



«SUPPLY CHAIN MANAGEMENT»

THESIS

Inventory management in the retail business: An insight regarding supermarket chains

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Η παρούσα εργασία αποτελεί πνευματική ιδιοκτησία του/της φοιτητή Λίβανου Δημήτριου που την εκπόνησε. Στο πλαίσιο της πολιτικής ανοικτής πρόσβασης ο συγγραφέας/δημιουργός εκχωρεί στο ΕΑΠ, μη αποκλειστική άδεια χρήσης του δικαιώματος αναπαραγωγής, προσαρμογής, δημόσιου δανεισμού, παρουσίασης στο κοινό και ψηφιακής διάχυσής τους διεθνώς, σε ηλεκτρονική μορφή και σε οποιοδήποτε μέσο, για διδακτικούς και ερευνητικούς σκοπούς, άνευ ανταλλάγματος και για όλο το χρόνο διάρκειας των δικαιωμάτων πνευματικής ιδιοκτησίας. Η ανοικτή πρόσβαση στο πλήρες κείμενο για μελέτη και ανάγνωση δεν σημαίνει καθ' οιονδήποτε τρόπο παραχώρηση δικαιωμάτων διανοητικής ιδιοκτησίας του συγγραφέα/δημιουργού ούτε επιτρέπει την αναπαραγωγή, αναδημοσίευση, αντιγραφή, αποθήκευση, πώληση, εμπορική χρήση, μετάδοση, διανομή, έκδοση, εκτέλεση, «μεταφόρτωση» (downloading), «ανάρτηση» (uploading), μετάφραση, τροποποίηση με οποιονδήποτε τρόπο, τμηματικά ή περιληπτικά της εργασίας, χωρίς τη ρητή προηγούμενη έγγραφη συναίνεση του συγγραφέα/δημιουργού. Ο συγγραφέας/δημιουργός διατηρεί το σύνολο των ηθικών και περιουσιακών του δικαιωμάτων.

Inventory management in the retail business: An insight regarding supermarket chains

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Abstract

The retail industry is a complex network supply chain that is responsible for the movement of billions of products worldwide. Inventory management plays a crucial role in various factors for a retail company, such as revenue, inventory costs, product waste and the reputation of the company to their customers. Therefore, it is important that inventory is managed effectively in order to be successful. Inventory management has certain objectives that need to be attended. Since the beginning of the last century, there was much research done in the specific field. This paper acts like a tool for managers, in order to identify the main objectives of inventory management and also demonstrates methods and techniques that have been developed throughout the decades in order to introduce them in the optimal ways that inventory is managed.

Keywords

Inventory, management, retail, supermarket, objectives,

Table of contents

Abstract	2
1.Introduction	4
2. Literature review	7
3. Inventory management objectives	8
3.1 Demand forecasting	8
3.2 Lead time management	12
3.3 Optimal inventory levels	14
3.4 Reduction of waste	15
3.5 Cost effective storage	16
3.5 Enhancing operational efficiency	17
3.6 Ordering costs	18
4.Methodology	21
5.1 Inventory management techniques and methods	23
5.1.1 Just in time method	23
5.1.2 Economic order quantity (EOQ)	24
5.1.3 ABC analysis	25
5.1.4 Vendor-Managed Inventory (VMI)	26
5.1.5 Radio frequency identification technology (RFID)	27
5.2 Key performance indicators (KPIs)	28
5.2.1 Demand forecasting KPIs	29
5.2.2 Time series forecasting	31
5.2.3 Lead time management KPIs	31
5.2.4 Optimal inventory levels KPIs	33
5.2.5 Reduction of waste KPI's	35
6. Case studies	38
6.1 Walmart's Vendor managed inventory model	38
6.2 Walmart's Just-in-Time in Inventory Management	39
6.3 Tesla's inc. inventory management	39
6.4 ALDI's lean thinking on inventory management	40
7. Conclusion	41
8.References	43

1.Introduction

In today's world managing the supply chain has become a difficult task for most of the companies worldwide. Given the structure of the world economy, every event, even in a remote country, has its consequences in every company in the world. History has shown us that events like the Covid-19 pandemic and the wars in both Middle east and Ukraine can have major impact in every company in the world. Retail companies, such as supermarket chains, are a category that can be easily affected by worldwide events because there is a constant need to replenish their stocks and every disruption in their supply chain can seriously affect the way they function.

Modern retail businesses must be viewed as supply chains that are not independent but rather tied together in order to achieve the common goals (Lambert DM et al, 1998). Especially supermarket chains are massive networks of manufacturing companies, transportation companies, warehouses and retail stores all tied up in numerous supply chains.

Modern supply chains are also a sea of people with various expertise. These people have the task of cooperating with each other, in order to effectively handle the never-stop flow of information that is given every day. Another important task is to build relationships that will ensure that all members of the supply chain will work towards the common goal, that is to ensure the flow of products to the final consumer.

The ultimate goal of every retail company is twofold. One major goal is to increase their revenue and the other it to keep the existing number of customers while also trying to increase it. In the retail world, there is an ever-increasing competitive environment that gives consumers numerous choices. The second major goal is to keep fuction costs as low as possible.

Inventory management plays a key role in ensuring that they function at their best and have the maximum profit. Taking into consideration that inventory comprises a great percentage of a company's running cost, it is vital that it is handled in the best way possible. This can be achieved by managing correctly the human, technological and material resources (R. Ishfaq et al., 2016).

The efficiency in inventory management stands in making sure that the right products are available at the right time and in the right quantities, with no stockouts or overstocking. Communication with all the members of the supply chain is important to ensure the right flow of products.

This paper will focus on the importance of inventory management in retail businesses and specifically supermarket chains. Through the literature review, the main challenges in managing the inventory will be indicated and the importance of it. The major techniques will be analyzed and how they were enforced in the first place. In addition, the key performance indicators (KPIs) for inventory management will be outlined and the importance of them will be analyzed. By improving these certain objectives, companies can enhance their inventory management to decrease revenue loss. There will also be an extensive description of the methods used by retail companies in order to effectively manage inventory and meet the objectives indicated in the KPIs. Lastly, case studies about effective inventory management of the most successful retailers will be given. Through case studies it will be shown how companies dealt with inventory management in the past, but also how they apply technological advancements in order to reach their goal.

The role of inventory management is to ensure that stocks of raw material or other supplies (finished goods or works in progress), are kept at levels that provide maximum service levels at minimum costs (J. D. Sterman and G. Dogan, 2015).

The main reasons for retailers, especially supermarket chains, to effectively manage their inventories are intended to increase customer satisfaction and increase profits. Customers' satisfaction can be achieved either by the best quality at the lowest possible price or by finding what they need at any given time. Especially for supermarkets, the service level of the products must be kept high, in order to ensure that no empty shelves will appear in the stores. Inventory management can also help decrease the overall costs of the company, thus enabling it to avoid stock-outs that increase customer satisfaction and offer better discounts.

Demand forecasting is maybe the most difficult task when it comes to inventory management. Demand forecasting is the prediction, projection or estimation of expected demand of products over a specified period of time.

Businesses that mainly operate in the food industry and other consumer sectors use forecasting of demand (Kerkkanen et al. 2009). If the demand for a product follows a steady pattern and is continuous, then a simple reference to the historical data of sales is usually enough for a correct prediction. Successful businesses show improvement in customer service and low-level inventories at the same time.

Errors in demand forecasting can lead to unnecessarily high stocks (Chan et al. 1999). In supermarket chains, forecasting food products, especially those with short life cycles, is crucial to minimizing losses from unsold items. Ineffective returns systems is also another important challenge for the retail companies. Handling unsold or damaged products can either lead to serious losses or minimize costs. Regarding supermarkets, daily returns constitute a great number of products that must be effectively managed.

Inventory management has been studied a lot in the decades since the previous century. This paper aims to give managers a general insight into its effective management through the literature review and act as a tool to begin with the difficult tasks that are tasked with. This paper will also indicate the progress that has been made so far and what challenges retail businesses still face when it comes to inventory management. It will also point out the importance of inventory management in the retail business and give answers in its effective management. Through the case studies and the extensive review of the techniques used by major retailers worldwide, conclusions will be drawn for future improvements. Also, an insight from Greek supermarket chains will be given through personal experience and knowledge.

2. Literature review

Inventory management is a major issue for companies worldwide. Extensive research has been done in order to find ways to maintain it effectively. Researchers from a wide range of fields have contributed to the advancement of inventory management theories. Significant interest in research on inventory management has been shown as early as the 1920s. Ever since there have been advancements but the research is still going on because the challenges seem to rise every year (Ziukov S. 2015).

Inventories can be also referred to as stock. Stock in retail includes finished goods or raw materials, such as groceries and meat products that are ready for sale, through little or no processing (Bonney M. 1994). Inventory is a company's asset that its management is a challenging task.

Inventory is essentially the company's revenue that is gained upon sales. But it is also the reason for low cash flow if it remains unsold and stored and increases the company's expenses (Gumus AT et al, 2010).

The main objective is to ensure the perfect balance between supply and demand. This can be achieved by reducing the procurement and carrying costs that result from excessive inventories (Disney SM, Towill DR. ,2002). However, costumer demand must always be met, in order to ensure a satisfied customer will be loyal to the company.

Suppliers, manufacturers or retailers try to remain competitive and gain advantages in their own field and in order to achieve that they need to improve the performance of their supply chain.

When it comes to supermarket chains, there is no easy solution to effectively manage inventory. A supermarket trades in a wide range of products that include fresh dairy and meat products, agricultural products, packaged goods and nonfood products. Each category must be handled differently when it comes to inventory. Supermarkets must select different models for every category when they manage their inventories. The employees usually fill the shelves every evening based on what the previous day was. Inventory management of this type is only suited to low-cost items that are in high demand and are sold regularly. Alftan et al. (2015) argue that although the decision methods have seen advances, the retail stores still face challenges in making the right decisions. It is not uncommon that management of the store orders sees many variations.

Inventory plays a major role in the supply chain of a company. In many cases, the funds that are invested in inventory can exceed all the other assets within the organization. As a result, in order to ensure that there is enough capital for operational and sales activities, the best possible management is required. In essence, effective inventory management ensures the cost efficiency and overall stability of the company. There are certain objectives that must be met when managing inventory. These objectives must be handled in the best possible way and at the same time because one can greatly affect the other.

3. Inventory management objectives

3.1 Demand forecasting

Today's retail market changes at a faster pace than ever before. Grocery chains and other retail industries must be able to respond to the ever-changing demand of their customers. Nowadays,

consumers are influenced by numerous sources and people in social media, television and radio. For this reason, accuracy in predicting demand is becoming even more challenging.

If only there was a magic ball that would tell us what the demand of a product would be. Demand forecasting is maybe the most crucial objective when it comes to inventory management. Especially in a super market, forecasting demand is crucial especially when it comes to fresh food products with little lifespan (Van Donselaar et al. 2006). In order to minimize losses without losing sales an accurate forecast is mandatory.

Demand forecasting requires the best possible communication between members in the same organization and between all members in the supply chain. It also needs accurate feedback from the end customers in order to predict possible changes in the years to come. To optimize inventory, reduce stockouts and meet customer demands several forecasting techniques have been developed.

Unsold goods comprise a great amount of cost in a company, due to unnecessary carrying costs. They can be reduced by more accurate demand forecasts which reduce safety stocks (Ehrenthal et al, 2013).

There are three types of demand forecasting, short term, medium term and long term.

Short-term forecasting covers a time span of a few days and up to a month. In retail industries, such as groceries chains that have to manage fresh food products with little lifespan, short term forecasts are essential, even daily.

Fresh food products, especially vegetables and fresh meat, must be sold within a few days and are daily replenished in most stores. The stocking of these kinds of products is out of the question because of their little lifespan. For that reason, the demand for these products must be calculated according to previous days and time of season.

Medium term forecasting usually covers a month or so. It is often used when a retail wants to launch a promotional campaign, that usually lasts about a week or two. In retail chains, there is a seasonal change where products and sales are directed based on the season. Medium term forecasting is used in these instances.

Long term forecasting is used by businesses when an investment plan is considered. For example, demand forecasting for the next 5-10 years is crucial when a new warehouse is considered to be established or opening stores in a location where there is no previous presence.

There are certain factors that affect demand forecasting, especially in supermarket chains.

a) Seasonality

There are specific times of a year such as Christmas, Easter, national holidays that certain products have high demand around those days. For example, at Christmas, demand for decorations, chocolates rise the days before Christmas. Furthermore, every country and even a certain region in a country has their own unique demand in certain products that retail stores try to meet in order to increase sales (J.C.F. Ehrental at al, 2014) .

Retailers often try to limit seasonality in demand around those times, in order to avoid surges in demand that will not be able to meet. This is usually done by not offering discounts every day or advertising. However, consumers around holidays often shop on certain days like weekends and the last two days before Christmas making it hard for retailers to smooth demand (Aviv & Federgruen, 1997).

Demand seasonality, when not taken into consideration effectively, leads to stock out or stocking of products that will hardly be sold out of these specific days. Not well synchronized replenishment leads to out-of-stock items that could be easily sold (Gruen and Corsten, 2008).

b) Promotions and discounts

There is a sharp rise in consumers that buy only items that are offered a discount. Especially in supermarkets, where consumers spend a substantial amount of their income in every day goods such as food products, promotions play a very significant role. Promotions are usually offered in items that the retailer wants to boost sales. Promotions can either be a direct discount or can be a higher amount offered at the same price (Lindsey-Mullikin et al, 2011).

Demand forecasting during promotions is very important for the retailer in order to meet the surge in demand. A customer that cannot buy the promotional product can stay extremely dissatisfied. In some cases, customers can lose their faith in the retail and never come back.

c) Price elasticity

Today's consumers are very sensitive even to minimal changes in prices, especially in products they buy very often like food, toilet paper etc. Even the most faithful consumers in a certain brand name can easily switch to another same product, when the price changes. More and more consumers tend to buy private-label products that in the last decade have seen a surge in demand and have increased their share of total sales.

In recent years and those during the Covid-19 pandemic there was a surge in e-commerce. As consumers became more and more acquainted with online shopping, it was easy to spot price changes and offers that contributed to price elasticity in demand.

Even a little change in prices and shift demand in cheaper products thus leading to inaccuracies in inventories in certain products.

d) Product shelf life

There is an even growing concern about the food that is wasted in grocery stores because it perished before being sold. It is estimated that about one third of the food that is produced worldwide is wasted and never consumed (FAO, G. 2011). A significant amount is wasted due to poor management from retail stores and leads to high costs for all members of the supply chain.

In supermarket chains the main reasons for food waste are poor handling, unexpected consumer behavior, overstocking and bad quality control (Wang, X., & Li, D. ,2012). These have negative results and serious costs and ways to minimize them are trying to be found.

Accurate demand forecasting and price control are needed in order for food waste to be reduced at a minimum.

In the second part of this paper, certain methods that retail stores implement will be discussed in order to make more accurate demand forecasts. Tools and technologies used will be discussed and certain challenges that remain will be mentioned.

3.2 Lead time management

Lead time is the time that is required from when an order is placed until it is delivered. In retail companies, lead time plays a crucial role in ensuring that goods are always available in stores and at the required quantities. Lead time is often the reason for overstocking and lack of stock resulting in empty shelves and dissatisfied customers. Supermarkets try to effectively manage the lead time, as it impacts several aspects such as demand forecasting, inventory control and supply chain efficiency.

Retail companies nowadays have adopted complex supply chain networks and offshore outsourcing in order to be more competitive. This has made them more susceptible to supply chain disruptions (Trkman & McCormack, 2009).

For example, cloth retailers have manufacturing companies throughout the globe and clothes must often be delivered from distant places. History has shown there can be major disruption that results in longer lead times.

The effects of supply chains disruptions are often more critical due to lean manufacturing and just-in-time production. These are common practices that manufacturers and retailers follow in order to minimize possible inaccuracies in demand forecasts. However, these practices make retailers more vulnerable when disruption occurs (Ghadge et al, 2012).

Lead time can be divided into the order lead time, transportation lead time and receiving lead time.

- a) Order lead time is defined as the period from when an order is placed to when the supplier ships the goods that have been ordered. Order lead time is affected by various factors, such as seasonality, promotions and marketing strategies.

Seasonality can affect order lead time because the supplier has to handle significant larger amounts of products than usual and possible delays are expected. Retail companies often stock seasonal goods much earlier, in order to avoid stockouts, based on their demand forecast.

Promotions and discounts usually demand higher stocks. Suppliers and retailers need to have good communication in order for promotion to be a success. Disruptions or late deliveries are often the case for a promotion to fail, because of a lack of products in retail stores.

Marketing strategies often aim to swift demand for certain products that are more easily available. If a certain item is low on stock, supermarkets give serious discounts on another similar item in order to prevent empty selves.

- b) Transportation lead time includes the time that is required to load, transit and unload the products ordered to the final destination, like the central warehouse. Transportation time varies depending on which kind of route the products are delivered, for example, by sea, air or road. Many products have a more complex supply chain so that more than one means of transport is required. For example, bananas are transported both through the sea and road.
- c) Receiving lead time can be described as the time needed to deliver the products to the point of sale, such as grocery stores. This kind of lead time depends heavily on the capabilities of the company's transportation system and the amount and location of the distribution centers. Further from the distribution center stores are located, there are more chances of delays happening.

Lead time management is very crucial for all members of the supply chain, and they must cooperate with each other in order to have the desired results. Lead time can directly affect inventories and decisions in stock levels, order quantities and many more.

Lead times can affect both the production and ordering decisions by all types of companies. They are often entangled with other inefficiencies in inventory management such as variabilities in consumer demand. Larger lead times result in uncertainty when it comes to inventory management and demand planning (de Treville et al, 2004).

The bullwhip effect and lead times are often connected to a cycle. The bullwhip effect is the phenomenon where a small change in consumer demand leads to higher changes in the supply chain, moving up from the retailers to the manufacturers. If the mean lead time increases, then the bullwhip effect is amplified (Hosoda et al, 2015). In contrast, the bullwhip effect can often be the cause of longer lead times (So and Zheng, 2003).

Lead times can also affect the relationship between customer satisfaction and the safety stock required to maintain that. If lead times are increased, then customer satisfaction is decreased, leading companies to hold more safety stock in order to prevent that from happening (Kelepouris, T. et al, 2008).

In supermarkets, managing the lead time effectively has two main goals. One is to ensure that customer satisfaction is always at the required service level and the other is that inventory levels are always balanced. This is even more important in food products with short life span, that can easily be wasted if they are not on time on the shelves. Lead times also play a role in promotional campaigns and discounts in a given time period. If consumers cannot find the products at a discount, the retailer's fame is seriously damaged.

In order to achieve these two goals, retail companies must place sufficient orders in products, so that they have the necessary stock to cover the lead time. In cases where there are disruptions in the supply chain, problems arise, and companies face a certain dilemma. One choice is to place larger orders in order to stock products with a sharp rise in holding stock and the other is taking the risk to not have enough products to sell, thus losing sales.

3.3 Optimal inventory levels

One of the main objectives of inventory management is to ensure that there is always enough stock to cover the demand and avoid any stockouts. Holding stock significantly increases the company's expenses but lack of stock not only decreases revenue but also harms the company's fame to their customers.

The inventory level is crucial to the company's profitability. It is generally desired to begin every season with low inventory levels and continue as such throughout the year (M. Keramatpour et al.,2018).

Low inventory allows the retail store to effectively track discrepancies in the information system that otherwise would be difficult (M. Barratt et al.,2018). The inventory level has a certain cost that is better maintained at the minimum.

A retailer can always increase the revenue not only by meeting the demand of its customers, but also by decreasing the holding costs and the number of unsold products.

Optimal inventory levels are hard to achieve because they depend on many factors such as demand, lead time, product shelf life and seasonality. Therefore, it is impossible to maintain the optimal inventory levels at all times. Retailers must choose the service level for their items, giving more attention to products that are very popular.

In supermarket chains, different categories of products are sold, each with a different life span. The most demanding are fresh food products, especially agricultural products.

Finding the perfect balance between customer demand and inventory levels is the goal of every retail business. But because consumers nowadays easily change their demand for products faster than the previous decades, it is better to keep low inventory levels. However, shortages that can lead to customers' losses are unacceptable.

3.4 Reduction of waste

The world is becoming more and more aware of the limited resources of the planet and the importance of effectively managing them, in order to reduce waste. Waste refers to products of all kinds that have not been sold, such as expired food products, damaged items etc.

Food waste is the result of bad decisions and actions by retailers, food service providers and consumers (FAO, 2019). Significant actions have been taken in order to tackle food waste. The European Union (EU) has been committed to a 50% reduction in food waste within the years up to 2030 (European Commission, 2018). Effective inventory management of food products, especially those with short life span, can significantly help towards this direction.

Retailer food waste remains a smaller portion, in comparison with the food waste generated by households and manufacturers (Cicatiello, C et al., 2016). However, retailers such as supermarkets chains have great influence on other members of the food supply chain and can help in reduction of the food waste (Young, C.W. et al, 2018).

In addition to the environmental reasons, reducing waste can also contribute to cost savings. According to (Venkat, K., 2011), retail companies in the United States lost about \$65 billion in a year alone, due to the waste of food.

In supermarket chains, another cause of product waste is the infestation of fresh or packaged food products with insects. These infestations lead to serious degrading of the quality of the products

and even make them dangerous for consumption due to the diseases they may carry. There is a plethora of insect species that can infest dry foods such as rice, flour and dried foods that are rich in sugar. In order to prevent insect infestation retailers need to do quality control in the products they receive from suppliers, especially in the categories that are most prone to be infested (flour, rice etc).

In addition, the conditions in which they are stored both in the warehouses and in the stores must be the ones that prevent the reproduction of insect species. In summer months, waste due to insect infestation is greater. Hygiene auditors can help prevent insect infestation from spreading to other products by doing quality check in retail stores, thus preventing food waste.

Another reason for food waste is the damaged packages that occur both in the warehouses and in the retail stores. The reduction of damaged goods can be achieved by better handling both in the warehouses and in the stores.

3.5 Cost effective storage

Every warehouse has limited storage capacity, and its space must be managed effectively, so as to store as many products as required in order to cover the demand from consumers. It is impossible to maintain a high service level in all products. Retailers set a specific service level for every product based on its demand and avoid the high stock of others that are not so easily sold.

The service level is the expected probability of not running out of stock, until the next replenishment. The service level for a certain product or a variety of them is determined by the retail company. The higher it is, there is little chance of losing sales.

High service level requires having higher safety stock, in order to prevent stock outs. However, it can only be done with certain products because it increases the holding cost rapidly. In the clothing industry, service levels are high in seasonal products and other basic clothing that comprise most of the sales.

Low service level is used for items that are considered luxurious, in order to maintain some kind of exclusivity. For example, in the fashion industry some items are not available in high numbers so that are considered rare and have increased price (T.-M. Choi, 2016).

In supermarkets chains, buyers try not only to cover demand for existing products but also to find new products to meet the ongoing trends that develop among consumers.

Therefore, there is a need for even more space to store new products. Effectively managing the storage enables retailers to store more products in a given space. Supermarkets not only store products in their main warehouses but also try to invest in stores with high-capacity storage areas. These stores have increased rent thus significantly contributing to the expenses. Managing the storage space effectively is crucial. Storing items that are not easily sold takes up space that could be used to store more sellable items.

However, most retailers face difficulties in having the right stock in the right quantity at any given time. The difficulty in maintaining the service level for its product rise from the fact that due to the antagonizing environment in supermarkets, there is a constant need for new products, discounts, and special offers. In addition, more and more products with short lifespans exist because consumers are now more aware of the contribution of preservatives in their health.

Maintaining such a rich inventory requires a lot of storage space both in the warehouses and in the retail stores that effectively increases costs. There must be an inventory planning system applied to each store separately according to its needs.

3.5 Enhancing operational efficiency

Enhancing operational efficiency in inventory management is essentially trying to balance marketing aims with the goals of inventory managers that have to make sure there are always the required quantities. Marketing aims to increase sales through various strategies such as advertising, discounts and promoting new products and introducing them to consumers. All these increase the service level of the products, which results in a need for increased inventory.

In order for retail businesses to survive in an ever-competing environment, they relieve well on good inventory management in order to be ahead of other companies in terms of customer service. The key to that path is good coordination of product availability, managing the store's available capacity, ordering costs and balancing inventory levels.

It is common practice that some retailers offer real-time availability of certain products to their potential customers. They usually decide on a fixed inventory level for a product and reveal it to the customer in order to influence their decision to buy it. This is product availability.

By product availability, retailers make their products more appealing to the customers and run a lower risk of excessive inventory of unsold items. They also have a greater control of sales over inventory (R. Cui et al., 2019).

Product replacement is a common strategy used by retail companies in order to control the often-excessive cost of inventory. Frequent product replacement has many advantages. Reduced space for every item is one of them. When a product is replenished often, there is no need to order large amounts that require valuable space to store.

As a result, the free space can be used for other products thus enabling the retailer to increase the variety of products in a given time.

Excessive inventory can be caused by various reasons. A sudden drop in demand could make products not so appealing or there was overproduction. Retailers usually drop prices in order to minimize inventory in a short time.

Often, excessive inventory is caused if inventory is not reviewed in a given time.

It is not uncommon that retail stores receive different items than what they have ordered. The fault may sometimes lie in the warehouse where different packages are loaded. These items must be returned to the warehouse but often are misplaced and lost (A. Solti et al, 2018).

3.6 Ordering costs

Every retail business, such as supermarket chain, has an information system that depicts the stock levels of every product currently available for sale. It is crucial that actual inventory stocks either in the warehouses or in the retail stores are in compliance with the stocks depicted in the information system (W. Zhou and S. Piramuthu, 2015).

It is not uncommon that due to various reasons this relationship is often disturbed. As a result, operational consequences in both stores and warehouses occur.

There can a number of reasons for this disruption. Outdated inventory systems are one reason. Some systems cannot update stock levels in time, leading to false stocks for a period of time. Also, system glitches may cause the reporting of false stocks that must be recounted in order to be fixed.

Inventory systems are also provoked by hacking. Even if it is not so common, there may be instances that the system is hacked and a general discrepancy in all the company's stock levels occurs. Another reason for this discrepancy could be the mishandling of the company's personnel. When stock levels, especially in stores, are counted, they must be done with the utmost responsibility, in order for mistakes to be fixed.

To conclude with, maintaining a healthy inventory system is crucial in order to ensure that the availability of products is always in the right amounts to cover the demand but not more than that (R. Cui et al.,2019). A retail store can have serious losses if stock levels are not depicted properly, because there will not be an easy way to make sure which products need to be ordered. As a result, customers may not be able to find the products they need and in the long-term stop purchasing at all, damaging the company's reputation and dropping the retail store's income.

In order for retail companies to stay competitive one major issue is the prices of the products available for sale. In recent times, especially in Greece, the consumer's buying power has been seriously decreased. The country's economic recession sharply decreased the available income, and inflation decreased the buying power.

As a result, consumers have become very cautious about the price of what they buy and prefer to choose items that are on some sort of discount. Furthermore, they tend to give more and more attention to the quality of the products that they are willing to buy, especially if they are expensive. Price and quality of a product usually is the supplier's responsibility, as he has the task of producing the best quality products at the lower possible cost. However, in retail industries, the managers that are buying the inventory items have the task to find the best suppliers that will ensure that.

The ordering costs are the value of the products, a retail such as a supermarket need, in order to replenish their inventory. The ordering costs consist of the cost of producing the items, the cost of transporting the products to the warehouse or the retail stores and the revenue the supplier must make. For the retailer, there are also the costs of placing an order and the cost of storing the order. Transportation costs depend on which member of the supply chain will pay for them. For example, a supplier may not be willing to pay for the transportation cost of an order X, unless it reaches a certain quantity number Y. In order to tackle that problem, managers use the joint replenishment system. In essence, managers try to incorporate in the order other products that need to be

replenished in a short period of time. That way they achieve free transportation from the supplier (Ir. Paul P.J. Durlinger, 2015).

The transportation costs can increase if there are disruptions in the supply chain. For example, a strike or a natural disaster like a flood can disrupt the transportation system and significantly increase costs and lead time. In addition, natural disasters, pests' infestation and others can significantly reduce product availability thus increasing the final price, since it will be harder acquiring the desired inventory levels.

The cost of placing an order is essentially the cost of the people that work in the buying department. It varies depending on the number of people needed in order to place all the orders that are required at any given time. These costs are fixed because they consist only of the wages of the staff, therefore rarely are they taken into consideration.

The ordering costs can significantly affect the final prices at the end of the supply chain, which are the retail prices. Poor managing of ordering costs can affect not only the inventory management section but all the way up to the retail stores and consumers.

4. Methodology

Modern companies in the retail sector are vast supply chains that involve numerous businesses and people from various fields. In our modern society, there are millions of different products available, and their numbers are growing day by day in the fast-paced society we live in. In addition, consumer preferences are changing at a rapid pace. For all these reasons, retailers are obliged to manage a vast inventory effectively in order to increase their revenue and minimize their losses. Inventory management is crucial to the retail industry and the best way possible to manage it must be found.

The purpose of this paper is to analyze some of the various methods and techniques that are used in inventory management that have been developed and implemented over the decades. It will outline the importance of inventory management in the retail sector and focus mainly on supermarket chains. Also, by analyzing the methods, it aims at giving inventory managers a helpful insight into literature and help implement them in practice. It can offer valuable insights to supermarket chains to improve their inventory efficiency and their overall organization performance. Moreover, this paper aims at directing managers to focus on the most important points when handling inventory.

The importance of this paper is crucial because inventory makes up a great percentage of a retailer's capital and must be managed effectively. Also, supermarkets are the main providers of food supplies for millions of consumers worldwide and are called to manage inventories from numerous supply chains. Inventory management is the key to reducing food waste worldwide and this paper gives insight into the ways this can be achieved. Finally, this paper aims to organize the

massive literature into simpler points and give an insight that is mainly focused on supermarket chains and their handling.

This paper was conducted by extensive research of the current literature on inventory management. Existing academic literature was used to describe the current inventory methods and techniques and point out the most important challenges managers currently faced. Through the literature review, the most important objectives of inventory management were presented and what problems managers are called to solve. In the main part, the various methods to implement effective inventory management were indicated, based on key performance indicators for each objective that were found in the literature. In addition, some of the most common techniques that are universally used were described, along with the way they can be implemented in retail companies. Finally, their importance was indicated. This paper also includes case studies from major retailers such as Walmart and Amazon that are technological leaders in inventory management. The case studies aim at giving examples on how some the techniques and methods described in this paper can be implemented in retail companies.

Google scholar was the main source of academic literature that was used in this paper. Extensive research was done to find academic papers that described the various methods and key performance indicators that are analyzed. The research was qualitative as only research paper was conducted.

5.1 Inventory management techniques and methods

As has been stated in the literature review, inventory management plays a crucial role that can affect all the operations within a retail company. In supermarket chains, inventory management can be regarded at the heart of the organization that supplies the whole body, which can be regarded as the retail stores. Many companies worldwide face significant problems with inventory issues (O. Abdolazimi et al., 2021). Supplies are needed for a company to maintain its sales activities effectively. Stock is essentially a company's asset that holds a significant amount of funds and must be managed with caution. The most successful companies are the ones who have manages and control their inventory in the ever-changing environment of the modern world.

Inventory management has a direct impact on a company's performance and can guarantee that there is always the availability of products to meet customer demand (I. M. D. P. Asana et al., 2020). As the complex procedure that it is, it has many aspects that must be taken into consideration. Many methods and techniques have been developed over the decades in order to tackle the challenges that managers have faced. In this chapter, the challenges that are faced will be discussed and the various techniques and methods used will be analyzed.

5.1.1 Just in time method

The concept of "just in time" can be attributed to the Japanese motor company Toyota in the decade of the 1970s (Sugimori Y et al.,1977). The main idea is to reduce inventory levels by producing exactly what is needed to cover the demand. Essentially, it is a way to save money and resources by producing whatever is necessary, thus reducing waste. Just-in-time system is now widely applied in manufacturing companies and in recent decades it has been also applied in other sectors like retail businesses (Schonberger R. J.,2007).

The core aspect of just in time method is reducing inventory levels. At the same time, managers must ensure that there will be no stockouts. It is a pull strategy where products are only produced

if they are to be sold. In order for managers to implement a just-in-time method, very good demand forecasting is needed. Also, a very good relationship with the suppliers is needed, in order to make sure that products can be supplied at the right time with the right quantities.

Just in time method in retail companies has many benefits. It helps reduce dead stock (items that are unlikely to be sold or they will be at a long period of time), it helps meet changes in customer demand and helps reduce waste especially in the category of fresh groceries and dairy products. For example, in fashion companies, demand for certain products can be shifted at a rather fast pace. When implementing a just-in-time system, stocking unnecessary items that will be out of fashion is prevented thus reducing costs.

Of course, implementing a just-in-time system in a retail company does not come without risks. Maintaining low inventory and depending on suppliers to deliver products on time are the two main keys for a successful just in time system. However, in instances where supply chains are disrupted, low inventory can be the cause of empty shelves. Shortages and disruptions are most likely to occur in spatially complex supply chains extended worldwide (Bode C., Wagner S. M., 2015), as it is in the fashion industry.

Just in time system can help retail industries and supermarkets only if applied carefully and with trusted suppliers. It can significantly help trace and reduce dead stock and save a considerable amount of money by unsold products, especially in the category of fresh foods with little life span.

5.1.2 Economic order quantity (EOQ)

Economic order quantity (EOQ) describes the ideal number of items a manager should buy in order to meet demand while keeping costs low. It is a tool that helps balancing the costs of storing items, running out of stock, and placing orders (Erlenkotter, D,1990). EOQ indicates the ideal time to order, the cost of placing an order, and the holding costs. Traditional EOQ models consider the trade-off between ordering and storage costs (Schwarz, L.B. ,2008). The EOQ model was first developed by Ford W. Harris in 1913 and has been not only widely used ever since but also been refined over time. The formula for the EOQ is:

$$Q = \sqrt{\frac{2DS}{H}}$$

Where Q= EOQ units

D= demand rate (number of items sold per year)

S= Setup costs (shipping, handling and transportation costs)

H= Holding costs (per year, per unit)

Economic order quantity assumes that demand, ordering and holding costs of the products on which is used, remains constant over time. Its final goal is to minimize inventory levels and help companies avoid dead stock. The EOQ is essential for maintaining smooth material flow, which is very important for any production or retail company. When large quantities are ordered, ordering and transportation costs remain low but holding costs rise because higher inventory of products is required. If managers choose frequent orders with low quantities, then monthly ordering costs increase but inventory levels remain low because there is no need to hold stock.

EOQ is an important tool for inventory management but has its limitations, especially in times when supply chains are disrupted or face challenges. Then the lead times, transportation costs and demand show fluctuations that EOQ cannot accurately calculate. For example, EOQ is not accurately indicate the quantities that are need in seasonal products, when demand show sharp rises. Also, in times when supply chains are seriously disrupted, like in the covid-19 pandemic or during a natural disaster EOQ is not a trustworthy tool. However, it remains a useful tool for inventory management.

5.1.3 ABC analysis

One of the most common methods used in inventory management is ABC analysis, which divides product stocks into classes based on total annual product usage or total cost of inventory storage (S. Jayakumaran et al.,2020). ABC analysis is a straightforward method that helps companies identify items that significantly impact on overall inventory costs, resulting in a more efficient and effective inventory (A. R. Fahriati et al., 2021).

ABC analysis is also called Pareto analysis, and it is a very useful tool for managers that want to optimize their inventory. The Pareto principle divides the items of an inventory into three categories A, B,C. Category A consists of products that have high value and demand from customers. They account for a small percentage of the total inventory but contribute greatly to the company's revenue. These items must be always monitored to ensure that they are always available and no stockouts will occur. Category B are items of moderate demand and value that are needed

to be at enough quantities, so the company does not lose revenue. Category C are items of little value and demand but make up most of the inventory.

The current approach enables managers to identify the items that contribute the most to the revenue and require greater attention than those that are not so important. It can help retailers increase their profitability and their performance in the retail market. The implementation of ABC analysis can help reduce the risk of losing revenue from items with high demand (Belinda Ray Silaen et al.,2024). Focusing on Category A items, retailers get the chance to make better decisions regarding sales, discounts, promotions and inventory procurement. These all lead to better customer satisfaction, as long as it makes them more competitive. A regular review and update of the ABC items also help retailers follow the fast-changing trends among consumers. It also helps marketing and sales efforts by giving them the right items at the right time. Retailers in the clothing industry can divide their products in the A,B,C categories based on their consumption value (M. A. Ali et al.,2023).

ABC analysis is a helpful tool for retailers for the identification of slow moving or obsolete products that take up valuable space both in the warehouse and in the shelves because they can categorize them according to their importance and value (A. C. Janine, 2024). Through data analysis of sales, demand and customer preferences, retailers can be one step ahead of the customer offering them what they need , at the time they need it. Implementing ABC analysis has been a proven tool in optimizing inventory and other operations by retailers.

5.1.4 Vendor-Managed Inventory (VMI)

Vendor managed inventory is an inventory technique where the supplier or vendor takes full control and responsibility of its own inventory from the retailer. The vendor has the obligation of monitoring inventory levels, placing orders, collecting sales data and making all other inventory related decisions. The vendor has its inventory store in the retailer's warehouse and from that point he manages it for the best possible outcome. VMI is an efficient replenishment practice designed to enable the vendor to respond to demand without the distortive effect of purchasing decisions in the retail chain (ECR Best Practices Operating Committee, 1995).

In order for the VMI model to take place, the supplier and the retailer must have very good communication and cooperation. Formal agreements must be made from the beginning which include return policies, inventory levels and delivery schedules. Moreover, the most important

thing that can make VMI work is the sharing of data. In order the vendor to effectively manage inventory, he must have access to real time sales data, inventory levels and more. That way the vendor can make the right decisions regarding demand because more accurate forecasts are possible. From that point, vendors do all the restocking, order times, sizes and the frequency.

VMI has many benefits for both the supplier and the retailer. The retailer does not have the need to focus so much on inventory management and can shift the focus to other important aspects like advertising, sale promotions etc. Through VMI the supplier has better control over their inventory and has greater view of the actual sales. As a result, more accurate production planning is possible thus reducing waste. The supplier can also make more timely restocking because lead times are best known by the supplier and possible disruptions can be prevented. Also, VMI helps in building a more resilient supply chain between the retailer and the supplier that can better respond to disruptions and other risks. Finally, stronger and more lasting relationships are formed, which is very crucial in the competitive environment of the retail businesses.

VMI has some potential risks that both members must be aware of. As mentioned before, communication is the key for VMI to work. Miscommunications can lead to inventory discrepancies such as higher lead times, wrong order quantities and untimely restocking. Moreover, because electronic tools are used for sharing important information such as sales data, the system is more prone to security breaches. Also, sudden demand changes can disrupt forecasts and restocking.

VMI should be used by retailers that sell a large number of products from numerous vendors. By relinquishing control of the inventory to the vendors it becomes more easily manageable. When suppliers have control of their own inventory can make better decisions that ultimately lead to an increased revenue for both members. Major retailers like Amazon and Walmart have implemented the VMI system.

5.1.5 Radio frequency identification technology (RFID)

RFID or radio frequency identification is a wireless communication technology that is used in order to capture data, which may have different attributes like serial number, date of purchase and quantity (Fatah Chetouane,2015). An RFID system consists of three components. A small transponder called RFID tag, a receiver or reader and a scanning antenna. When the scanning antenna and transceiver are combined, they are referred to as an RFID reader or interrogator. The

exchange and collection of the data is done through electromagnetic waves between the tag and the reader. RFID technology came to prominence during the decade of the 80s but it was not until 2005 that was implemented by Walmart for inventory management. Since then, it is used in various fields such as the meat industry, healthcare and for inventory control. It is a very efficient method that has been proven to increase efficiency and is continuously refined, with its use growing ever since.

RFID tags consist of an integrated circuit (IC), an antenna and a substrate. The part of an RFID tag that encodes identifying information is called the RFID inlay. There are two types of RFID tags, passive and active. A passive tag cannot transmit radio waves on its own and has a limited range of up to 3 meters. Also, its storage capacity for information is quite limited. An active RFID tag has its own battery and has a range of up to 90 meters. There are also three types of RFID systems, low frequency, high frequency and ultra-high frequency that is the technology used in inventory management.

Though very efficient RFID technology is not widely used yet but there is growing attention to implement it in the supply chain, inventory control and management. There has been much research conducted in recent years on using RFID as a form of information system that will help reduce error in inventory, misplacements, shrinkage and counterfeiting (Jacky S.L. Ting et al, 2012). Manufacturing organizations already use RFID to reduce inventory discrepancies. Although the ultimate goal is to adopt RFID technology in inventory management is acknowledged, a simple collection of data is not enough. The collected data needs to be gathered and analyzed in order to help managers identify problems and give solutions.

5.2 Key performance indicators (KPIs)

Today business conditions in all fields but especially in the retail sector have become a complex environment where information is crucial to be earned and shared among all members. This

information includes the performance of an organization in certain points and objectives that has to face. There is a need for a system that will measure the performance and indicate when things are not as they are supposed to be. One such approach is measuring the performance of organizations through the key performance indicators KPIs. These can be various indexes and measures that help managers identify how successful they were in accomplishing their goals.

In order for a correct measurement through KPIs to take place, the company must have excellent organization and communication between its members. It is very important that there is constant measurement because it's the key for improvement in performance and management skills (Besic & Djordjevic, 2007). Measure the company's performance is also a tool of control over the daily activities and so improvement in all departments of the company. Apart from control, KPIs also function as developing and guiding tools because they set goals for the members of the organization in order to fulfill the strategy that has been set. They can also function as motivation tools for further improvement.

In the literature review, some of the most important objectives in inventory management were discussed and analyzed. Demand forecasting, lead time management, optimal inventory levels, reduction of waste, cost effective storage, enhancing operation efficiency and ordering costs were those that were mentioned and their key performance indicator will be discussed. It is not uncommon that KPIs of one objective can be similar to another because they are all part of inventory management. They belong to the same body and are intertwined.

5.2.1 Demand forecasting KPIs

Demand forecasting is one of the most important objectives of inventory management. There are some important key performance indicators (KPIs) that managers must have in my mind that will be mentioned. Moreover, some demand forecasting methods will be analyzed.

Demand forecasting KPIs are some of the followings:

a) Forecast accuracy

Supermarkets are a retail sector that offers a high variety of products to its customers. Its product has its own service level and lead time and must be treated separately. Due to the complexity of the retail sector, accurate forecasts play a crucial role in demand forecasting. Forecast errors can

have a serious impact on the company's revenue (Ivanov D et al.,2017). High forecasts increase inventory management costs like holding stock and ordering costs. Lower forecasts can lead to stockouts and empty shelves thus increasing customer dissatisfaction.

Forecast accuracy= (Actual Demand–Forecasted Demand)/actual demand x 100

b) Demand durability

Durable demand has a product that its sales remain unchanged for a prolonged period of time. Items with high demand durability often make up a sizeable amount of a company's revenue. Managers must give increased attention to items with demand durability because consumers are in constant need for those items. A stockout in these goods can have a negative impact on the retailer's image.

c) Inventory accuracy

Inventory accuracy describes the inventory levels that have been recorded in the information system, in contrast with the actual inventory levels. More often than not, there are serious deviations which have serious repercussion in all inventory management. Inventory accuracy has been studied a lot in order to find the reasons for this phenomenon and decrease its impact on the overall supply chain costs (Atali et al, 2006).

d) Forecast value added (VA)

When managers are tasked to make forecasts rely heavily on the information they have on hand like, previous demand, product popularity, sales data etc. However, there is always a judgmental adjustment in the forecasts which aims to improve the forecast by incorporating factors like weather conditions or political events that are not usually happening. The process of evaluating and measuring, the impact of such judgmental approaches in forecast accuracy and identifying the circumstances that lead to the adjustment, is the aim of the FVA (Gilliland, 2008).

Other key performance indicators in demand forecasting include supplier performance, customer demand and the cost of forecasting. As supplier performance is described, how well the supplier scores in certain indicators such as lead time of delivery of their goods, overall quality of products,

constant cover of demand etc. Customer demand is one of the most important KPIs in demand forecasting. It is essentially the goal of the manager doing the forecast. Customer demand is quite often very uncertain and requires experience and personal opinion in order to get it right. As the cost of forecasting is described the fixed costs for the company of every forecast. Typically, these costs include the salaries of the people involved in it.

5.2.2 Time series forecasting

Time series forecasting is one of the most common methods that managers use in order to predict the demand of an item. It is a statistical method that makes use of historical data of the sales of a certain item which are used in order to make predictions about future demand and sales ratio. The forecasting process has three main steps which are data collection, model development and forecasting. Data collection is the gathering of historical data about demand and sales of the item that interests us. Model development is about finding the appropriate statistical model in order to incorporate historical data. Forecasting uses the model and the historical data in order to predict future values.

Time series forecasting has many benefits for the retail industry. Improved inventory management can be achieved because managers can predict future demand which helps them optimize inventory levels to meet customer demand. They can also minimize inventory costs. Another benefit is enhanced customer service. Prediction of future demand means reduced likelihood of stock outs and backorder which are crucial for product availability. Time series forecasting can also help managers save money. By minimizing inventory costs and reducing waste, managers can improve profitability and reduce the overall cost of the supply chain.

5.2.3 Lead time management KPIs

Lead time management is another important objective of inventory management. Lead time affects directly the reorder point of a product and can have a serious impact on the availability of products thus affecting the company's image towards the customers. Some important KPIs in lead time are the following which can help managers have better control over their suppliers and inventory.

A) Lead time accuracy

Lead time accuracy depicts the actual time of arrival of an order against the estimated time.

$$\text{Lead time accuracy} = (\text{estimated lead time} - \text{actual lead time}) / 100$$

Lead time poses a significant threat for all members of the supply chain. Even minor disruptions can seriously affect a retail organization's function and can undermine its fame. Lead times can also affect the reorder point which is the number of items that must remain in order to place an order. High lead times need higher safety stock in order for managers to make sure that there will be no stock, especially in items with high demand. Managers need to calculate the lead time percentage of every supplier in order to make more accurate orders.

b) Suppliers lead time

Suppliers lead time is the time space that is needed for products to arrive from a supplier from the point that an order is placed. This time span can vary according to the supplier and according to the time period of the year, the quantity of products that must be sent and the location of the supplier. The lead time of the supplier is subject to disruptions, especially when products have to be transferred from different countries and even continents.

c) Order cycle time

Order cycle time is the time space that is needed from a placement of a customer's order up until the order is delivered. In supermarket chains it can also describe the time that is needed for products be delivered to the stores from the main warehouse and the shelves be refilled once again. Order lead time shows the efficiency of a retail to keep up with the demand of its customer and its capability to avoid stockouts.

d) Lead time variability

Lead time variability is an indicator that depicts the variability of the lead times in a specific time period. This variability can be the source of unexpected stockouts or reduce quantities of necessary

items. There can be cases that it can lead to serious loss of revenue. For example, in the fashion industry, there are items that are designed to be sold in a very narrow time frame. Variability in lead time can have a significant impact on the timely arrival of certain items and can cause the season to be a failure.

5.2.4 Optimal inventory levels KPIs

Optimal inventory levels are the core of successful inventory management. Maintaining the right inventory levels at all times can ensure that no revenue losses will be taking place. The most important KPIs are the following.

a) Stockouts

Stockout is the situation where a specific product is not available for sale. Stockouts remain a serious problem for retailers. It is estimated that the European Grocery Industry losses due to stockouts reach 400 billion euros every year (Efficient Consumer Response, 2003). There are three types of stockouts in supermarket chains: retail store ordering and forecasting, shelving and store practices which are responsible for the phenomenon that products are on store inventory but not on shelves and all combined upstream causes (Gruen, T. et al., 2002).

b) Inventory turnover ratio

The inventory turnover ratio measures how often an inventory is sold and replaced at a given period of time which is usually annually. It shows us how fast the products move out of the warehouse or the retail store. Higher inventory turnover indicates that less cash is tied up in products that are slow moving and may never be sold. It also shows how efficiently products move through the retail company, from warehouse to customer (Jin Kyung Kwak, 2019).

Inventory turnover is a generally acceptable indication of operational efficiency. However, (Gaur et al., 2005) suggested the use of a new empirical method which adjusted inventory turnover for performance comparison across years, by controlling some parameters affecting inventory turnover ratios of companies. They observed inventory turnover ratio was influenced by gross margin, capital intensity, and sales surprise in the retail industry. It was found that sales growth rate also affected inventory turnover ratio in retail companies (Gaur and Kesavan, 2015).

The inventory turnover ratio formula is the following

$$\text{Inventory Turnover Ratio} = \text{Average Inventory} / \text{Cost of Goods Sold (COGS)}$$

c) Days sales of inventory

The days sales of inventory (DSI) is a financial indicators that shows the average time in days a retailer needs in order to turn inventory into sales.

$$\text{DSI} = (\text{Average inventory} / \text{COGS}) \times 365 \text{ days}$$

$$\text{DSI} = \text{days sales of inventory} \quad \text{COGS} = \text{cost of goods sold}$$

DSI indicates the time duration that a company's cash is tied up in its inventory. A small value of DSI is preferred since it indicates that the retailer is selling the inventory at a rapid pace. That high turnover leads to potentially higher profits for the company since the sales have increased. However, a large DSI value indicates that the retailer struggles with obsolete, high-volume inventory that may never be sold, and it was a bad investment. It is also a sign that the company is retaining a high inventory level in anticipation of a sharp increase in demand that usually happens at a seasonal period of the year, such as Christmas.

DSI is a measure of the effectiveness of inventory management by a company. Managers need to calculate how many days inventory will be available before it is sold. That is why inventory is cash tied up and the faster it is acquired the more efficiently the company operates.

d) Order cycle time

Order cycle time is the average time period that is required to send an order from the time it was placed. In supermarket chains, this is the time that it is required to send products based on the stores' orders from the main warehouse. It is one of the most important KPI's because it depicts the order fulfillment process and the efficiency of the operations.

Order cycle time is affected by many factors such order quantity, warehouse capabilities, the availability of products and demand forecasting. Order quantity affects cycle time because the larger the order, the more time is required to be prepared and sent to the stores. It must also be taken into account, that the fleet number of the retailers is a finite number and if order quantities

are large in many stores, then it will take more time to deliver all the orders on time. This usually happens in high demand periods like Christmas and other holidays. Retailers often outsource certain products in cooperation with other companies, in order to reduce the quantity of products that have to be transferred from the main warehouse.

The warehouse capabilities include the number of staff that work in the preparation of the store orders, the size of the truck fleet available for transportation and the efficiency of the organization to manage and send orders. It is not uncommon for the warehouse to lack efficient staff that have experience in processing orders and the use of technological tools. The main operations of a warehouse include receiving products, assigning storage location to products, picking, sorting, shipping and delivering orders (R. de Koster et al., 2007). Effective management of those everyday activities can have a significant impact in the order cycle time.

Demand forecasting also plays a major role in order cycle time. In supermarket stores, especially in Greece, product orders are placed by the store staff. Although there is the availability of scanners that give real time data about the sales rate of each product, it remains a personal choice of the user about what quantity the store needs. Especially in periods when there is demand fluctuations, the final decisions are often taken from the store managers that order based on their experience. This often leads to the bullwhip effect among the supply chains that are involved in the retail industry. As it has been stated, the bullwhip effect is the phenomenon that demand is amplified from customers all the way up to suppliers. A small change in retail sales can cause great variations at suppliers (Forrester, J. W., 1958).

5.2.5 Reduction of waste KPI's

Waste in the retail industry refers to the dead stock and items such as food products that were not sold and have expired. It is a major loss of revenue in supermarket chains and must be addressed with utmost care.

a) Excess inventory

Excess inventory are items that a retail store has in such quantities that exceed the immediate needs. It can be due to excessive ordering, overstocking or due to the inability to sell them at the required time. Excess products are costly for the companies because they tie up cash, occupy

valuable warehouse space and increase carrying and labor cost. When it comes to food products that are easily expired the waste increases not only against the company but also against the environment because resources were used to produce food that was never consumed.

Excess inventory can limit a company's cash flow because it ties up capital that could be used elsewhere. This capital could be invested in other activities such as new products or marketing strategies or buying new equipment. For small businesses, overstocking can often prove fatal for their viability because they cannot afford the losses on sales. For larger retailers it can simply mean a serious reduction in their revenue. If the warehouse is filled with unnecessary items, the amount of stock that can be kept at hand is significantly reduced and the company loses its ability to react faster to customer demands. Also, introducing new products in the stores can be tricky if there is not enough space on the warehouse. Excess inventory can be managed in various ways. Discounts and special promotions are one way. Through discounts, a retailer cannot only achieve a reduction in dead stock but also the customers' satisfaction due to the lower prices.

b) Waste percentage

As waste percentage is described the number of products that never reach the consumers in relation to the total inventory of the company. The reasons for this can be wrong demand expectations, overstocking, defects, pest infestations, demand variations. It is estimated that about 10% of the food that is sold by supermarket chains never reaches the consumers. This is a high percentage that has a huge impact on a retailer's profitability and the environment. Since the Covid-19 pandemic, online retailing has seen a sharp increase (Dannenberg P et al, 2020). Especially in supermarkets, online retailing now comprises a serious amount of their sales. Online consumers usually prefer to buy food that will be consumed during the whole week. That is why online retailers discard food items earlier than they expire. Waste percentage should be the goal of inventory managers to be reduced in order to improve the whole operational efficiency.

c) Stock Aging report

Inventory aging report is a tool used by inventory managers that provides an insight of the age distribution of products in stock. Essentially it categorizes inventory depending on the time that have remained in inventory. It is usually done in brackets such as 0–30 days, 31–60 days, and 61–

90 days. Having a clear picture of how long items have been in inventory enables companies to recognize slow moving items, excessive inventory and obsolete inventory.

d) Inventory shrinkage

Inventory shrinkage is the phenomenon when the actual number of products in inventory are quite smaller than what is recorded in the inventory management system. The factors contributing to that phenomenon can be a combination of administrative errors, damage, spoilage, theft or suppliers' fraud.

e) Cycle count

Cycle count is an efficient way to detect inefficiencies and estimate the accuracy of inventory records. This is achieved by counting the physical inventory in batches and not all at once. Counting inventory is very important because it helps managers have a clearer view of the actual inventory and correct discrepancies because greater issues are caused. Cycle count is efficient because it does not require to disrupt operations and can involve less of the staff. It can be organized daily, weekly or monthly. Cycle count can save time, minimize the work effort and offer a reliable way to improve inventory accuracy.

6. Case studies

6.1 Walmart's Vendor managed inventory model

Walmart's inventory management is one of the most successful ones worldwide and the company is the technological leader in the particular field. The company's size is huge and effective and efficient inventory management is the only way in order to function properly. Its strategies and methods are ahead of any other supermarket chain in the world. Walmart's innovation and implementation of advanced technology can be an example for every retailer. Advanced inventory management is the core of Walmart's organizational capabilities and has made the company the leader, like other companies in the retail world such as Amazon.

One of the reasons that Walmart has such successful inventory management is the effective implementation of the Vendor managed inventory model. In this model, suppliers are directed connected to the company's information system. This enables them to see live the sales of their products and decide immediately in which store there is a need for a refill. Walmart monitors and controls this procedure and has full control over the transit of goods from warehouses to the stores. Through this strategy, the company does not need to stock items in their warehouse for transportation to the stores thus saving valuable space. Moreover, suppliers can regulate the transit and inventory levels accordingly for their own products. As a result, mistakes that can lead to

overstocking or lack of products are easily avoided. Finally, Walmart does need less personnel in their warehouses to manage each supplier's goods because the responsibility is shifted to the suppliers. VMI gives the company the opportunity to significantly reduce the cost of inventory management, while having the stores covered at all times (Ruonan Lin,2019).

6.2 Walmart's Just-in-Time in Inventory Management

Another method that Walmart implements in managing inventory is Just in time method. In the company this method is applied in the form of cross-docking. The idea behind it is that the supplier's trucks meet with the company's truck at the warehouse or distributions center. The products are transferred immediately to Walmart's trucks which then transport them to the stores. Through cross docking there is no need for goods to be stored at the warehouse, thus freeing up space and reducing holding costs. Another advantage of this method is that the fastest delivery of products to the stores and Walmart can respond faster to demand fluctuations and other related changes. Cross docking improves the operational efficiency and resilience of the company.

6.3 Tesla's inc. inventory management

Tesla Inc. is the largest manufacturer of electric cars in the world and was the first company that started to mass produce EVs. The company was established by Martin Eberhard and Marc Tarpenning who were inspired by the promise of electric power. Elon Musk, a passionate individual about sustainable technology, invested in the company and became chairman in 2004. Tesla's inventory management revolves around the seven Gigafactories in three different countries. The majority of the components needed to assemble their vehicles are outsourced. The assembling is taking place in the Gigafactories. Tesla only manufactures cars on demand, which enables the company to only store car components that will be used thus saving important capital and resources. Also, Tesla has simplified the production line and employs fewer temporary staff in order to improve efficiency and speed of production.

Tesla also gives significant importance in developing a sustainable and healthy model regarding its supply chain strategy. In order to achieve this, has implemented a comprehensive Environmental, Social and Governance (ESG) program. Through this program, Tesla aims to achieve responsible sourcing, waste reduction and the promotion of renewable energy sources.

6.4 ALDI's lean thinking on inventory management

Aldi is a large supermarket chain that originated in Germany. It has about 12000 stores in 18 different countries and is one the largest chains in the world. Aldi is a discount supermarket chain. Through efficient operation and inventory management, the company managed to offer products significantly cheaper than its competitors. Saving time, space and energy is the key in order to minimize costs. This is achieved by incorporating the principles of lean thinking into daily operations.

Lean production is often associated with manufacturing, however, its principles can equally be incorporated to service operations, as Aldi has managed. One example of lean thinking is that the company sources its groceries such as fruit and vegetables from local farmers thus significantly reducing long and costly delivery journeys. This constitutes the time-based management approach that Aldi has adopted in all its operations. The time-based principles are also applied to staff training. The company trains its staff to do a variety of tasks inside the stores and gain knowledge of the function of the whole business. That way less staff is required for its daily operations thus reducing costs.

Aldi has also reduced its range of products by selling fewer variations of each category. This gives the company the opportunity to buy larger quantities of each item. Selling fewer varieties is one way to take advantage of economies of scale and source cost effectively the items. The company achieves that way much less space for its inventory both in the warehouse and in the stores.

7. Conclusion

Modern companies in today's world are a vast complex of supply chains that are often stretched across various countries and even different continents. Supply chain management is crucial for most companies as disruptions can have a devastating impact on their function. Supply chains affect the most, the inventory of the companies, which is the most crucial part in their function. Especially for the retail industry, inventory and its effective management are often the key to their success. For supermarket chains, inventory ensures the flow of products along their organization. This is the most important aspect because it ensures that their customers are always satisfied that they will find what they need, which is the most important feature in the retail world.

Inventory management has been studied thoroughly even from the early decades of the previous century as its importance was quickly realized by both manufacturing and retail companies. Throughout the decades managers have tried to improve their inventory as they realized that it is an asset that affects the company's function all the way and is one of the most important steps to improve profitability. Inventory management in retail companies have two main reasons that must be effectively managed. One reason is that it ensures the flow of products across the organization and the other is that it can seriously reduce costs by eliminating dead inventory that is a serious problem for most retailers.

Throughout the decades, managers from different companies worldwide have developed methods and techniques that they best saw fit, in order to manage their inventory. Through experience various techniques and methods have been developed. There is various academic literature from

various fields that contribute to the difficult task of managing inventory and highlight its importance not only for companies but also for the population and the environment. Gone are the times, we thought we could produce anything we want, whenever we want without consequences.

Managers have nowadays many tools at their disposal in order to efficiently manage inventory and can set goals for them and their personnel in order to cooperate towards this common goal. However, even further research is needed as technological advances and the ways it can effectively implement in the retail industry are needed. There are several challenges that still remain such as sustainability, food waste reduction and efficient staff training in new techniques in order to achieve optimal inventory management.

Inventory management has been studied a lot in the decades since the previous century. There are many methods and techniques being developed and implemented by various companies in the retail sector. However, not all methods can be applied in the same way in every company. It is still the responsibility of the managers to choose not only the most effective ways to implement in their inventories, but also how they will apply and where they will focus the most. Inventory management is, and remains to a certain degree, an empirical procedure.

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Υπεύθυνη Δήλωση Συγγραφέα:

Δηλώνω ρητά ότι, σύμφωνα με το άρθρο 8 του Ν.1599/1986, η παρούσα εργασία αποτελεί αποκλειστικά προϊόν προσωπικής μου εργασίας, δεν προσβάλλει κάθε μορφής δικαιώματα διανοητικής ιδιοκτησίας, προσωπικότητας και προσωπικών δεδομένων τρίτων, δεν περιέχει έργα/εισφορές τρίτων για τα οποία απαιτείται άδεια των δημιουργών/δικαιούχων και δεν είναι προϊόν μερικής ή ολικής αντιγραφής, οι πηγές δε που χρησιμοποιήθηκαν περιορίζονται στις βιβλιογραφικές αναφορές και μόνον και πληρούν τους κανόνες της επιστημονικής παράθεσης.