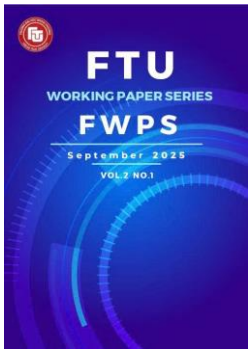

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QUẢN LÝ HÀNG TỒN KHO THÚC ĐẨY THÀNH CÔNG THỊ TRƯỜNG: BÀI HỌC TỪ APPLE

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Tóm tắt

Quản lý hàng tồn kho đóng vai trò quan trọng trong việc tối ưu hóa chuỗi cung ứng và hiệu quả kinh doanh. Nghiên cứu phân tích chiến lược quản lý hàng tồn kho của Apple, đánh giá hiệu quả của và rút ra bài học để áp dụng rộng rãi hơn. Trước tiên, nghiên cứu xây dựng nền tảng lý thuyết về hàng tồn kho và quản lý hàng tồn kho. Sau đó, nghiên cứu phân tích hệ thống quản lý hàng tồn kho của Apple, gồm mô hình chuỗi cung ứng, nguyên tắc và chiến lược trong các giai đoạn sản xuất, như dự báo nhu cầu, sản xuất đúng lúc, tối ưu kho bãi. Hiệu suất của chiến lược được đánh giá qua các chỉ số như tỷ lệ luân chuyển hàng tồn kho, số ngày lưu kho cho thấy chiến lược của Apple nâng cao hiệu suất vận hành, giảm chi phí và tăng khả năng đáp ứng thị trường. Tuy nhiên, nghiên cứu cũng chỉ ra những thách thức như sự dễ bị tổn thương của chuỗi cung ứng và phụ thuộc vào các nhà cung cấp chính. Cuối cùng, nghiên cứu đưa ra khuyến nghị nhằm tối ưu hóa quản lý hàng tồn kho từ những thành công và hạn chế của Apple, cung cấp gợi ý cho doanh nghiệp muốn cải thiện chuỗi cung ứng.

Từ khóa: Quản lý hàng tồn kho, công nghệ, chuỗi cung ứng, Apple

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INVENTORY MANAGEMENT DRIVES MARKET SUCCESS: LESSONS FROM APPLE

Abstract

Effective inventory management plays a crucial role in optimizing supply chains and ensuring business success. This research aims to analyze Apple's inventory management strategies, evaluating their effectiveness and extracting valuable lessons for broader application. The study first establishes a theoretical foundation of inventory and inventory management. It then provides an in-depth examination of Apple's inventory management system, covering its supply chain model, management principles, and strategic approaches at different production stages, including demand forecasting, Just-in-Time (JIT) practices, and warehouse optimization, etc. Apple's performance in inventory management is assessed using key metrics such as inventory turnover ratio and days in inventory, which reveals that Apple's strategic inventory management significantly enhances operational efficiency, reduces costs, and improves responsiveness to market demand. However, challenges such as supply chain vulnerabilities and high dependency on key suppliers are also identified. The study concludes with recommendations for optimizing inventory management based on Apple's successes and limitations, offering insights applicable to other businesses seeking to refine their supply chain processes.

Keywords: Inventory management, technology, supply chain, Apple

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1. Introduction

In today's global marketplace, effective inventory management is crucial for business success. Koumanakos (2008) found that firms with high inventory levels, rather than lean operations, tend to experience lower returns on investment. As consumer preferences shift and competition rises, efficient inventory management is essential for sustaining market share and profitability. It involves overseeing stock levels, optimizing supply chains, and ensuring product availability to meet demand (Toomey, 2000), ultimately balancing supply and demand, reducing costs, and enhancing customer satisfaction.

Apple Inc. exemplifies effective inventory management, complementing its innovation with a lean inventory strategy. Instead of maintaining large stockpiles, Apple minimizes excess inventory while ensuring product availability, reducing storage costs, improving cash flow, and swiftly adapting to demand. A key element is its Just-in-Time (JIT) system, which minimizes surplus by producing and stocking products as needed. Apple's robust supplier network and long-term contracts secure priority access to raw materials, enabling cost savings, higher quality, and production flexibility.

This study examines Apple's inventory management strategies, tools, and technologies to highlight how effective practices foster competitive advantage. The findings emphasize the role of data-driven decision-making and innovation in improving responsiveness, reducing costs, and achieving market success.

2. Theoretical basis

2.1. Inventory

2.1.1. Defiition

In today's global marketplace, effective inventory management is crucial for business success. Koumanakos (2008) found that firms with high inventory levels, rather than lean operations, tend to experience lower returns on investment. As consumer preferences shift and competition rises, efficient inventory management is essential for sustaining market share and profitability. It involves overseeing stock levels, optimizing supply chains, and ensuring product availability to meet demand (Toomey, 2000), ultimately balancing supply and demand, reducing costs, and enhancing customer satisfaction.

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2.1.2. Theories about tax effect on economic growth

Inventory can be categorized in several ways. This section analyzes different types of inventories based on their stage in the production process. Basically, inventory falls into three categories: raw materials, work-in-process, and finished goods.

The first categories - raw material inventory - comprises components and parts used in the manufacturing process to produce finished or semi-finished goods. These raw materials, often transformed significantly during manufacturing, become unrecognizable in the final product. For instance, the oils used in shampoo production bear little resemblance to their original state. However, it is important to acknowledge the varying shelf lives of raw materials. Perishable ingredients, for example, necessitate careful inventory management to mitigate the risks of spoilage, obsolescence, and associated losses.

Finished goods inventory comprises products that are ready for immediate sale to customers. This inventory serves as a buffer against both predictable and unpredictable market demand fluctuations. For example, manufacturers may build up finished goods inventory during periods of low demand to meet anticipated surges in sales, such as the holiday season. Consequently, effective management of finished goods is crucial for satisfying customer demand, minimizing stockouts, and preventing revenue losses.

Work-in-process comprises semi-completed goods within the manufacturing process, characterized by a short production cycle. For example, a women's clothing designer's work-in-

progress inventory can include cut fabric, destined for dresses, that has not yet undergone sewing. Work-in-process inventory occurs from such things as work delays, long movement times between operations, and queuing bottlenecks; therefore, should be kept to a minimum level.

Other categories of inventory should be considered from a functional standpoint:

Maintenance, Repair, Operations (MRO) inventory consists of the materials, equipment, and supplies needed to sustain a business's ongoing operations. This category spans a broad range of items, ranging from critical spare parts to fix a machine to standard office supplies. While essential for maintaining operational functionality, MRO inventory management presents a significant challenge due to the vast number and diverse sourcing of items involved.

Movement or transit inventories refers to goods being transported between various stages of the supply chain, including manufacturers, warehouses, and distribution centers. This category underscores the importance of tracking both the physical movement of inventory and the accurate and timely recording of these movements within business records.

2.2. Inventory management

Purchasing goods and the management of such inventory is a critical concern for firms striving to stay competitive in the market. Prior reports found that an average focal firm allocates 56% of its revenue to manage the direct costs of purchased goods (Monczka et al., 2002; Handfield, 2002). A significant aspect of this issue is that inventory management entails indirect costs ranging from 30-35% of the purchased goods' value (Wallin et al., 2006). Effective inventory management can help firms to stabilize supply-demand relationships while enhancing profitability by optimizing both direct investments in purchased goods inventory and the indirect costs of its management.

2.2.1. Definition of Inventory Management

Inventory Management is defined as the process of monitoring and controlling the ordering, storage, and use of materials or products in a business to ensure that inventory levels are maintained at desired targets (Heizer & Render, 1988). According to Greeff & Ghoshal (2004), this process can be managed using a **demand-driven pull system**, a **forecast-driven push system**, or a hybrid approach that combines both with its primary aim to ensure the right amount, at the right time to meet customer demand while avoiding issues of overstocking or understocking.

This is rather important for **technology firms**, where rapid product innovation and short life cycles require highly responsive and strategic inventory management. Wallin et al. (2006) highlight **Dell**'s build-to-order model, a pull-based system where purchase orders for components are placed only after confirmed customer demand, minimizing excess stock and obsolescence risk. In contrast, Wanke and Zinn (2004) describe **HP**'s push-based approach, which relies on sales forecasts to produce inventory in advance, ensuring the availability of goods.

2.2.2. Process of Inventory Management

Effective inventory management is a complex system which can be generally divided into **05 phases**: Inventory Planning and Forecasting, Procurement, Inventory Storage and Control, Order Fulfilment, Review and Improvement.

Firstly, the **Inventory Planning and Forecasting phase** involves ***Demand Forecasting***, where businesses analyze historical sales data, market trends, and seasonal variations to predict future product demand. Accurate forecasting enables companies to plan their inventory needs proactively, reducing the risk of stockouts or overstock situations.

Secondly, the **Procurement phase** includes ***Purchasing and Ordering***, based on the insights gained from demand forecasting. In this stage, businesses procure the necessary raw materials or products to meet anticipated demand. Following procurement, the ***Receiving and Inspection*** component ensures that upon delivery, the received goods are inspected to confirm they meet quality standards and match the purchase orders.

Thirdly, the **Storage and Inventory Control** encompasses ***Storage and Organization*** which involve systematically storing the inspected inventory within the warehouse to facilitate efficient access and space utilization. ***Inventory Tracking*** utilizes management technologies, such as barcode scanning, RFID technology, etc. to monitor stock levels in real-time, ensuring accurate records and timely updates. Based on this real-time data, ***Stock Replenishment*** is conducted to reorder products and maintain optimal stock levels, preventing both shortages and excesses. Common replenishment techniques are Just-In-Time (JIT), Economic Order Quantity (EOQ), and reorder point formulas to determine when and how much stock to order.

Fourthly, the **Order Fulfillment phase** is activated when customer orders are received. In this stage, businesses promptly pick, pack, and ship the products to customers, ensuring timely delivery and maintaining customer satisfaction.

Lastly, the **Review and Improvement** phase focuses on maintaining the integrity of the inventory system. ***Inventory Auditing*** involves conducting regular audits to reconcile physical stock with recorded data, identifying discrepancies, and ensuring accuracy. Additionally, ***Returns Management*** establishes a clear Reverse Logistics process, including inspection, restocking, or disposal as necessary, to minimize losses and inform future inventory decisions.

However, the inventory management process can **vary significantly across industries**, tailored to the specific demands and characteristics of each sector, underscoring the necessity for industry-specific inventory management processes. In the electronics industry, companies often deal with high-value items and rapid technological advancements, necessitating precise demand forecasting and agile procurement strategies to prevent obsolescence and overstocking.

2.2.3. Important Key Performance Indicators of Inventory Management

To assess the effectiveness of inventory management, various KPIs are available. Among these, several key indicators directly reflect how well a business meets the three objectives of inventory management, as outlined below:

First, the Inventory Turnover Rate measures how frequently inventory is sold, used and replaced over a specific period, indicating the efficiency of inventory management. A high turnover rate suggests that a company is selling its inventory quickly, which is generally

favorable. In contrast, a low turnover rate may indicate overstocking, slow sales, or inventory management issues, potentially leading to increased holding costs.

Second, the Days In Inventory measures the average number of days that inventory remains in stock before it is sold, reflecting how efficiently inventory is managed. A lower value indicates that inventory is being sold quickly, while a higher value suggests slower sales or excess stock.

Third, Cash Conversion Cycle measures the time it takes for a company to convert its investments in inventory into cash flows from sales. It reflects the efficiency of a firm's inventory turnover, accounts receivable collection, and accounts payable management.

3. Analysis of Apple's Inventory Management

3.1. Introduction to Apple

3.1.1. Overview of Apple

Founded in 1976, Apple has become a global technology leader, known for its innovative consumer electronics, software, and digital services. The company's integrated hardware and software ecosystem drives strong customer loyalty, with the iPhone's retention rate reaching 90% in 2023. Its diverse product lineup—including iPhones, iPads, Macs, Apple Watches, and AirPods—along with a growing services division, fuels its market dominance. In 2024, Apple's revenue exceeded $395 billion, reinforcing its position as one of the world's most valuable brands.

Apple's success is driven by an efficient global supply chain, a transformation led by CEO Tim Cook. Unlike competitors, Apple does not manufacture its products but relies on outsourcing partners, primarily in Asia. To reduce risks and optimize operations, Cook streamlined supplier networks from over 100 to just 24, halved warehouse numbers, and implemented a just-in-time (JIT) inventory system, turning over stock every five days. With a supply chain spanning 50+ countries and millions of workers, Apple ensures precise product launches and distribution, maintaining its industry leadership.

3.1.2. Apple's Supply Chain Model

Apple's supply chain is global, complex, and highly optimized, structured into four key operational cycles (Budiono & Ellitan, 2024):

Procurement Cycle: Apple sources components worldwide, leveraging its buying power to secure high-quality materials at competitive prices. Suppliers must register through Apple's Prospective Supplier Portal to meet strict quality and ethical standards. The company operates in 31 countries, with 349 suppliers based in China, and its top 200 suppliers account for 97% of the supply chain. Apple mitigates risks by using multiple suppliers for key components, ensuring stability and securing favorable pricing through long-term contracts and prepayments.

Manufacturing Cycle: Apple outsources production to partners like Foxconn and Pegatron in China, strategically locating assembly near component suppliers to reduce costs and lead times. Using lean manufacturing and JIT inventory management, Apple replenishes inventory

every five days—faster than Dell (10 days) and Samsung (21 days). Additionally, Apple invests in customized manufacturing equipment and automated assembly technologies to maintain product consistency and high production standards.

Replenishment Cycle: Finished products are transported from factories to distribution centers and eventually to customers. Apple strategically utilizes a mix of air, sea, and ground transportation to optimize delivery speed and cost. While air freight is costly, Apple relies on it, particularly through partnerships with airlines like Cathay Pacific, to ensure rapid product availability and reduce inventory holding costs. The ability to move products swiftly is crucial in the tech industry, where demand fluctuations and short product life cycles require responsive logistics. To further enhance efficiency, Apple collaborates with third-party logistics (3PL) providers to manage transportation and warehousing, ensuring timely global distribution.

Customer Order Cycle: Apple's products are sold through various channels, including Apple Stores, online platforms, and authorized resellers. By stocking limited standardized products in high volumes, Apple optimizes inventory levels and sales per store. Advanced AI-driven demand forecasting further refines inventory management, ensuring products are available where and when customers need them. Feedback from sales channels also helps Apple adjust production and enhance efficiency, reinforcing its highly responsive supply chain.

3.2. Overview of Apple's Inventory Management

3.2.1. Types of Inventories

First of all, ***the Raw Materials Inventory*** comprises all the unprocessed inputs that the company sources from suppliers with the goal of turning them into finished goods. These are the foundational components Apple sources from suppliers globally to build its devices such as the silicon chips, screens, and metal casings that come together to form an iPhone or a Mac.

Another type of inventory that Apple manages is ***Work-in-Progress (WIP) Inventory,*** which are partially processed materials not yet ready for sales. For instance, an iPhone in the WIP stage might have its internal components assembled but not yet have its final casing or screen installed.

Thirdly, ***the Finished Goods Inventory*** are the completed products, like iPhones, iPads, and Macs, which are ready to be sold to customers. Apple manages this inventory in close collaboration with its suppliers and retail partners at a global level, ensuring products are available where and when customers demand them. Once the products have been manufactured, the company can track sales progress by using a vendor-managed inventory (VMI), an inventory management strategy in which suppliers manage inventory on behalf of the manufacturer. The suppliers will keep in touch with the manufacturer to replenish immediately whenever there is a shortage.

While less publicized, Apple also manages ***MRO Inventory***, which are Maintenance, Repair, and Operations items. These are the supplies that keep Apple's offices, factories, and retail stores running smoothly. Examples consist of office supplies, cleaning products, repair tools, safety equipment, etc.

3.2.2. Inventory Management Principles

Tim Cook, Apple's current CEO, was personally invited by Steve Jobs from 1998 when he rejoined Apple. Apple's inventory management philosophy is encapsulated in the famous saying of him: “Inventory is evil”. This view stems from the belief that inventory, especially in the technology sector, depreciates very quickly. As Tim Cook pointed out, the value of products such as phones, tablets like the one Apple is manufacturing, can decrease significantly by 1-2% per week in storage.

Moreover, he also compares Apple's inventory management to the business of dairy products: “If it gets past its freshness date, you have a problem”. Therefore, the longer technology goods remain in stock, the more they lose value due to the emergence of new technologies, changing market demand and the risk of damage and obsolescence.

In summary, Apple's inventory management principle is believed to be ***“to minimize inventory levels”*** or ***“the less the better”***, in order to maximize product value, maintain a competitive advantage and quickly adapt to changes in the technology market.

3.3. Apple’s Strategies on Inventory Management

3.3.1. Pre-production

Apple has been implementing numerous strategies during the pre-production phase, ranging from standardized supplier selections, partner relationship management to its customers’ demand forecasting. This section will focus on analyzing the **demand forecasting** strategy of Apple during the pre-production phase.

Regarding the **qualitative techniques**, Apple used judgemental approaches, which relies on gathering opinions and knowledge from people, rather than solely on statistical data (Petropoulos et al., 2022). This approach is based on the idea that people have insights into what products will be popular and how much of them will be needed in the future. In the application of this approach, Apple believes that customers recognize the quality of their products and its demand. This belief forms the foundation of their judgmental forecasting strategy, leading to an active seeking of input from people to understand demand.

In order to gather such input, Apple employed a ***consensus-based method or Delphi method***, where a small group of experts generates demand predictions (Linstone, 1975). For example, top managers may join a discussion or debate about market conditions, product potential, and competitive factors to arrive at a general demand forecasting. Apple also adopted a ***test-marketing method*** to estimate the potential demand rate of the products. Specifically, during early product development, Apple assembles small groups of customers to try out prototypes, providing feedback on potential market reception.

Besides the above approach, other qualitative methods such as sentimental analysis and market research are also used. For instance, positive consumer response on social media to larger-screen smartphones paved the way for the successful release of the iPhone 6 and 6 Plus, leading to record-breaking first-weekend sales exceeding 10 million units (Apple Inc., 2014).

It can be seen that Apple's approach to demand forecasting diverges from companies that prioritize direct customer surveys. Instead, Apple relies primarily on internal knowledge, analysis of historical trends, and targeted market trials, coupled with a policy of maintaining

secrecy around future product strategies. Apple's customer surveys normally happen in the after-sales phase, using Net Promoter Score (a metric based on single-question survey, rating the likelihood of customers to recommend a business from -100 to +100) and other techniques to investigate customers' satisfaction level and feedback for future product development.

Apple's demand forecasting incorporates a **data-driven quantitative** approach, primarily through time series and regression analyses. These allows for the identification of patterns, trends, and seasonality, facilitating demand prediction, as well as the relationship between demand and key influencing factors, enabling the company to assess demand sensitivity and refine its strategic decisions across pricing, promotion, distribution, and production

Other methods supported by artificial intelligence and machines are also adopted by this tech-giant. During the Covid-19 pandemic, Apple utilized machine learning to improve demand forecasting for the budget-friendly iPhone SE, enabling rapid adjustments to strategies, effectively addressing the unforeseen surge in demand during this pandemic.

3.3.2. In-production

Apple's success in inventory management can be partially attributed to the adoption of **Just-In-Time (JIT) principles** in the in-production phase, as promoted by Tim Cook. ***By principles***, the JIT emphasizes that materials should be delivered directly to the work-in-process area in the appropriate quantities, at the right location, at the right time. ***Regarding its objectives***, JIT aims to minimize costs of inventory inspection, handling, damage, and maintenance (Epps, 1995; Rosenberg and Campbell, 1985). The implementation of JIT has been observed across various manufacturers globally, including technologically-driven firms such as the Toyota Case (Monden, 1993), Samsung Electronics (Suh & Kim, 2009).

Before implementing JIT inventory management, Apple faced numerous challenges in inventory management, characterized by a cumbersome, complicated, and risk-laden process due to **03** reasons:

[1] Apple's vast network of over 100 warehouses and manufacturing facilities made it complex to manage production and inventory.

[2] Apple's substantial inventory of components such as screens, keyboards, processors, and other parts requires significant capital and storage space.

[3] Apple's large inventories created risks of devaluation due to obsolescence, expiration, and increased storage management costs. Technology products have a short lifespan, typically only one to two years, causing their values to depreciate by approximately 1-2% daily.

For all the mentioned reasons, according to CNN, before Steve Jobs and Tim Cook overtook Apple in 1997, the company's inventory management was considered a disaster, with over 400 million USD worth of inventory surplus, requiring the immediate implementation of Just-In-Time (JIT) model. Specifically, inventory surplus occurs when stock exceeds projected demand, leading to excess inventory with no immediate use (Dickersbach & Passon, 2015).

To further explain, by applying JIT, Apple keeps its inventory lean and does not stockpile excessive goods. Rather than accumulating stock, Apple orders components and materials as required for production, thereby minimizing costs and waste. ***On the one hand***, by minimizing

the amount of cash bound within its supply chain, this strategy frees up cash, allowing Apple to maximize its financial flexibility and overall profitability. ***On the other hand***, Apple's rapid product refresh cycle is supported by its low inventory strategy, allowing it to seamlessly transition to new models without carrying excessive stock of older versions, avoiding both discounting and obsolescence.

After applying JIT, Apple realized significant improvements in its supply chain operation. ***First***, JIT principles directly impacted key inventory metrics, notably reducing holding time and increasing inventory turnover, contributing to a leaner, more responsive supply chain. Tim Cook helped Apple to achieve an exceptionally better inventory turnover from 30 days to 05 days—far exceeding competitors such as Dell (10 days) and Samsung (21 days). ***Second***, this lean inventory model facilitates the seamless launch, manufacturing, and distribution, effectively eliminating inventory surpluses and minimizing the risk of obsolescence. Apple successful decreased its on-hand inventory from **$400 million** in December to **$78 million** by September 25.

3.3.3. Post-production

Apple is renowned for its innovative approach to inventory management, particularly in post-production. Its strategies optimize efficiency, reduce costs, and ensure product availability.

In 1998, under Tim Cook's leadership, Apple implemented a ***stringent inventory*** management strategy, reducing suppliers from over 100 to 24 and halving the number of warehouses. This streamlined the supply chain and significantly improved inventory turnover, allowing Apple to rotate stock every five days—a remarkable feat in the technology sector. By minimizing excess inventory, the company reduced costs and mitigated the risk of obsolescence. Additionally, Apple established rigorous supplier evaluations and cost-benefit analyses to maximize efficiency.

A key component of Apple's approach is the integration of ***Radio Frequency Identification (RFID)***. According to Zhu et al. (2012), RFID technology, consisting of tags and readers connected to a computer system, enables ***real-time inventory tracking***. By reducing human error and automating stock management, RFID enhances supply chain efficiency. A study by Northern Apex Corporation demonstrated that RFID reduced inventory processing time from 37.9 seconds to just over one second, significantly improving logistical operations.

Beyond RFID, Apple employs ***GPS tracking*** to monitor product movement within the distribution network, ensuring accurate delivery estimates and optimized routing. This system enhances inventory accuracy, minimizes delays, and strengthens security through ***real-time alerts*** in case of route deviations. By integrating GPS with RFID, Apple develops a ***smart inventory management system*** that leverages predictive analytics to reduce inefficiencies and optimize stock levels.

Apple's Lean Retail strategy further enhances inventory management by maintaining ***minimal in-store stock*** and relying on ***online fulfillment***. Rooted in Just-in-Time (JIT) principles, this approach lowers storage costs, prevents overstocking, and ensures product availability. Real-time tracking enables dynamic stock adjustments, facilitating efficient store-to-store and warehouse-to-store transfers. Additionally, Apple's Lean Retail model improves

customer experience by prioritizing interactive displays and personalized services while offering online orders and in-store pickups to extend product accessibility beyond physical store limitations.

3.3.4. Throughout the supply chain

Apple employs **Vertical Integration** throughout the supply chain to control production, distribution, and inventory flow, while implementing **FIFO** (First In, First Out) to streamline raw material usage and finished goods handling.

Vertical integration is a strategy where a company gains greater control over its supply chain by managing key processes internally rather than relying on external suppliers. Apple strategically implements vertical integration in three key areas: chip design, production, and distribution. *First*, Apple designs its own processors, including the M-series and A-series chips, optimizing performance and efficiency across its devices. While Apple does not manufacture these chips itself, it collaborates closely with TSMC to ensure seamless production. *Second*, Apple controls product development and software integration by designing its own hardware and software ecosystem, aligning macOS/iOS with its devices for a seamless user experience. However, Apple outsources manufacturing and assembly to partners like Foxconn and Pegatron, maintaining strict oversight to ensure quality and efficiency. *Third*, Apple manages its global distribution network, selling directly through Apple Stores, online platforms, and authorized resellers, all to retain pricing control and enhance customer experience. According to Bajarin (2011), Apple is "four companies in one," integrating hardware, software, services, and retail, a model that sets it apart from other competitors in the field. However, it is important to note that Apple primarily designs and integrates, but outsources manufacturing and assembly.

Apple's inventory management approach also incorporates the **First-In, First-Out (FIFO) method**, ensuring older stock is sold first. This system helps Apple maintain a steady flow of inventory across product lines, including iPhones, iPads, and wearables, while minimizing the risk of holding outdated models. Additionally, FIFO improves inventory valuation, ensuring that product costs reflect current market conditions and supporting better financial reporting.

Apple transitioned from the Last-In, First-Out (LIFO) method to FIFO in January 2021, marking a shift in its inventory strategy. However, the subsequent decline in inventory turnover ratio—dropping by approximately 12 percent to 31.84 as of December 2024—reflects broader supply chain adjustments rather than the direct impact of FIFO. Despite this trend, the method remains beneficial in protecting stock value and reducing depreciation risks, ensuring the profitability of Apple's products.

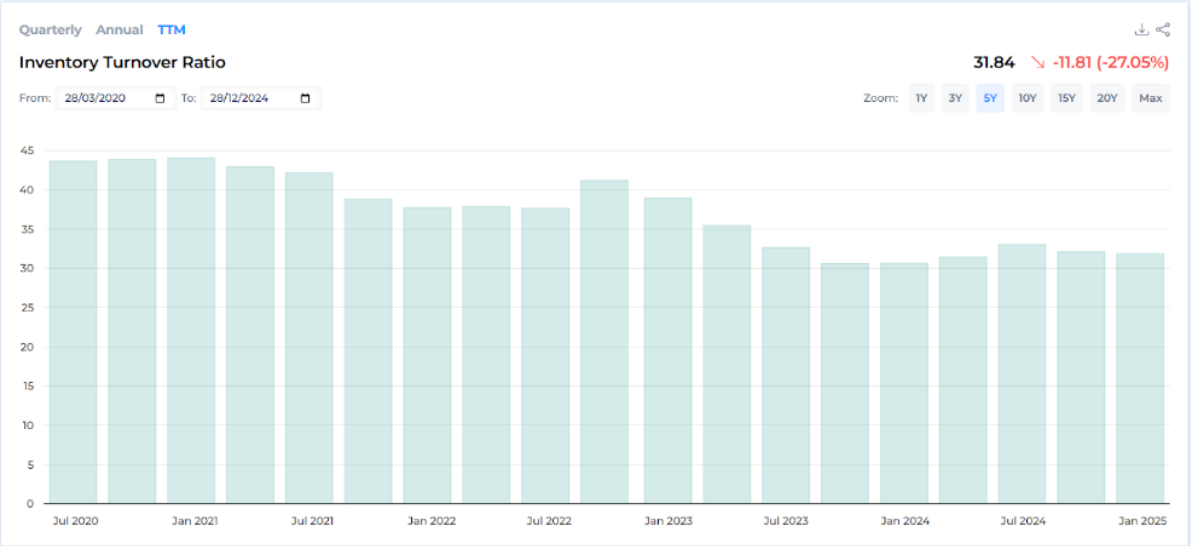

Figure 7: Apple's inventory turnover ratio from July 2020 to January 2025

Source: StockViz

Apple's vertical integration and FIFO strategy enhance supply chain efficiency, demand forecasting, and cost control. By overseeing chip design, production, and distribution, Apple reduces lead times and optimizes inventory flow. Implementing these strategies have help maintain stock value and adaptability in the competition.

3.4. Apple's Performance Results on Inventory Management

3.4.1. Inventory Turnover ratio and Days in Inventory

From the 2010s onward, Apple has gained success through the effective application of the aforementioned Inventory Management strategies and widened the gap with its competitors in the Technology sector, such as Dell or Motorola, regarding those two metrics. The following numbers highlight the company's outstanding Inventory Management as well as its products' popularity in the market. In other words, Apple is more capable to sell and replace its inventory for a given period of time compared to the majority of its competitors. (Vasilaki, M., & Tsakalidis Jr, G., 2019)

Table 1. Inventory turnover and days in inventory of Apple and its competitors in 2011

Company	Inventory Turnover (TTM)	Days of Inventory (TTM)
Apple	69.4	5.3
Dell	35.7	10.2
Hewlett-Packard	13.8	26.5
Research in Motion	15.7	23.2

Motorola Mobility	12.6	29

Source: Reuters (2011)

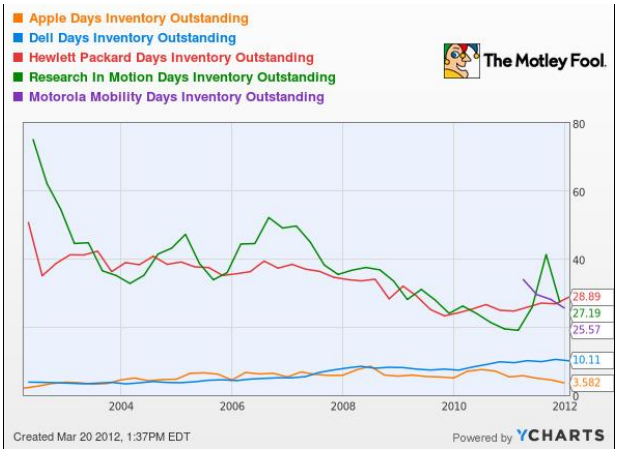

Figure 8. Days in inventory outstanding of Apple and its competitors from 2004 to 2012

Source: The Motley Fool

In fact, the research firm Gartner ranked Apple's inventory management as the best in the world from 2010 to 2013. Furthermore, in July 2011, Apple achieved a remarkable milestone by selling out all of its newly launched iPad 2s, which completely eliminated its storage costs.

Continuing into the 2020s, Apple has succeeded in maintaining its strong performance in Inventory Management, with the company significantly outperforming competitors in the same industry, such as Samsung, Dell, Xiaomi, etc. in terms of Days in Inventory, and achieving the lowest figure among all. This record-breaking inventory metric also represents a highly competitive advantage for Apple compared to other competitors in the technology market at that time.

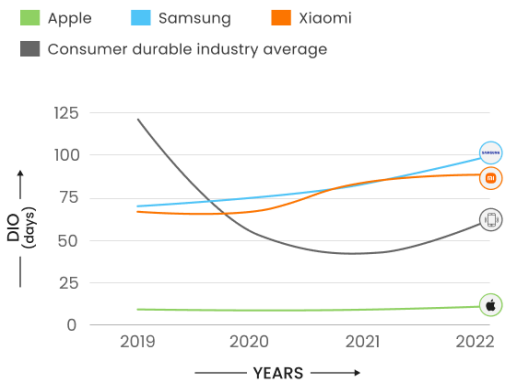

Figure 9. Days in inventory of Apple and its competitors from 2019 to 2022

Source: HighRadius

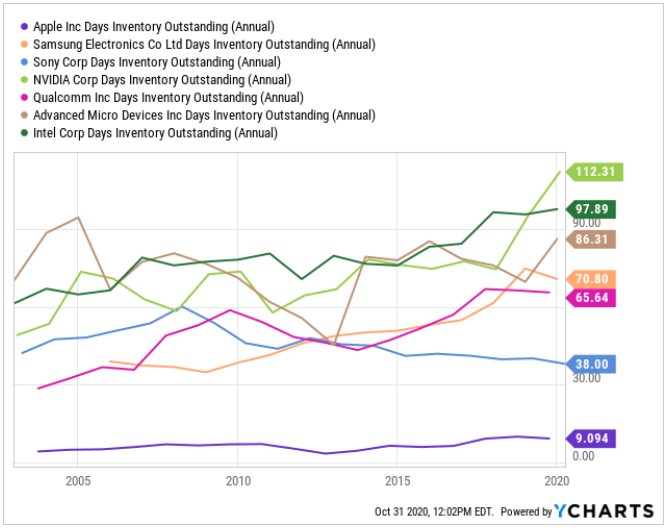

Figure 10. Days in inventory outstanding of Apple and its competitors from 2005 to 2020

Source: PhoneArena

Regarding the past two years, Apple's performance in Inventory Turnover has shown a slight downward trend compared to previous years. However, Apple is still far ahead of its competitors both within its sector and its industry.

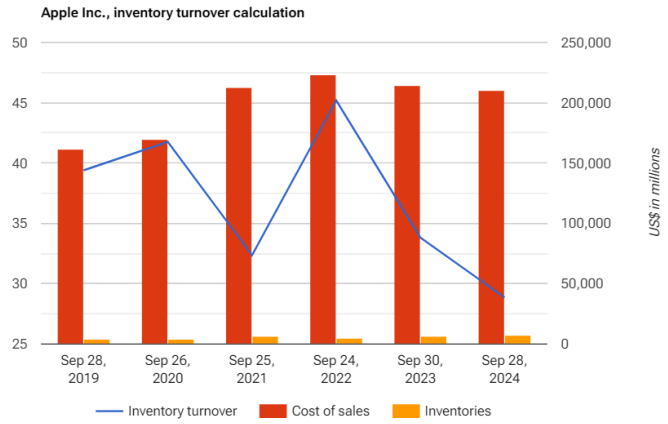

Figure 11. Apple inventory turnover calculation from Sep 2019 to Sep 2024

Source: Stock Analysis on Net

In summary, Apple's inventory management demonstrates relative stability and outstanding efficiency throughout the year, with a moderately consistent Inventory Turnover ratio and Days in Inventory. Although there are some slight fluctuations in these metrics, they likely reflect the seasonal demand, product launches, or supply chain adjustments within the company. Moreover, the higher Inventory Turnover and the lower Days in Inventory also reveal the shorter process from manufacturing to sales, and the greater number of profitable companies, which also explains the reasons for Apple's high profitability in years (Jing, J., 2018).

3.4.2. Cash Conversion Cycle

Another metric that further illustrates Apple's inventory management performance results is the Cash Conversion Cycle. According to Vasilaki, M., & Tsakalidis Jr, G. (2019), the cash

conversion cycle indicates the required time for a company to sell its inventory, collect its receivables and pay its short-term liabilities to the suppliers. Remarkably, Apple has had a negative cash conversion cycle over the past ten years. This means Apple has a low Days Inventory Outstanding (DIO) and could convert its investment in inventory into cash flows from sales at a very fast pace as well as manage its inventory successfully. Moreover, this figure also depicts that Apple did not have to pay its suppliers until after receiving cash from customers, indicating that Apple used its working capital efficiently.

Table 2. Apple's cash conversion cycles from 2013 to 2017

Efficiency ratios	2017	2016	2015	2014	2013
Cash conversion cycles (days)	-86	-71	-60	-56	-41

Source: Vasilaki, M., & Tsakalidis Jr, G. (2019)

4. Evaluation

4.1. Achievements

4.1.1. Apple Compared to Itself: Internal Improvements Over Time

First, Apple's streamlined supply chain has led to faster production cycles and lower costs. The adoption of JIT principles reduced its supplier base from over 100 to just 24 and cut warehouse storage, improving inventory turnover from 30 days to just 5 days (2012). By minimizing excess stock and depreciation risks, Apple ensured steady product availability. The 2011 iPad 2 launch exemplified this efficiency, with all units selling out immediately, eliminating storage costs.

Second, Apple's lean inventory system has also strengthened financial performance and cash flow. By maintaining a negative cash conversion cycle, Apple sells products before supplier payments are due, maximizing liquidity. In 1997, the company reduced its inventory surplus from $400 million to $78 million within a year, freeing up capital for reinvestment. The reduction in storage costs and supplier consolidation further improved profit margins, allowing Apple to allocate more resources toward research and development, marketing, and global expansion.

Third, technological advancements have further enhanced inventory accuracy and efficiency. RFID tracking and GPS logistics provide real-time stock visibility, reducing errors and improving order fulfillment. RFID automates inventory identification, making processing 37 times faster than barcode scanning, while GPS tracking minimizes delays. Additionally, Apple's Lean Retail strategy dynamically adjusts in-store inventory based on demand, reducing storage costs.

4.1.2. Apple Compared to Competitors: Industry Achievements

Firstly, Apple's faster inventory turnover gives it a clear advantage over competitors in ***reducing markdown risks and minimizing waste.*** In 2011, With Days in Inventory at just 5.3 days, Apple outperforms other industry peers like Dell (10.2 days) and Hewlett-Packard (26.5

days). Keeping inventory turnover low helps Apple ensure quicker stock movement and better adaptation to new product cycles.

Secondly, Apple's vertical integration strategy has further ***solidified its supply chain control.*** Unlike Google, which relies on Qualcomm for processors, Apple designs its own M-series chips and outsources production to TSMC, ensuring better performance optimization. This integration allows Apple to minimize reliance on third-party suppliers, reduce production delays, and adjust inventory levels more effectively compared to competitors with fragmented supply chains.

Thirdly, modern demand forecasting enables Apple to ***align production with actual consumer demand, preventing both overstocking and understocking***. By utilizing real-time sales data from its online and retail stores, Apple ensures efficient stock fulfillment. Samsung, by contrast, has faced excess inventory issues in its smartphone segment (2022), while Google's Pixel lineup suffered stock shortages due to inaccurate forecasting (2021). Apple's data-driven approach ensures precise inventory management, reinforcing its competitive edge in supply chain efficiency.

4.2. Pitfalls

4.2.1. Causes of the Inventory Management Failure

One of the primary reasons for Apple's inventory crisis was its over-reliance on a single manufacturing hub. The company depended heavily on Foxconn, its largest manufacturing partner, with a majority of high-end iPhones being assembled at a single Foxconn facility in Zhengzhou, China. In November 2022, this facility faced severe disruptions due to COVID-19 lockdowns and worker protests, causing significantly reduced capacity in iPhone 14 Pro production (The New York Times, 2022). Since Apple had centralized its manufacturing in one location, it lacked the flexibility to quickly shift production to alternative sites, leading to a significant bottleneck in its supply chain.

Another critical factor contributing to Apple's inventory failure was the miscalculation of consumer demand. Initially, Apple anticipated higher sales for the iPhone 14 and 14 Plus compared to the iPhone 14 Pro and Pro Max. Based on this projection, the company allocated fewer components for the Pro models. However, consumer demand shifted in favor of the Pro versions due to their superior camera technology and performance enhancements (Gordon Kelly, 2022). This forecasting error led to an oversupply of standard models while premium variants faced severe shortages, preventing Apple from adequately meeting customer demand.

In addition to forecasting errors, Apple's reliance on a JIT inventory strategy, aimed at optimizing stock levels and minimizing holding costs, became a major weakness when unexpected supply chain disruptions occurred. By operating with minimal buffer stock, Apple had no reserve inventory to compensate for production slowdowns. This lack of flexibility proved costly during the iPhone 14 Pro shortage, as the company was unable to quickly address the supply gap. As a result, customers faced extended wait times of four to six weeks, leading to missed sales opportunities, increased consumer frustration, and a negative impact on overall customer satisfaction.

4.2.2. Consequences of the Inventory Crisis

The late 2022 supply chain crisis had a profound financial impact on Apple, as the company struggled to meet consumer demand during the peak holiday shopping season. According to Carlos Cordon (2022), The iPhone supply constraints led to an estimated $1.5 billion loss in Black Friday sales, with one in three retail stores across the U.S. and Europe experiencing stock shortages for the iPhone 14 Pro. In China, sales declined by over 30% year-on-year, exacerbating the company's financial strain. According to CNBC, Apple's iPhone revenue reached $42.6 billion, falling short of market expectations of $43.2 billion.

Beyond financial losses, the inventory shortage also damaged Apple's brand reputation and customer loyalty. Many frustrated customers either switched to competing brands or postponed their purchases due to product unavailability. Furthermore, the scarcity of iPhone 14 Pro models fueled a secondary market where resellers exploited the situation by selling the devices at inflated prices. This further frustrated consumers and tarnished Apple's brand image (Reuters, 2022). Moreover, Apple may also face inventory write-downs if its products become obsolete or excessive or lose value relative to their cost. This could result in significant accounting charges, including impairments, markdowns, and other related expenses. The rapid and unpredictable pace of technological obsolescence poses a particular risk in the industry in which Apple operates. In the highly competitive tech sector, products can quickly lose relevance as newer, more advanced models enter the market, making inventory management even more challenging (Apple Form 10-K, 2024). If Apple fails to accurately anticipate market trends and consumer preferences, it risks accumulating unsold inventory that must be heavily discounted or written off, further impacting profitability.

4.3. Lesson learnt

Firstly, businesses can achieve long-term success by **continuously improving and adapting to market demands**, much like Apple has done. By streamlining supply chains and enhancing inventory turnover, companies can create more agile production cycles. Apple's use of AI-driven demand forecasting and RFID tracking demonstrates how technology can help technological firms respond swiftly to consumer trends, minimize excess stock, and sustain high inventory turnover rates.

Secondly, **strategic supplier consolidation and vertical integration**, as seen in Apple's approach, can significantly enhance supply chain efficiency. By reducing the supplier base and designing key components in-house, focal firms can cut storage costs and improve production control. Similar strategies will assist businesses safeguard their supply chains from disruptions and optimize inventory management, ensuring greater resilience and cost-effectiveness.

Thirdly, **aligning production with consumer demand** is critical for maintaining optimal inventory levels. Apple's use of real-time sales data from online and retail stores allowed it to prevent overstocking and understocking. Businesses should follow this model by investing in advanced predictive analytics and data integration systems. These tools enhance demand forecasting, optimize inventory replenishment, and reduce markdown risks, ultimately improving profitability.

Lastly, ***adopting a lean inventory strategy***, as demonstrated by Apple's shift from LIFO to FIFO, offers significant financial benefits. This transition helps to minimize depreciation

risks, improve inventory turnover, and maintain strong cash flow. Companies should continuously evaluate and adjust their inventory management policies to reduce holding costs and enhance liquidity, ensuring long-term financial stability. This is particularly crucial for firms operating in industries driven by ever-changing consumer preferences and high risks of obsolescence and depreciation, such as electronics and smartphones.

5. Recommendations

Ultimately, this research yielded valuable lessons regarding the implementation of inventory management strategies within a global context. Apple's approach, characterized by meticulous planning, technological integration, and strategic supplier relationships, provides a compelling case study for businesses seeking to optimize their inventory management. The insights gleaned from this analysis contributes to a deeper understanding of how robust inventory management can serve as a pivotal driver of competitive advantage in today's dynamic business environment.

However, the research is subject to certain limitations. Primarily, this research is limited by its reliance on public data, potentially affecting the accuracy of internal process representation. Access to proprietary data and internal operational details would have allowed for a more in-depth analysis. Furthermore, the research is inherently limited by the dynamic nature of the technology industry and supply chains. Some of Apple's strategies analyzed in this paper have been employed since the 1900s, which means that they are likely to evolve, requiring ongoing analysis to maintain relevance.

References

Alderei, F. S., Alneyadi, S. S., Alhassani, A. M., Alefari, W. S., Abdulrahman, A., & Khalifa, G. S. (2022). Operations Management Practices of Apple within UAE Market: An Exploratory Study. City University EJournal of Academic Research (CUeJAR), 4(2), 1-17.

Apple. (n.d.). Apple. https://www.apple.com/

Apple's iPhone Pro shipments may fall 20 mln units short of estimates—Analyst | Reuters. (n.d.). Retrieved March 1, 2025, from https://www.reuters.com/technology/apples-iphone-pro-shipments-may-fall-20-mln-units-short-estimates-analyst-2022-11-29/

Apple's supply chain transformation—IMD business school for management and leadership courses. (2025, February 7). https://www.imd.org/research-knowledge/operations/case-studies/apple-s-supply-chain-transformation/?form=MG0AV3

Ashcroft, S. (2022, February 4). Tim Cook: Supply chain guru behind Apple growth. https://supplychaindigital.com/technology/tim-cook-supply-chain-guru-behind-apple-growth

Australian Institute of Company Directors (AICD). (n.d.). A case study of Apple's supply chain. AICD. https://www.aicd.com.au/risk-management/framework/plan/a-case-study-of-apples-supply-chain.html

Bisht, S. (2021, December 10). Analyzing Tech giant Apple's supply chain planning. Medium. https://medium.com/@shefalibisht00/analyzing-tech-giant-apples-supply-chain-planning-a124ed4ad2ee

Budiono, K., & Ellitan, L. (2024). The efficiency and performance of Apple's supply chain management. ULIL ALBAB Jurnal Ilmiah Multidisiplin, 2, 46-67.

Cfa, E. N. (2017, April 7). Apple lesson of the day: Inventory is evil. The Motley Fool. https://www.fool.com/investing/general/2012/03/23/apple-lesson-of-the-day-inventory-is-evil.aspx

Chikonde, L. C. (2022) STUDY OF APPLICATION OF SYSTEMS AND OPERATIONS MANAGEMENT AT APPLE INC.

Daco L. (2024, October 19). Phân tích chiến lược quản lý hàng tồn kho của Apple. seeact.vn. https://seeact.vn/quan-ly-hang-ton-kho-cua-apple/

Dave, P., Balu, N., Dave, P., & Balu, N. (2022, April 29). Apple sees bigger supply problems after strong start to year. Reuters. https://www.reuters.com/technology/apple-beats-sales-estimates-with-big-bumps-iphones-services-2022-04-28/

Dealroom. (n.d.). What is vertical integration? Dealroom. https://dealroom.net/faq/vertical-integration

Dickersbach, J. T., Passon, M. F., Dickersbach, J. T., & Passon, M. F. (2015). Surplus and Obsolescence Planning. *Service Parts Planning with SAP SCM™: Processes, Structures, and Functions*, 155-169.

Disfold. (n.d.). Apple's supply chain explained. Disfold. https://blog.disfold.com/apple-supply-chain/

Dybek, M. (2024b, November 2). *Apple Inc. (NASDAQ:AAPL) | Analysis of Short-term (Operating) Activity Ratios*. Stock Analysis on Net. https://www.stock-analysis-on.net/NASDAQ/Company/Apple-Inc/Ratios/Short-term-Operating-Activity?srsltid=AfmBOoo78nskf9vV9x5KrI79ft31gL8Ks9Km5K1GITTG36fryQ4C1F1u

GenK. (2012, April 5). Quản lý kho hàng của Apple là tốt nhất thế giới. GenK. https://genk.vn/quan-ly-kho-hang-cua-apple-la-tot-nhat-the-gioi-201204050125538.chn

GIẢI PHÁP QUẢN LÝ VÀ PHÂN PHỐI HÀNG TỒN KHO BẰNG RFID. (n.d.). Tân Hưng Hà. Retrieved March 1, 2025, from https://tanhungha.com.vn/case-study-giai-phap-quan-ly-va-phan-phoi-hang-ton-kho-bang-rfid-n845.html

Greeff, G., & Ghoshal, R. (2004). Practical E-manufacturing and supply chain management. Elsevier.

He, W., 2013. An Inventory Controlled Supply Chain Model Based on Improved BP

Heizer, J. H., & Render, B. (1988). Production and operations management: Strategies and tactics. http://ci.nii.ac.jp/ncid/BA12479724

Here, A. (2017, April 21). How Apple's Inventory Management is So Lean -. Supply Chain Today - Home Page. https://www.supplychaintoday.com/apples-inventory-management-lean/

Here, A. (2021, October 24). Logistics of Apple Explained -. Supply Chain Today - Home Page. https://www.supplychaintoday.com/logistics-of-apple-explained/

Here, A. (2024, December 23). How Tim Cook Transformed Apple's Supply Chain. -. Supply Chain Today - Home Page. https://www.supplychaintoday.com/how-tim-cook-transformed-apples-supply-chain/

Hristov, V. (2012, March 29). Apple's secret sauce for success is inventory management. *PhoneArena*. https://www.phonearena.com/news/Apples-secret-sauce-for-success-is-inventory-management_id28558

Investopedia. (n.d.). Tim Cook. Retrieved March 3, 2025, from https://www.investopedia.com/tim-cook-5224249

Jing, J. (2018). A case study on Apple, Inc which is affecting the world of Smati Technology Leader or heading down?

July, T. (2025, February 7). Apple's Financial efficiency: DSO, inventory, suppliers. HighRadiusTM | Integrated Receivables | a/R Management Software. https://www.highradius.com/finsider/apple-story/

Khan, S., & Bosgraaf, R. M. (2009). Inventory Management in a High Technology Organization: The impact on consumers from perspective of third party logistics provider. In Proceedings of the Second International Conference of Global Business and Management Forum 2009 (GBMF) (pp. 1-27). Global Business and Management Forum.

Koumanakos, D. P. (2008). The effect of inventory management on firm performance. International journal of productivity and performance management, 57(5), 355-369.

Li, Q. (2015). Examining the Relationship between Contract Manufacturing Inventory Efficiency and Information System Investment: an Empirical Study of the US Manufacturing Sector (Doctoral dissertation).

Linstone, H. A., & Turoff, M. (Eds.). (1975). The delphi method (pp. 3-12). Reading, MA: Addison-Wesley.

Lotzof, K. (2020) 'Your Mobile Phone is Powered by Precious Metals and Minerals', National History Museum, 7 October [online]. Available at: https://www.nhm.ac.uk/discover/your-mobile-phone-is-powered-byprecious-metals-and-minerals.html

Lydia, K. (2024, August 16). Why Is Apple's NPS the Best In the Industry?. Survicate. https://survicate.com/blog/apple-nps/

Macrotrends. (n.d.). Apple revenue 2010-2025. Macrotrends. https://www.macrotrends.net/stocks/charts/AAPL/apple/revenue

McCarthy, N. (2021). Infographic: The Apple Store empire. Statista Infographics. https://www.statista.com/chart/24857/total-number-of-apple-stores-worldwide/

Monden, Y., & Lee, J. (1993). How a Japanese auto maker reduces costs. Strategic Finance, 75(2), 22.

Muller, M. (2019). Essentials of inventory management. HarperCollins Leadership.

Nasdaq. (n.d.). How Apple's inventory can shed light on the genius of Tim Cook. Retrieved March 3, 2025, from https://www.nasdaq.com/article/how-apples-inventory-can-shed-light-on-the-genius-of-tim-cook-cm626349

Neural Network. Discrete Dynamics in Nature and Society, Volume 2013, pp. 1-7.

Ngunyule, S. (2020). Management and Control of Inventory: The Case Study of a South African Company. University of Johannesburg (South Africa).

Nomadic Learning. (2018, June). Tim Cook: The man who really saved Apple. Retrieved March 3, 2025, from https://nomadiclearning.com/blog/2018/06/tim-cook-the-man-who-really-saved-apple

Patel, M. T. S. D. S., & Diwedi, A. (2024). Inventory Management Technique in Manufacturing Industry.

Petropoulos, F., Apiletti, D., Assimakopoulos, V., Babai, M. Z., Barrow, D. K., Taieb, S. B., ... & Ziel, F. (2022). Forecasting: theory and practice. International Journal of Forecasting, 38(3), 705-871.

PhoneArena. (2022, June 20). Samsung reportedly has 50 million unsold phones in stock. PhoneArena. https://www.phonearena.com/news/samsung-has-50-million-unsold-phones-in-stock_id140868

Relokia. (n.d.). FIFO vs. LIFO: What's the difference? Relokia Accounting. https://accounting.relokia.com/fifo-vs-lifo/

ResearchGate. (2024). Strategic innovations in Apple's supply chain management: Objectives, methods, and strategies for navigating global market challenges. ResearchGate. https://www.researchgate.net/publication/385322850_Strategic_Innovations_in_Apple's_Supply_Chain_Management_Objectives_Methods_and_Strategies_for_Navigating_Global_Market_Challenges

Singla, A., Sukharevsky, A., Yee, L., & Chui, M. (2024, May 30). The state of AI in early 2024: Gen AI adoption spikes and starts to generate value. McKinsey & Company. https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai

Souring US-China Relations Threaten to Make Your iPhone More Expensive. (n.d.). Retrieved March 1, 2025, from https://www.bloomberg.com/graphics/2023-apple-supply-chain-shift-beyond-china/

Statista. (n.d.). Apple Inc. – Statistics & facts. Statista. https://www.statista.com/topics/847/apple/#topicOverview

Stockviz. (n.d.). Apple inventory turnover ratio. Stockviz. https://stockviz.com/en/AAPL/inventory-turnover-ratio

Straits Research. (2024). Apple surpasses expectations with strong Q3 2024 earnings. Straits Research. https://straitsresearch.com/statistic/apple-surpasses-earnings-forecasts

Suh, J. Y., & Kim, Y. J. (2009). Logistics lean integration strategies: case study of Samsung Electronics LCD inbound logistics. Journal of International Logistics and Trade, 7(1), 107-116.

Supply Chain Digital. (n.d.). Tim Cook: The supply chain guru behind Apple's growth. Retrieved March 3, 2025, from https://supplychaindigital.com/technology/tim-cook-supply-chain-guru-behind-apple-growth

Supply Chain Today. (n.d.). How Tim Cook transformed Apple's supply chain. Retrieved March 3, 2025, from https://www.supplychaintoday.com/how-tim-cook-transformed-apples-supply-chain/

Supply Chain Today. (n.d.). Logistics of Apple explained. Supply Chain Today. https://www.supplychaintoday.com/logistics-of-apple-explained/

T.T Amachree (2017), Inventory Management Strategies for Productivity Improvement in Equipment Manufacturing Firms, International Journal of Scientific & Technology Research, 6(8), 99-108

Tom's Guide. (2024, February 6). Google Pixel 9 Pro could be in short supply at launch — and this color could be especially hard to get. Tom's Guide. https://www.tomsguide.com/phones/google-pixel-phones/google-pixel-9-pro-could-be-in-short-supply-at-launch-and-this-color-could-be-especially-hard-to-get

Toomey, J. W. (2000). Inventory management: principles, concepts and techniques (Vol. 12). Springer Science & Business Media.

TYASuite. (2025, February 11). Top 5 Importance of inventory Management: A Comprehensive guide. Tyasuite. https://www.tyasuite.com/blog/post/importance-of-inventory-management

Uwihirwe, J. C., & Bazimya, S. Financial Performance Analysis and Evaluation of Apple Inc. between 1st October 2019 to 30th September 2022.

Vasilaki, M., & Tsakalidis Jr, G. (2019). Apple Inc. Equity Valuation.

Vergara, R. A. (2016). Samsung Electronics and Apple Inc.: A study in contrast in vertical integration in the 21st century. ResearchGate. https://www.researchgate.net/profile/Raymond-Allan-Vergara/publication/303860146_Samsung_Electronics_and_Apple_Inc_A_Study_in_Contrast_in_Vertical_Integration_in_the_21_st_Century

Wallin, C., Rungtusanatham, M. J., & Rabinovich, E. (2006). What is the "right" inventory management approach for a purchased item? International Journal of Operations & Production Management, 26(1), 50–68. https://doi.org/10.1108/01443570610637012

Wharton University of Pennsylvania. (n.d.). Vertical integration works for Apple, but it won't for everyone. Knowledge@Wharton. https://knowledge.wharton.upenn.edu/article/vertical-integration-works-for-apple-but-it-wont-for-everyone/

Why Apple's iPhone 14, iPhone 14 Plus Are Failing. (n.d.). Retrieved March 1, 2025, from https://www.forbes.com/sites/gordonkelly/2022/10/22/apple-iphone-14-plus-sales-iphone-14-pro-max-success/

Wild, T. (2017). Best practice in inventory management. In Routledge eBooks. https://doi.org/10.4324/9781315231532