-tune order quantities and reorder points may yield cost savings without the drastic increase in order costs associated with the JIT model. Adjusting safety stock and reorder points based on EOQ calculations could lead to improved inventory efficiency and cost-effectiveness, ensuring a leaner and more responsive inventory system.

Cost and Efficiency Comparison

The following table summarizes the cost and efficiency comparison between the three models:

Table 15: Comparison of Inventory Management Models

Aspect	Current Model	EOQ Model	JIT Model
Holding Costs	Moderate	Lower	Significantly Lower
Order Costs	Moderate	Higher	Significantly Higher
Total Costs	Moderate	Slightly Lower	Highest
Inventory Levels	High	Optimized	Very Low
Order Frequency	Balanced	More Frequent	Highly Frequent
Supplier Dependence	Moderate	Moderate	Very High
Implementation Effort	Low to Moderate	Moderate	High

The table 15 compares various aspects of three different inventory management models: the Current Model, the EOQ (Economic Order Quantity) Model, and the JIT (Just-In-Time) Model.

❖ Holding Costs

Current Model: Maintains moderate holding costs by balancing stock levels and storage needs.

EOQ Model: Achieves lower holding costs by optimizing order quantities and reducing excess inventory.

JIT Model: Significantly reduces holding costs by maintaining very low inventory levels and relying on frequent replenishments.

❖ Order Costs

Current Model: Manages moderate order costs through balanced ordering practices.

EOQ Model: Increases order costs due to more frequent orders required to maintain optimal inventory levels.

JIT Model: Results in significantly higher order costs due to the very high frequency of orders needed to keep inventory levels minimal.

❖ Total Costs

Current Model: Keeps total costs at a moderate level by balancing holding and order costs.

EOQ Model: Leads to slightly lower total costs because of the lower holding costs, despite higher order costs.

JIT Model: Incurs the highest total costs due to the substantial increase in order processing expenses, despite the reduction in holding costs.

❖ Inventory Levels

Current Model: Maintains high inventory levels to ensure product availability.

EOQ Model: Optimizes inventory levels to balance cost efficiency and stock availability.

JIT Model: Keeps inventory levels very low, relying on timely deliveries to meet demand.

❖ Order Frequency

Current Model: Balances order frequency to manage both holding and order costs effectively.

EOQ Model: Requires more frequent orders to maintain optimized inventory levels.

JIT Model: Necessitates highly frequent orders to sustain very low inventory levels.

❖ Supplier Dependence

Current Model: Maintains moderate dependence on suppliers, allowing for some flexibility in inventory management.

EOQ Model: Also involves moderate supplier dependence due to optimized but frequent ordering.

JIT Model: Creates very high dependence on suppliers for timely and reliable deliveries, significant for maintaining minimal inventory levels.

❖ **Implementation Effort**

Current Model: Requires low to moderate effort for implementation, with established processes and practices.

EOQ Model: Entails moderate implementation effort to adjust order quantities and inventory levels.

JIT Model: Demands high implementation effort to set up and manage frequent ordering and strong supplier relationships.

The comparison reveals that while the JIT model can drastically reduce holding costs, it results in the highest total costs due to increased order expenses and requires a high level of implementation effort. The EOQ model offers a balanced approach, optimizing the trade-off between holding and order costs and also results in slightly lower total costs compared to the current model. The current inventory management model, though not optimal, maintains a reasonable balance between holding and order costs, with moderate implementation effort and supplier dependence, but a total higher cost, not in every product, than the EOQ model.

For XYZ Retail, a hybrid approach that leverages aspects of the EOQ model to fine-tune order quantities and reorder points may yield cost savings without incurring the high order costs associated with the JIT model. Adjusting safety stock and reorder points based on EOQ calculations could lead to improved inventory efficiency and cost-effectiveness, ensuring a leaner and more responsive inventory system that meets customer demand while minimizing costs.

Comparative Summary

The comparative analysis shows that while the JIT model can reduce holding costs significantly, it is not feasible for XYZ Retail Company due to the excessive increase in order costs. The EOQ model offers a more balanced approach and results in slightly lower total costs compared to the current model.

For XYZ Retail Company, a hybrid approach is recommended. Leveraging aspects of the EOQ model to fine-tune order quantities and reorder points without incurring the

high costs associated with JIT could yield cost savings. Adjusting safety stock and reorder points based on EOQ calculations can help reduce inventory costs and improve overall inventory management efficiency.

The evaluation indicates that XYZ Retail Company's current inventory management model, while not optimal, maintains a reasonable balance between holding and order costs. The EOQ model offers a better balance and decreases total costs slightly due to more frequent ordering. The JIT model, although reducing holding costs significantly, leads to unfeasible increases in order costs.

A hybrid approach incorporating EOQ principles while cautiously moving towards JIT practices is recommended. This strategy involves fine-tuning order quantities, reducing safety stock, and improving demand forecasting to achieve a more efficient and cost-effective inventory management system. By adopting these recommendations, XYZ Retail Company can enhance its inventory management, reduce costs, and improve overall productivity.

Findings and Implications

The case study analysis of XYZ Retail Company's inventory management practices revealed several key insights. Firstly, the current reorder points for all products are significantly higher than the calculated reorder points based on actual sales data, lead times, and safety stock requirements. Secondly, the company maintains safety stock levels that are much higher than necessary, leading to increased holding costs. Thirdly, the company holds inventory levels that far exceed what would be required under an optimized system, resulting in excessive holding costs.

The EOQ model optimizes order quantities and reduces holding costs by determining the most cost-effective reorder points. The EOQ model can enhance competitiveness by improving inventory turnover and reducing excess inventory costs. However, the increased ordering frequency may require better supplier management to avoid stockouts.

The JIT system drastically reduces holding costs by aligning inventory levels closely with actual demand. It requires a significant increase in order frequency and a high level

of supplier reliability, which can lead to higher ordering costs and potential supply chain disruptions. Implementing JIT can significantly enhance profitability by reducing waste and holding costs. However, the risk of stockouts and supply chain disruptions can negatively impact competitiveness if not managed effectively.

The analysis revealed distinct benefits and drawbacks associated with the EOQ model and the JIT system. The EOQ model optimizes inventory levels, leading to lower holding costs. It provides a structured approach to ordering, reducing excess inventory. However, it increases the frequency of orders, which can lead to higher ordering costs. It also requires accurate demand forecasting to be effective. The EOQ model can improve the company's profitability by reducing excess inventory costs and improving cash flow. However, the increased ordering frequency necessitates efficient supplier management to prevent stockouts.

The JIT system minimizes inventory levels, leading to significantly reduced holding costs. It enhances responsiveness to market demand by keeping inventory lean. However, it requires a high dependency on supplier reliability and quick response times. There is also a potential for supply chain disruptions if there are delays or issues with suppliers. Implementing JIT can boost profitability by minimizing waste and holding costs. However, it requires robust supplier relationships and accurate demand forecasting to avoid stockouts and maintain competitiveness.

The current model maintains a balance between holding and ordering costs but is not optimal. Excessive safety stock and reorder points lead to higher holding costs, which negatively impacts profitability. The current practices can hinder competitiveness due to the inefficiencies in inventory management, resulting in higher operational costs and reduced responsiveness to market changes.

Implementing the EOQ model can enhance competitiveness by optimizing inventory levels, reducing holding costs, and improving cash flow. The increased order frequency requires effective supplier management, which can pose challenges but also opportunities for better supplier relationships and negotiated terms.

The JIT system can significantly improve profitability by reducing holding costs and enhancing responsiveness to market demand. The dependency on supplier reliability

and the potential for supply chain disruptions must be managed carefully to maintain competitiveness. This requires a high level of coordination and strong supplier partnerships.

Discussion

XYZ Retail Company's current inventory management practices involve maintaining high reorder points and safety stock levels. While this approach ensures that the company avoids stockouts and meets customer demand, it also results in significant drawbacks. The primary disadvantage is the excessive holding costs incurred due to high inventory levels. This ties up capital that could be better utilized in other areas of the business, such as marketing or product development. High inventory levels lead to increased storage costs, and the potential for inventory obsolescence can affect profitability. Additionally, the lack of optimization in order quantities and reorder points results in missed opportunities for cost savings.

The literature supports these findings, indicating that high inventory levels can lead to substantial holding costs and inefficiencies (Ravinder & Misra, 2016). Maintaining high safety stock levels, while beneficial for avoiding stockouts, often results in overstocking, tying up capital and increasing storage costs (Radăşanu, 2016).

The EOQ model provides a systematic approach to determining the optimal order quantity that minimizes total inventory costs. One of the key benefits of implementing the EOQ model is the reduction in holding costs. By calculating precise reorder points and order quantities, the company can maintain lower inventory levels while still meeting demand. This aligns with Silver, Pyke, and Peterson's (1998) findings that the EOQ model helps reduce excess inventory and optimize order quantities. However, the EOQ model also has its drawbacks. It requires frequent ordering, which can increase order processing and transportation costs. This increased frequency of orders necessitates efficient supplier management to ensure timely deliveries and avoid stockouts. Additionally, accurate demand forecasting is pivotal for the EOQ model to be effective. Any inaccuracies in forecasting can lead to either stockouts or excess inventory, negating the benefits of the model.

Despite these challenges, the EOQ model can significantly enhance the company's competitiveness by optimizing inventory turnover and improving cash flow. The improved efficiency in inventory management can also lead to better customer satisfaction through more reliable product availability. This perspective is echoed by

Silver et al. (1998), who emphasize the importance of accurate demand forecasting and efficient supplier management in leveraging the benefits of the EOQ model.

The JIT system aims to align inventory levels closely with actual demand, thereby minimizing holding costs. This approach can lead to substantial cost savings by reducing the need for large storage facilities and minimizing waste due to obsolescence. JIT also promotes a leaner, more agile supply chain, enhancing the company's ability to respond quickly to changes in market demand. However, implementing JIT requires a high level of coordination and reliability from suppliers. Any delays or disruptions in the supply chain can lead to stockouts, negatively impacting customer satisfaction and sales. The increased order frequency associated with JIT can also result in higher ordering costs, which must be carefully managed to avoid eroding the cost savings from reduced holding costs.

Transitioning to a JIT system involves significant changes to the company's operational processes and supplier relationships. This transition must be managed carefully to ensure that the benefits outweigh the risks. Literature on JIT supports these findings, noting the importance of strong supplier relationships and the potential cost savings from reduced holding costs (Chopra & Meindl, 2016).

The comparative analysis of the EOQ and JIT models highlights their respective impacts on the company's competitiveness and profitability. The EOQ model provides a balanced approach by optimizing order quantities and reducing holding costs, albeit with an increase in ordering frequency. This model can enhance profitability by improving inventory turnover and reducing excess inventory costs. However, it requires efficient supplier management and accurate demand forecasting to be fully effective. On the other hand, the JIT system offers the potential for significant cost savings through reduced holding costs and a more responsive supply chain. However, the high dependency on supplier reliability and the risk of supply chain disruptions pose challenges that must be addressed to maintain competitiveness.

Given the benefits and drawbacks of both the EOQ and JIT models, a hybrid approach that leverages the strengths of each model could be the most effective strategy for XYZ Retail Company. This approach would involve using the EOQ model to optimize order quantities and reorder points, thereby reducing holding costs and improving inventory turnover. Simultaneously, the company could integrate JIT principles to enhance supply chain responsiveness and reduce waste.

Implementing a hybrid approach would require a phased transition, starting with adjustments to reorder points and safety stock levels based on EOQ calculations. The company would then gradually incorporate JIT practices, focusing on improving supplier relationships and demand forecasting. This approach allows the company to achieve cost savings and efficiency improvements while mitigating the risks associated with a full-scale transition to JIT.

The discussion of inventory management models for XYZ Retail Company highlights the need for a balanced approach that optimizes inventory levels while maintaining operational efficiency. The current practices result in excessive holding costs and inefficiencies, negatively impacting competitiveness and profitability. The EOQ model offers a systematic approach to reducing inventory costs but requires efficient supplier management and accurate forecasting. The JIT system can further reduce costs and enhance responsiveness but poses risks related to supply chain reliability.

A hybrid approach that combines elements of both EOQ and JIT is recommended. This strategy allows the company to achieve the benefits of optimized order quantities and reduced holding costs while enhancing supply chain agility. By carefully managing the transition and focusing on improving supplier relationships and demand forecasting, XYZ Retail Company can enhance its inventory management, reduce costs, and improve overall competitiveness and profitability. This recommendation is supported by the literature, which suggests that integrating various inventory management practices can yield significant benefits (Chopra & Meindl, 2016; Radăşanu, 2016; Silver et al., 1998).

Conclusion

The analysis compared the company's current practices with the Economic Order Quantity (EOQ) model and the Just-In-Time (JIT) system, highlighting the benefits and drawbacks of each model and discussing their impact on competitiveness and profitability. The potential for a hybrid approach that integrates elements of both EOQ and JIT was also explored.

The current inventory management practices at XYZ Retail Company involve maintaining high reorder points and safety stock levels, leading to excessive holding costs. While this approach ensures product availability, it ties up capital and results in inefficiencies that hinder the company's competitiveness (Sanders, 2020).

The EOQ model provides a systematic method for optimizing order quantities and reducing holding costs. However, it increases the frequency of orders, which can lead to higher ordering costs and necessitates efficient supplier management. Despite these challenges, the EOQ model can enhance profitability by improving inventory turnover and reducing excess inventory costs (Ahmadi et al., 2019).

The JIT system minimizes inventory levels and holding costs by aligning inventory closely with actual demand. This approach can significantly reduce waste and enhance responsiveness to market changes. However, the high dependency on supplier reliability and the increased frequency of orders pose risks of supply chain disruptions and higher ordering costs (Bancroft & Li, 2021).

The findings suggest that neither the EOQ model nor the JIT system alone is ideal for XYZ Retail Company. While the EOQ model offers a balanced approach to inventory management, the JIT system provides substantial cost savings but with higher risks. Therefore, a hybrid approach that leverages the strengths of both models is recommended.

This hybrid approach would involve optimizing reorder points and safety stock levels using EOQ principles to reduce holding costs and improve inventory turnover. Concurrently, integrating JIT practices can enhance supply chain responsiveness and reduce waste, provided that supplier relationships and demand forecasting are improved (Karlsson, 2023).

To implement this hybrid approach effectively, XYZ Retail Company should focus on optimizing reorder points and safety stock levels based on EOQ calculations to reduce

excess inventory and holding costs. Improving demand forecasting accuracy will adjust inventory levels more closely with actual demand, reducing the risk of stockouts and excess inventory. Strengthening supplier relationships is crucial to develop robust partnerships with reliable suppliers to ensure timely deliveries and support the increased order frequency required by JIT practices. A phased implementation, starting with EOQ adjustments and progressively integrating JIT principles, will help manage risks and ensure a smooth transition.

The evaluation of inventory management models for XYZ Retail Company highlights the need for a balanced approach that optimizes inventory levels while maintaining operational efficiency. The current practices result in excessive holding costs and inefficiencies, negatively impacting competitiveness and profitability. The EOQ model offers a structured approach to reducing inventory costs but requires efficient supplier management and accurate forecasting. The JIT system can further reduce costs and enhance responsiveness but poses risks related to supply chain reliability.

A hybrid approach that combines elements of both EOQ and JIT is the most effective strategy for XYZ Retail Company. By carefully managing the transition and focusing on improving supplier relationships and demand forecasting, the company can achieve significant cost savings and enhance its inventory management practices. This strategy will ultimately improve overall competitiveness and profitability, positioning XYZ Retail Company for sustainable growth and success in the marketplace.

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