INVENTORY MANAGEMENT AND CONTROL: EXPLORING EFFECTIVE STRATEGIES FOR EFFICIENT OPERATIONS

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A PROJECTED SUBMITTED TO THE DEPARTMENT OF MATHEMATICS, FACULTY PHYSICAL SCIENCES, UNIVERSITY OF BENIN, BENIN CITY, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE (B.Sc. HONOURS) DEGREE IN INDUSTRIAL MATHEMATICS

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DECLARATION

This project work was carried out by ONOJORHOVWO OKIEMUTE EGONO. I have not copied the work of any author. All work has been duly cited and acknowledged.

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CERTIFICATION

This is to certify that this project was carried out by Onojorhovwo Okiemute Egono the Department of Mathematics, University of Benin, Benin City.

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(Project Supervisor)

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(Head of Department)

DEDICATION

This project is dedicated to the Almighty God who has saw me throughout my course of study. Also to my lovely parents Mr and Mrs Onojorhovwo who have been supporting me with love and never ending advices which became guidelines I used in school.

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This work wouldn't have been today without the help of numerous individuals who has contributed massively to this work being a success.

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ABSTRACT

Inventory management and control play a crucial role in the efficient operations of any organization. Effective inventory management strategies aim at maintaining optimal levels of inventory, minimizing costs, and maximizing customer satisfaction. This project aims to explore and analyze various effective strategies for inventory management and control, with the ultimate goal of optimizing operations and improving overall efficiency.

In carrying out this study various models were used in optimizing inventory management and minimizing costs. Based on the application of the inventory models it was discovered that inventory plays a crucial role in the manufacturing company. Effective implementation of inventory management, in line with these recommendations, can lead to improved management practices, ultimately enhancing production efficiency and ensuring the optimal utilization of materials and resources within the manufacturing company.

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CHAPTER ONE

INTRODUCTION

1.0 INTRODUCTION.

Inventory management and control is essential for businesses of all sizes and industries. Without proper management of inventory, businesses can face a host of problems including overstocking, under-stocking, increased costs, and decreased customer satisfaction. Effective inventory management and control significantly impact the efficiency of operations, profitability, and ultimately, the success of the business. This article explores strategies and best practices for inventory management and control that businesses can adopt to improve their operational efficiency and meet customer demands more effectively.

1.1 BACKGROUND TO THE STUDY.

Inventory is a term used to describe the array of goods held by a company for the purpose of sale or production. It is often considered as one of the most critical assets of a business, as it represents a significant portion of the company's investment. The history and background of inventory management can be traced back to the earliest forms of commerce and trade.

One of the earliest civilizations known to have implemented inventory management practices was ancient Mesopotamia, around 3000 BC. The Mesopotamians developed written records, in the form of clay tablets, to

keep track of their inventory. These records helped merchants and traders maintain an accurate account of the goods they possessed, bought, and sold.

In ancient Egypt, inventory management played a crucial role in facilitating trade and ensuring adequate supplies for the growing population. The Egyptians meticulously recorded and managed the vast quantities of supplies, including food, tools, and construction materials, needed for their ambitious projects like pyramids and temples. These inventories were essential for economic stability and enabled the government to anticipate and manage potential shortages.

The concept of inventory continued to evolve through the centuries, particularly during the Middle Ages. The development of long-distance trade and the rise of the guild system led to more sophisticated inventory management techniques. Merchants in Europe established inventory control systems to keep track of goods transported through complex trade networks. These systems helped optimize stock levels, reduce the risk of shortages, and enhance overall business efficiency.

With the advent of the Industrial Revolution in the 18th century, inventory management became even more crucial. As mass production increased, businesses needed to manage larger quantities of raw materials, work-in-progress, and finished goods. This led to the emergence of new inventory management systems and methods.

During the 20th century, innovative concepts and technologies revolutionized inventory management practices. The widespread adoption of scientific management principles, pioneered by Frederick Taylor and others, introduced more systematic approaches to inventory control. The use of barcodes, electronic data interchange (EDI), and computerized inventory management systems further enhanced efficiency and accuracy in inventory tracking and control.

In recent decades, advancements in information technology have significantly transformed inventory management. The rise of enterprise resource planning (ERP) systems has allowed businesses to integrate inventory management with other key functions such as accounting, sales, and supply chain. This seamless integration allows for real-time tracking, demand forecasting, and automated replenishment, reducing stockouts and minimizing excess stock.

Today, inventory management has become more strategic and data-driven than ever before. Businesses leverage advanced analytics and machine learning algorithms to optimize inventory levels, minimize carrying costs, enhance customer satisfaction, and streamline supply chain operations. Concepts like just-in-time (JIT) inventory and lean production have gained prominence, emphasizing the need for minimizing inventory while ensuring the availability of goods when needed.

In conclusion, the history and background of inventory management can

be traced back to ancient civilizations and have evolved in response to changing economic conditions and technological advancements. From clay tablets and paper records to sophisticated computerized systems, the management of inventory continues to be of paramount importance for businesses, enabling them to maintain profitability, improve customer service, and drive overall operational efficiency.

1.2 STATEMENT OF THE PROBLEM.

In today's competitive business landscape, effective inventory management and control have become critical for companies to ensure efficient operations. However, businesses struggle to develop and implement strategies that optimize inventory levels, minimize carrying costs and enhances overall operational efficiency. This raises the need to explore effective strategies that can address the challenges associated with inventory management and control. The problem to be investigated in this project is:

What are the key challenges faced by businesses in inventory management and control, and how can effective strategies be developed and implemented to overcome these challenges and achieve efficient operations?

1.3 OBJECTIVE OF THE STUDY.

The major objective of this study is explore effective strategies for efficient operation in an organization. The specific objectives of the study

are as follows:

1. To analyze the impact of inefficient inventory management on operational efficiency.

2. To identify and evaluate effective strategies for improving inventory management and control.

3. To quantify the potential benefits, such as cost savings and improved customer satisfaction, of implementing effective inventory management strategies.

4. To understand the challenges and barriers that hinder efficient inventory management and control.

5. To contribute to the existing body of knowledge on inventory management and control strategies for efficient operations.

1.4 SIGNIFICANCE OF THE STUDY.

This study 'Inventory Management and Control: Exploring Effective Strategies for Efficient Operations' holds great significance in the field of supply chain management and operations. Inventory management is a crucial aspect for any organization as it directly affects its profitability, customer satisfaction, and overall efficiency. The study explores the strategies and practices that can be implemented for effectively managing and controlling inventory.

One of the key reasons why this study is significant is because efficient inventory management can lead to cost savings for businesses. By having

the right amount of inventory at the right time, organizations can avoid overstocking or under-stocking, both of which can be costly.

Overstocking ties up valuable capital and incurs storage costs, while under-stocking can result in lost sales and dissatisfied customers. The study aims to identify strategies that can help organizations optimize their inventory levels, minimize holding costs, and maximize profitability.

1.5 SCOPE OF THE STUDY.

This research work focuses on analyzing and evaluating the different strategies and techniques that can be implemented in inventory management and control to achieve efficient operations. The study aims to explore various aspects such as inventory control methods, forecasting techniques, demand management, and technology utilization in inventory management.

The research will delve into the challenges faced by organizations in managing inventory effectively and how these challenges can be overcome through the implementation of appropriate strategies. The study will also examine the impact of efficient inventory management on overall operational efficiency, customer satisfaction, and cost reduction.

1.6 LIMITATIONS OF THE STUDY.

Some limitations and factors in this research study are as follows:

1. Lack of Diverse Perspectives: This study may have focused on a specific perspective or only included input from a limited group of

participants (e.g., management or warehouse personnel).

2**. Limited Time frame:** This report has been conducted over a short period of time, which may restrict the understanding of long-term effects or the impact of external factors.

3. **Data Reliability:** This study's findings has been limited by the reliability and accuracy of the data collected.

4. **Limited Scope:** This study may have focused on specific aspects of inventory management, The lack of a comprehensive examination of all relevant aspects of inventory management may limit this study's applicability and usefulness.

5. **Contextual Factors:** This study may not have considered the impact of contextual factors, such as company size, industry dynamics, or regional differences. Different organizations may require different inventory management strategies based on their unique contexts, so a one-size-fits-all approach may not be applicable.

6**. Changing Business Environment:** This study's findings may not be applicable in a rapidly changing business environment. Factors such as technological advancements, market trends, or global events can significantly impact inventory management practices and render the strategies explored in this study outdated or less effective.

1.7 DEFINITIONS OF TERMS.

i. **Inventory:** Inventory refers to the complete list of goods, raw materials, or supplies that a company holds for production, sale, or use in its operations.

ii. Stock Keeping Unit (SKU): A Stock Keeping Unit is a unique code or number assigned to a specific product or item within the inventory. It helps in identifying and tracking the individual items.

iii. Reorder Point: The reorder point is the inventory level at which a new order for a particular item or product should be placed to avoid running out of stock. It is calculated based on factors such as lead time, demand, and safety stock.

iv. Safety Stock: Safety stock is an additional quantity of inventory that is kept on hand as a buffer to protect against unexpected fluctuations in demand or delays in supplier deliveries. It acts as a safety net to prevent stockouts.

v. Lead Time: Lead time refers to the time it takes for a supplier to deliver the ordered goods or materials after an order has been placed. It is an important consideration in inventory management to ensure that stock is replenished in a timely manner.

vi. Economic Order Quantity (EOQ): The economic order quantity is the optimal order quantity that minimizes the total costs of ordering and holding inventory. It takes into account factors like demand, holding

costs, and ordering costs to determine the most cost-efficient quantity to order.

vii. Just-in-Time (JIT): Just-in-Time is a inventory management strategy where products or materials are received or produced just in time to fulfil customer demands. It aims to minimize inventory holding costs by having materials arrive exactly when needed.

viii. Stockout: A stockout occurs when an item is unavailable or out of stock when it is needed. It can result in lost sales, dissatisfied customers, and disruptions to production or operations.

ix. ABC Analysis: ABC analysis is a technique used to prioritize items in inventory based on their value or importance. It categorizes items into three groups: A items (high-value items that require close control), B items (moderate-value items), and C items (low-value items that require less attention).

x. FIFO and LIFO: FIFO (First-In, First-Out), and LIFO (Last-In, First-Out) are two methods used to organize and value inventory. FIFO assumes that the earliest acquired items are sold or used first, while LIFO assumes that the most recently acquired items are sold or used first. These methods can impact financial statements and tax calculations.

xi. Stock Turnover: Stock turnover or inventory turnover refers to the number of times inventory is sold or used within a specific time frame. It is calculated by dividing the cost of goods sold by the average inventory

value.

xii. Warehousing: Warehousing refers to the storage and management of inventory in a designated facility or warehouse. It involves tasks such as receiving, organizing, storing, and distributing goods to fulfill customer orders.

xiii. Demand Forecasting: Demand forecasting is the process of estimating future customer demand for products or items. Accurate demand forecasting is crucial in inventory management to avoid overstocking or under-stocking inventory.

xiv. SKU Rationalization: SKU rationalization is the process of reviewing and streamlining the number of stock-keeping units in inventory to optimize efficiency and reduce costs. It involves eliminating or consolidating low-selling or redundant SKUs.

xv. Replenishment: Replenishment is the process of restocking inventory to maintain desired stock levels. It involves monitoring stock levels, calculating reorder points, and placing new orders with suppliers.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

A truly effective inventory management system will minimize the complexes involved in planning, executing and controlling a supply chain network which is critical to business success. The opportunities available by improving a company's inventory management can significantly improve bottom line business performance.

Oftentimes, inventory is the largest items in a manufacturer's or distributor's balance sheet. As a result, there is a lot of management

emphasis on keeping inventories down so that they will not consume too much cash.

2.1 CONCEPT OF INVENTORY

Inventory plays a crucial role in the effective operation of manufacturing and retail organizations. Many companies incorporate inventories into their daily operations, with inventories often comprising the largest portion of their current assets, particularly in the case of manufacturing firms. The importance of managing and controlling inventories cannot be overstated. Neglecting inventory management can pose a significant risk to a company's long-term profitability and may even lead to business

failure. Various professional bodies and scholars have provided differing definitions of inventory.

According to Nwaorgu (2005:123), inventory can be described as tangible assets held for resale in the normal course of business, for use in production for sale, or for consumption in the production of goods and services.

Jain (1999:472) defines inventory as the sum of intangible assets held for sale in the ordinary course of business, those in the process of production for eventual sale, and those currently consumed in the production of goods and services intended for sale.

Morse (1997:454) characterizes inventory as a general term encompassing goods stored in warehouses and stockyards, with the majority typically intended for use in production or operational activities, along with finished products awaiting dispatch to customers.

Ama (2000:209) states that inventory comprises both the goods a firm is producing for sale and the components that constitute these goods.

A critical decision in both manufacturing and retail operations revolves around determining the optimal level of inventory to maintain. Once established, this inventory level becomes a significant input into the budgeting process.

2.2 TYPES OF INVENTORY

There are four different top-level inventory types: raw materials, work-in-progress (WIP), merchandise and supplies, and finished goods. These four main categories help businesses classify and track items that are in stock or that they might need in the future. However, the main categories can be broken down even further to help companies manage their inventory more accurately and efficiently.

1. Raw Materials: Raw materials are the materials a company uses to create and finish products. When the product is completed, the raw materials are typically unrecognizable from their original form, such as oil used to create shampoo.

2. Work In Progress (WIP): WIP inventory refers to items in production and includes raw materials or components, labour, overhead and even packing materials.

3. Finished Goods: These are the products that are completed and that are ready to be purchased by consumers. Pandey (2002) defined finished goods as those products that are completed and are ready for sale.
Stock of raw materials and work-in-progress facilitates production

while stock of finished goods is required for the smooth marketing operations.

4. Maintenance, Repair and Operations (MRO) Goods: MRO is inventory — often in the form of supplies — that supports making a product or the maintenance of a business.

2.3 IMPORTANCE OF INVENTORY

1. Demand forecasting: Inventory allows businesses to anticipate and plan for customer demand. By analyzing historical data and market trends, businesses can determine the appropriate quantity of products to stock in order to meet customer needs without overstocking or understocking.

2. Customer satisfaction: Maintaining adequate inventory levels ensures that products are readily available when customers want to purchase them. This reduces the likelihood of customer dissatisfaction due to out-of-stock products, leading to increased customer loyalty and repeat business.

3. Supply chain management: Inventory management is crucial for optimizing supply chain efficiency. It enables businesses to coordinate production, distribution, and procurement activities effectively. By

having accurate inventory levels, businesses can avoid stockouts, minimize lead times, and create a smoother supply chain flow.

4. Production planning: Inventory management helps in planning production schedules. By keeping track of raw materials, work-in-progress, and finished goods inventory, businesses can plan production activities, allocate resources, and streamline operations. This can lead to improved production efficiency and cost savings.

5. Cost control: By accurately tracking inventory levels, businesses can control their costs more effectively. Inventory costs include purchasing, storage, and obsolescence expenses. By regularly monitoring inventory levels and turnover rates, businesses can avoid overstocking, prevent stockouts, and minimize carrying costs.

2.4 INVENTORY CONTROL

Inventory control, also called stock control, is the process of ensuring the right amount of supply is available in an organization. With the appropriate internal and production controls, the practice ensures the company can meet customer demand and delivers financial elasticity.

Successful inventory control requires data from purchases, reorders, shipping, warehousing, storage, receiving, customer satisfaction, loss

prevention and turnover. According to the 2017 ”State of Small Business report”, almost half of small businesses do not track their inventory, even manually.

Inventory control enables the maximum amount of profit from the least amount of investment in stock without affecting customer satisfaction. Done right, it allows companies to assess their current state concerning assets, account balances and financial reports. Inventory control can help avoid problems, such as out-of-stock (stockout) events. For example, Walmart estimated it missed out on $3 billion worth of sales in 2014 because its inadequate inventory control procedures led to stockouts.

An integral part of inventory control is chain management (SCM), which manages the flow of raw materials, goods and services to the point where the company or customers consume the goods. Warehouse management also squarely falls into the arena of stock control. This process includes integrating product coding, reorder points and reports, all product details, inventory lists and counts and methods for selling or storing. Warehouse management then synchronizes sales and purchases to the stock on hand.

Inventory management is a higher-level term that encompasses the complete process of procuring, storing, and making a profit from your merchandise or services. While inventory control and inventory

management may seem interchangeable, they are not. Inventory control regulates what is already in the warehouse. Inventory management is broader and regulates everything from what is in the warehouse to how a business gets the product there and the item's final destination.

2.5 INVENTORY POLICY

The type of decision to be taken about inventory management is similar regardless of the size and complexity of the business. However, all decisions may be made by one man in a simpler or smaller business, while a bigger or separate level of top management will usually be concerned with inventory decision in complex businesses.

Inventory policies are used as guides in the process of establishing programs and controls in business organizations so that a suitable rate of return will be earned on the inventory investment. In most cases the decisions or policies will cover:

i. How much to order i.e the optimal quantity of an item that could be ordered whenever an order is placed.

ii. When should an order be placed?

iii. How much safety stock should be kept

2.6 INVENTORY COSTS

The costs of inventory purchase, storage, and management are referred to as inventory costs. It comprises expenses such as ordering, carrying, and shortage / stock-out charges. Inventory is one of a company's or manufacturer's most valuable assets. They must manage it well, and it comes at a cost in terms of inventory maintenance, storage, replacement, and movement. All of these expenses are referred to as inventory costs.

2.6.1 INVENTORY COSTS TYPES

The three basic categories of inventory-related costs are ordering, holding, and shortage costs. These categories serve to categorize the many various inventory costs that exist, and we will identify and describe some of the numerous sorts of expenses below.

1. Ordering costs: Ordering costs embrace payroll taxes, advantages, the procurement department's wages, labour costs, etc. These costs area units are sometimes engulfed within the Associate in Nursing overhead price pool and assigned to the number of units created in each amount.

2. Inventory holding costs: The total cost of maintaining unsold inventory is known as inventory holding costs. Within a single supply chain, inventory holding costs are considered as part of the total inventory costs. Warehousing, insurance, labour, transportation, depreciation,

inventory shrinkage, damaged or spoilt goods, obsolescence, and opportunity expenses are all expenditures that must be considered.

3. Shortage costs: Shortage costs are the expenses experienced by a company when it does not have enough inventory on hand. These expenses include lost revenues from clients who go elsewhere to make purchases, lost margin on unfinished orders, and overnight shipping charges to acquire goods, not in stock. This is a crucial factor when selecting how much inventory to keep on hand, especially for businesses that compete on customer service.

4. Spoilage costs: If perishable goods are not sold quickly enough, they can decay or spoil; hence inventory control is critical to avoid spoilage. Many sectors are concerned about products that expire. The expiration and use-by dates of their products have an impact on businesses such as food and beverage, pharmaceutical, healthcare, and cosmetics.

5. Inventory carrying costs: This is a facet of inventory cost that is less well-known. To determine the magnitude of this cost's influence on your P&L statement, you'll need to do some math. The amount of interest a company loses on unsold stock sitting in warehouses is referred to as inventory carrying costs. When considering the impact of inventory on a business, business owners sometimes overlook the impact of the above

aspects. The inventory holding expenses appear on the Profit & Loss statement as part of the rental charge.

2.7 INVENTORY MODELS

Inventory models are mathematical models used by businesses to determine the optimal level of inventory to maintain. These models help businesses strike a balance between carrying enough inventory to meet customer demand and avoid stockouts, while minimizing inventory holding costs and the risk of obsolescence.

There are several types of inventory models, including the Economic Order Quantity (EOQ) model and the Economic Production Quantity (EPQ) model. Each model has its own assumptions and calculations, but they all aim to answer similar questions:

1. How much inventory should be ordered or produced at one time?

2. When should the inventory be replenished?

3. How much safety stock should be kept to account for demand variability?

The EOQ model, for example, calculates the order quantity that minimizes the total cost of ordering and holding inventory. It takes into account factors such as order costs, carrying costs, and demand rates. By

using this model, businesses can determine the optimal order quantity and reorder point to maintain efficient inventory levels.

The EPQ model is similar to the EOQ model but is used when production is involved. It calculates the production quantity that minimizes the total cost of setup (or changeover) and holding inventory. This model considers production setup costs, production rates, and demand rates.

These inventory models are valuable tools for businesses in sectors such as retail, manufacturing, and distribution, as they provide insights into how to optimize inventory levels and improve operational efficiency. By using these models, businesses can make informed decisions about replenishing inventory, reducing costs, and ultimately meeting customer demand.

2.8 FACTORS AFFECTING THE INVENTORY MANAGEMENT

Inventory is important for business it has a crucial role play in the organization's growth. When inventory is important you must manage inventory efficiently in order to increase the effectiveness.

However, there are several factors that affect inventory efficiency. The factors that are affecting the effectiveness of inventory are discussed below:

1. Financial factor: It is obvious that the most important factor is money. For effective inventory management getting financial investment right is significant, as the progression of the cycle includes a lot of monetary danger.

When you plan the expenditure of each stock management task, for example, item ordering, tax expenses related to the stocks, and so on. Deliberately you will have the option to manage your inventory management process and minimize significant financial issues.

2. Market demand : Understanding market demand is very important for effective inventory management. As it all depends on the demand and supply.

As it is important to deliver products on time in order to keep our customer satisfied. Demand is something, a business creates products as per the customer requirement sometimes the quantity of high sometimes low.

For instance, you need a charger for using a mobile phone, without a charger you will not be able to charge your phone. Eventually mobile will be of no use without a charger.

Therefore, it is important that you have enough chargers for charging several phones. There shall not be a shortage of charge (inventory) so that businesses of yours do not suffer.

Thus, you must keep track of demand high time, low time, when sales are high & low so that you can plan accordingly.

3. Inventory theft: Inventory theft is one of the most common issues across the world. It is also one of the reasons that influence inventory. According to the Tech jury, "28% of retail inventory losses in the US are due to employee theft."

For instance, you think inventory is available in the stock but when you check your warehouse you don't find inventory as per the expectation. It affects business in a negative way.

4. Lead time: In this competitive world, everything needs to be delivered quickly and that is why supply chains are becoming more complex every day. For those industries who bring their inventory from another country or another region via plane or ship, lead time is very crucial.

When inventory is coming from this far obviously it takes time to reach so this type of scenario impacts inventory. Therefore, strategy shall be created keeping in mind all these factors so that inventory management is not affected.

5. Product types: When you are thinking about inventory effectiveness you need to ensure that inventory is used before they are expired or broken. Inventory can be any type.

For instance, in the retail sector fresh vegetable or food have only a few days' life after that their effectiveness decreases. Therefore, the inventory shall be managed and utilized in a way so that they are consumed before they expire.

CHAPTER THREE

METHODOLOGY

3.0 INTRODUCTION

In this chapter, we will give insights on models used in inventory management and control especially when it has to do with investigating tactics to enhance operational efficiency in a manufacturing company.

3.1 ECONOMIC ORDER QUANTITY.

The Economic Order Quantity (EOQ) model is a widely used inventory management technique that helps businesses determine the optimal order quantity for minimizing costs while meeting customer demand. The model calculates the ideal quantity to order by balancing the costs of inventory carrying and ordering.

The EOQ formula is derived by considering two main costs: carrying cost and ordering cost. The carrying cost is the cost of holding inventory in stock, which includes expenses such as warehousing, insurance, obsolescence, and the opportunity cost of tying up capital. The ordering cost, on the other hand, includes expenses related to placing an order, such as paperwork, processing, and shipping.

3.1.1 THE DERIVATION OF EOQ MODEL FORMULA

Variables:

T = Total annual inventory cost

P = Purchase unit price, unit production cost

Q = Order quantity

Q* = Optimal order quantity

D = Annual demand quantity

K = Fixed cost per order, setup cost

h = Annual holding cost per unit, also known to be carrying or storage cost

The single-item EOQ formula helps find the minimum point of the following cost function:

Total Cost = Purchase Cost or Production Cost + Ordering Cost + Holding Cost

Where,

- Purchase cost: This is the variable cost of goods: purchase unit price × annual demand quantity. This is P × D

- Ordering cost: This is the cost of placing orders: each order has a fixed cost K, and we need to order D/Q times per year. This is K × D/Q
- Holding cost: the average quantity in stock (between fully replenished and empty) is Q/2, so this cost is h × Q/2

$$T = PD + K\left(\frac{D}{Q}\right) + h\left(\frac{Q}{2}\right)$$

To determine the minimum point of the total cost curve, calculate the derivative of the total cost with respect to Q (assume all other variables are constant) and set it equal to zero (0):

$$0 = -\left(\frac{DK}{Q^2}\right) + \left(\frac{h}{2}\right)$$

Solving for Q gives Q* (the optimal order quantity):

$$Q^{*2} = \left(\frac{2DK}{h}\right)$$

Therefore,

$$Q^* = \sqrt{\frac{2DK}{h}}$$

3.1.2 ASSUMPTIONS OF THE ECONOMIC ORDER QUANTITY (EOQ) MODEL

The Economic Order Quantity (EOQ) model relies on several assumptions to simplify the inventory management process. Here are the most common assumptions of the EOQ model:

1. Constant demand: The model assumes that the demand for the product or item remains constant over the period for which the EOQ is calculated. This means that there are no fluctuations or seasonality in the demand pattern.

2. No lead time: The EOQ model assumes that there is no delay or lead time between placing an order and receiving the inventory. In other words, the inventory is instantaneously replenished.

3. No stockouts: The model assumes that there are no shortages or stockouts during the period under consideration. Businesses can always fulfil the demand, and no costs are associated with stockouts.

4. Constant ordering cost: The ordering cost per order is assumed to remain constant regardless of the order quantity. This means that the cost of processing, paperwork, and shipping does not change with the quantity ordered.

5. Constant carrying cost: The carrying cost per unit of inventory is assumed to be constant throughout the period. The cost includes expenses such as storage, insurance, and obsolescence, and it is assumed that these costs do not fluctuate.

3.1.3 IMPORTANCE OF THE ECONOMIC ORDER QUANTITY (EOQ) MODEL

The EOQ model is important for several reasons:

1. Cost Optimization: The primary goal of the EOQ model is to minimize costs by finding the optimal order quantity. By balancing the costs of carrying inventory (holding costs) and placing orders (ordering

costs), businesses can determine the quantity that will result in the lowest total cost of inventory management. This helps businesses in optimizing their inventory levels and reducing unnecessary expenses.

2. Inventory Control: The EOQ model helps in efficiently managing inventory levels. By determining the optimal order quantity, businesses can ensure that they have sufficient stock to meet customer demand without excess inventory. This prevents stockouts and reduces the risk of holding obsolete or excess inventory.

3. Improved Customer Service: By using the EOQ model, businesses can maintain adequate stock levels to meet customer demand consistently. This leads to improved customer satisfaction, as they are more likely to receive products in a timely manner without experiencing frequent stockouts or delayed orders.

4. Cash Flow Management: The EOQ model helps businesses in managing their cash flow effectively. By optimizing the order quantity, companies can avoid tying up excessive capital in inventory. This ensures that cash is available for other operational expenses or investment opportunities.

3.1.4 LIMITATIONS OF THE ECONOMIC ORDER QUANTITY (EOQ) MODEL

Let's discuss the limitations of the Economic Order Quantity (EOQ) model. While the EOQ model is widely used and effective in many cases, it does have some limitations. Here are the key limitations to consider:

1. Assumptions may not hold true: The EOQ model relies on several assumptions, such as constant demand, no lead time, and no stockouts. In reality, these assumptions may not always be accurate, leading to less accurate results. Fluctuations in demand, lead times, and stockouts can significantly impact the effectiveness of the EOQ model.

2. Lack of consideration for uncertain demand: The EOQ model assumes a constant and known demand, which may not reflect the reality of dynamic and uncertain markets. If demand is highly variable or subject to significant seasonality, the EOQ model may not be able to dynamically adjust reorder quantities to accommodate these fluctuations.

3. Ignores quantity discounts and price breaks: The EOQ model does not take into account the potential benefits of quantity discounts or price breaks offered by suppliers. In practice, businesses may have the opportunity to reduce costs by ordering larger quantities at a lower unit cost, but the EOQ model overlooks these considerations.

3.Gives the manufacturer more control: In a JIT model, the manufacturer has complete control over the manufacturing process, which works on a demand-pull basis. They can respond to customers' needs by quickly increasing the production for an in-demand product and reducing the production for slow-moving items. This makes the JIT model flexible and able to cater to ever-changing market needs. For example, Toyota doesn't purchase raw materials until an order is received. This has allowed the company to keep minimal inventory, thereby reducing its costs and enabling it to quickly adapt to changes in demand without having to worry existing inventory.

4. **Local sourcing:** Since just-in-time requires you to start manufacturing only when an order is placed, you need to source your raw materials locally as it will be delivered to your unit much earlier. Also, local sourcing reduces the transportation time and cost which is involved. This in turn provides the need for many complementary businesses to run in parallel thereby improving the employment rates in that particular demographic.

3.2 ECONOMIC PRODUCTION QUANTITY (EPQ) MODEL

The Economic Production Quantity (EPQ) model is an optimization technique used in production and inventory management. It is an extension of the Economic Order Quantity (EOQ) model and is primarily

employed in cases where products are manufactured in-house rather than being ordered from suppliers. The EPQ model aims to determine the optimal production quantity that minimizes overall production and inventory costs.

3.2.1 FORMULA USED IN THE ECONOMIC PRODUCTION QUANTITY MODEL

The formula to calculate the Economic Production Quantity (EPQ) is as follows:

$$EPQ = \sqrt{((2DS) / (H(1 - (d/p))))}$$

EPQ represents the optimal production quantity that minimizes total production and inventory costs. D represents annual demand, S represents the fixed setup or production cost per run, H represents the holding cost per unit per year, d represents the demand rate per day, and p represents the production rate per day.

By utilizing this formula, companies can determine the optimal production quantity that minimizes total costs by balancing setup costs with holding costs. However, it is important to note that the EPQ model is a simplified approximation and should be used alongside additional factors and real-world considerations for more accurate and effective production planning and inventory management.

3.2.2 ASSUMPTIONS OF THE ECONOMIC PRODUCTION QUANTITY (EPQ) MODEL

1. Constant demand: The EPQ model assumes that the demand for the product remains constant over the production period. This assumption provides a predictable production quantity. However, in reality, demand may vary due to factors such as seasonality, changing market conditions, or consumer preferences.

2. No shortages: The model assumes that there will be no shortages or stockouts during the production period. It assumes that the production rate will be sufficient to meet all demand without interruption. However, it is essential to consider potential disruptions such as machine breakdowns, labour shortages, or delays in raw material availability.

3. Immediate production: The EPQ model assumes that the production process can start and finish immediately, without any setup time or delays. This assumption simplifies the model, but in reality, there might be setup times required for machine preparation, tooling, or other factors that might affect the production process.

4. No backorders: The model assumes that there will be no backorders or unfilled orders. All orders are assumed to be fulfilled immediately during the production period. However, in practice, backorders might

occur due to unforeseen circumstances, leading to possible additional costs and customer dissatisfaction.

3.2.3 IMPORTANCE OF THE ECONOMIC PRODUCTION QUANTITY (EPQ) MODEL:

1. Cost optimization: The EPQ model allows companies to determine the optimal production quantity that minimizes overall production and inventory costs. By striking a balance between setup costs and holding costs, companies can optimize their production processes and reduce costs.

2. Efficient resource utilization: The model helps companies allocate resources efficiently by providing insights into the ideal production quantity to meet demand. This ensures the effective use of labor, machinery, and raw materials, avoiding over or under-utilization.

3. Inventory management: The EPQ model aids in inventory management by determining the most cost-effective production quantity. It enables companies to avoid excessive inventory levels, thereby reducing holding costs, while still meeting demand and avoiding stockouts.

4. Production planning: The model provides valuable information for production planning. It helps in determining the production schedule,

establishing target quantities, and ensuring that production meets the required levels at the lowest cost.

3.2.4 LIMITATIONS OF ECONOMIC PRODUCTION QUANTITY

1. Constant demand assumption: EPQ assumes that demand remains steady, but in reality, demand can fluctuate, leading to overproduction or underproduction.

2. Ignoring external factors: EPQ doesn't consider external factors like changing market conditions, competition, or economic fluctuations, which can impact production and demand.

3. Fixed production costs: EPQ assumes that production costs remain constant, but in reality, costs can vary due to factors like raw material prices, labour costs, or inflation.

CHAPTER FOUR

APPLICATION OF INVENTORY MODELS

4.0 INTRODUCTION

This chapter demonstrates how inventory models are applied in manufacturing companies to optimize inventory management and implement efficient operations for inventory control.

4.1 APPLICATIONS OF THE INVENTORY MODELS

Example 1

A company produces a widget that requires raw materials to be produced. The cost of placing an order for raw materials is #50 while the cost of holding an item in inventory is #10 per year. The demand for the widget is 1000 units per year, and the lead time for the delivery of raw materials is two weeks. The company operates 50 weeks in a year. What is the optimal order quantity that the company should place to minimize its inventory costs?

Solution:

Using the EOQ formula:

$EOQ = \sqrt{((2 \times D \times S) / H)}$

Where:

D = Annual demand = 1000 units/year

S = Order cost = $50

H = Holding cost per unit = $10/year

EOQ = √((2 x 1000 x 50) / 10) = 100 units

Therefore, the optimal order quantity for the company is 100 units per order so as to reduce inventory costs and optimize inventory management.

Example 2

A manufacturing company produces plastic injection molded products using raw material. The annual demand for raw material is 10,000 units, the ordering cost is $250, and the carrying cost per unit per year is $5. The lead time for an order to arrive is four weeks. What is the EOQ, and what are the total inventory costs?

Solution:

Using the EOQ formula:

EOQ = √((2 x D x S) / H)

Where:

D = Annual demand = 10,000 units/year

S = Order cost = $250

H = Holding cost per unit = $5/year

EOQ = √((2 x 10,000 x 250) / 5) = 1,581 units

The company should order 1,581 units per order. With this optimal order quantity, the total inventory cost will be the sum of the ordering cost and the carrying cost. The total inventory cost is given by:

Total inventory cost = (D/Q) x S + (Q/2) x H

where Q is the order quantity.

Total inventory cost = (10,000/1,581) x 250 + (1,581/2) x 5

Total inventory cost = $1,312.75

Therefore, the company should order 1,581 units per order with a total inventory cost of $1,312.75.

Example 3

In a manufacturing company, the management wants to implement the Economic Production Quantity (EPQ) model to determine the optimal production quantity for a specific product. The company has the following information:

- Annual demand for the product: 10,000 units

- Setup cost per production run: $500

- Production rate per day: 100 units

- Holding cost per unit per year: $0.75

Using the EPQ formula:

EPQ = √((2DS)/(H(1 - (D/P))))

where D is the annual demand, S is the setup cost per production run, H is the holding cost per unit per year, and P is the production rate per day.

Substituting the values into the formula:

EPQ = √((2 * 10,000 * $500) / ($0.75 * (1 - (10,000 / 100))))

EPQ = √((10,000,000) / ($0.75 * (1 - 100)))

EPQ = √((10,000,000) / ($0.75 * (0.999)))

EPQ ≈ √(13,333,333.33)

EPQ ≈ 3,651 units

Hence, based on the EPQ model, the manufacturing company should produce approximately 3,651 units per production run to minimize inventory costs and optimize their production and inventory management.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

This study is geared towards optimizing the use of available resources, reducing costs, and increasing overall efficiency. The study further revealed that certain factors, such as demand forecasting and supplier optimization, play a crucial role in successful inventory management. It is essential for manufacturing companies to carefully analyze and implement suitable inventory techniques to ensure smooth operations and sustained growth. These techniques should prioritize minimizing stock levels without compromising on the ability to meet customer demand and maintain smooth production processes. Ultimately, the aim is to strike a balance between having enough inventory to meet customer demands without excess stock leading to unnecessary costs.

The study emphasized the significance of effective inventory management as the foundation for the existence and control of any manufacturing firm. It stressed the importance of reducing inventory to the lowest possible level, regardless of the chosen inventory system or technique. The key objective is to optimize the utilization of resources, cut expenses, and enhance overall efficiency within the organization.

To achieve these goals, the study highlighted the need for appropriate inventory techniques that are capable of accurately forecasting demand and optimizing supplier relationships. These factors were found to be critical for achieving successful inventory management in manufacturing companies. By carefully analyzing and implementing suitable inventory techniques, businesses can ensure that their operations run smoothly, meet customer demand effectively, and sustain steady growth.

Altogether, the study concluded that effective inventory management is fundamental for the success and control of manufacturing companies. It emphasized the importance of minimizing stock levels(using inventory models) while still being able to meet customer demands. Adopting appropriate inventory techniques, such as demand forecasting and supplier optimization, is essential for achieving efficient and cost-effective inventory management.

5.2 CONCLUSION

In conclusion, effective inventory management and control is crucial for efficient operations in any organization. By implementing the right strategies and utilizing technology, businesses can improve inventory accuracy, reduce carrying costs, minimize stockouts, and maximize customer satisfaction.

One important aspect of efficient inventory management is using inventory models to determine optimal order quantity and total inventory cost which helps in reducing costs and optimizing inventory management

Strategic forecasting and demand planning are also essential factors in effective inventory management. By accurately predicting demand patterns and adjusting inventory levels accordingly, businesses can avoid stockouts and overstocking, leading to improved customer satisfaction and cost savings.

Additionally, the implementation of quality control practices and supplier management strategies can greatly impact inventory control. By ensuring the quality of incoming materials and establishing strong relationships with reliable suppliers, businesses can reduce the risk of receiving faulty or late deliveries, minimizing disruptions in the supply chain.

Overall, the study emphasizes the importance of having a well-designed inventory management system and employing effective strategies to optimize inventory control. By aligning inventory levels with customer demand, reducing carrying costs, and improving order fulfillment processes, businesses can achieve efficient operations and gain a competitive edge in the market.

5.3 RECOMMENDATIONS

Having done some research in the manufacturing industry, I strongly believe that efficient inventory management and control is crucial for the success of any manufacturing company. It is essential for the company to maintain optimal levels of inventory to meet customer demands, avoid excessive carrying costs, minimize stockouts, and streamline operations.

The study not only addresses a fundamental aspect of manufacturing operations but also focuses on exploring effective strategies to improve inventory management. This is a critical area of concern for many manufacturing companies, as improper inventory management can lead to increased costs, lost sales opportunities, and inefficient production processes.

Exploring strategies for efficient operations in inventory management is especially relevant in today's dynamic business environment, where companies constantly face challenges such as changing customer demands, supply chain disruptions, and global market fluctuations. By understanding and implementing effective inventory management strategies, manufacturing companies can enhance their overall operational efficiency, reduce costs, and improve customer satisfaction.

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