

## Dynamics of Modern Inventory Management and Artificial Intelligence



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### Dynamics of Modern Inventory Management and Artificial Intelligence

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#### PREFACE

Inventory management is a critical aspect of supply chain and business operations. It involves the process of planning, organizing, and controlling the movement of goods, raw materials, and finished products within a company. The goal of inventory management is to ensure that the right products are available at the right time and in the right quantity to meet customer demand while minimizing waste and maximizing profits.

Effective inventory management requires a thorough understanding of the entire supply chain, including the sources of raw materials, production processes, and distribution channels. In addition, it requires an understanding of the various factors that impact demand, such as seasonality, market trends, and changes in consumer behavior.

In this book, we will explore the principles and practices of inventory management in detail. We will cover topics such as forecasting, safety stock, order quantities, and inventory control systems. We will also discuss the role of technology in inventory management, including the use of software and other tools to automate and optimize the process. We have also covered valuation of Inventory besides focusing on optimization of inventory resources. The recent most advancements of artificial intelligence have been linked with inventory management with a view to provide futuristic platform to all those who refer to this book.

Whether you are a business owner, supply chain manager, or student of business and logistics, this book will provide you with a comprehensive understanding of inventory management and its importance in ensuring the success of any organization.

#### **ACKNOWLEDGEMENT**

Writing a book is a long-drawn journey equivalent to an accomplishment of multidimensional task. As it will happen with any important accomplishment, this journey too had its share of highs and lows. Authors would not have sailed through successfully but for the generous advice from experts and friends. Our deepest thanks to our parents and family members whose silent contributions enabled us to accomplish this task. They deserve special mention here.

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Dr. Ashwin H. Parwani Dr. Ashvin R. Dave Dr. Ashish B. Joshi Dr. Tejas Dave

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#### **CHAPTER 1**

#### INVENTORY MANAGEMENT

#### **INVENTORY MANAGEMENT**

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# Chapter - 1 Inventory Management

#### 1.1 INTRODUCTION

In inventory management, the goal is to ensure that an organization has the right amount of stock on hand to meet customer demand, while also minimizing the costs associated with holding inventory. This can be a challenging task, as it involves forecasting demand, placing orders with suppliers, receiving and storing goods, and distributing them to customers or to other parts of the organization.

Effective inventory management involves a number of key activities, including:

Demand forecasting: This involves predicting the future demand for products, so that the right amount of inventory can be ordered and held in stock.

Order placement: This involves placing orders with suppliers to ensure that the necessary inventory is available to meet demand.

Receiving and storing goods: This involves receiving goods from suppliers and storing them in a manner that ensures they are in good condition and can be easily accessed when needed.

Distribution: This involves getting the right products to the right place at the right time, whether that means delivering them directly to customers or distributing them to other parts of the organization.

By managing inventory effectively, organizations can improve customer satisfaction, reduce costs, and increase profits. However, it is important to strike a balance between holding too much inventory (which can lead to higher storage and holding costs) and not having enough (which can result in lost sales and customer dissatisfaction).

#### 1.2 MEANING OF INVENTORY MANAGEMENT

Inventory management is the process of overseeing the flow of goods and materials, from procurement to storage and distribution. It involves tracking and controlling the levels of inventory, ensuring that there is enough to meet demand without excess, and minimizing the costs associated with holding inventory. This includes forecasting demand,

placing orders with suppliers, receiving and storing goods, and distributing them to customers or to other parts of the organization. Inventory management is an important aspect of supply chain management, as it helps to ensure that products are available to meet customer demand and that the supply chain is running efficiently. It also helps organizations to minimize costs by reducing the amount of excess inventory that needs to be stored and by minimizing the risk of stock-outs, which can lead to lost sales and customer dissatisfaction.

#### 1.3 DEFINITIONS OF INVENTORY MANAGEMENT

There are many different authors and experts who have provided definitions of inventory management. Here are a few examples:

"Inventory management is the process of ordering, storing, and using a company's inventory: raw materials, components, and finished products." - William J. Stevenson, Operations Management: Concepts and Cases

"Inventory management is the practice of managing and controlling the quantities, flow, and storage of goods, services, and related information to meet customer demand and achieve desired levels of profitability and efficiency." - Christopher J. Bogan and William A. White, Fundamentals of Supply Chain Management

"Inventory management is the process of planning, coordinating, and controlling the movement and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customer requirements." - F. David Richardson and Lisa G. Richardson, Fundamentals of Inventory Management

"Inventory management is the process of balancing the need for products with the cost of holding them in stock." - James R. Evans and William M. Lindsay, Operations Management: An Integrated Approach

"Inventory management is the process of overseeing the flow of goods and materials, from procurement to storage and distribution, in order to ensure that there is an adequate supply to meet demand and minimize costs." -

Steve H. Potter and Brad K. Williams, Introduction to Operations and Supply Chain Management

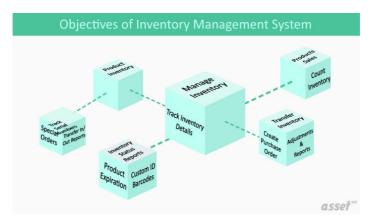
#### 1.4 OBJECTIVES OF INVENTORY MANAGEMENT

The objectives of inventory management can vary depending on the specific needs and goals of an organization. However, some common objectives of inventory management include:

- Material Availability: An inventory management system can help to
  ensure that the necessary materials and goods are available when needed
  by forecasting demand, placing orders with suppliers, and tracking the
  flow of goods from procurement to distribution. For example, a
  manufacturer might use an inventory management system to ensure that
  it has the raw materials and components on hand to meet production
  needs.
- 2. Better Level of Customer Service: An inventory management system can help to improve customer service by reducing the risk of stock-outs and ensuring that orders can be filled promptly. For example, a retailer might use an inventory management system to ensure that it has a sufficient quantity of popular products in stock to meet customer demand.
- 3. **Keeping Wastage and Losses to a Minimum:** An inventory management system can help to minimize waste and losses by ensuring that goods are stored and handled properly and by reducing excess inventory. For example, a food distributor might use an inventory management system to ensure that perishable goods are stored at the proper temperature and that they are rotated to minimize spoilage.
- 4. Maintaining Sufficient Stock: An inventory management system can help to ensure that there is enough inventory on hand to meet customer demand, but not so much that it becomes a burden in terms of storage and holding costs. For example, a clothing retailer might use an inventory management system to ensure that it has a sufficient quantity

of each size and style of clothing in stock, but not so much that it has to rent additional storage space.

- 5. **Cost-Effective Storage:** An inventory management system can help to optimize the storage of goods, reducing the amount of space needed and minimizing the costs associated with storage. For example, a warehouse might use an inventory management system to track the location of each item and to optimize the layout of the warehouse to minimize the amount of space needed.
- 6. Cost Value of Inventories Can Be Reduced: By managing inventory effectively, an inventory management system can help to reduce the cost of holding inventory, such as the cost of capital tied up in inventory and storage costs. For example, an organization might use an inventory management system to reduce excess inventory and streamline its supply chain, reducing the amount of capital tied up in inventory and the cost of storage.
- 7. Optimizing Product Sales: An inventory management system can help to optimize product sales by ensuring that the right products are available at the right time to meet customer demand. For example, a retailer might use an inventory management system to track the sales of each product and to adjust its ordering and stocking patterns to match customer demand.



#### 1.5 TYPES OF INVENTORY

Inventories are stocks of goods that are held by an organization in anticipation of future demand. There are many different types of inventory, each with its own characteristics and purposes. Here are a few examples:

- 1. **Raw materials inventory:** A manufacturer might maintain an inventory of raw materials, such as steel, aluminum, or plastics, to use in the production of its products.
- 2. **Maintenance, Repair, and Operating (MRO) inventory:** A facility manager might maintain an inventory of MRO items, such as spare parts, tools, and supplies, to use for maintenance, repairs, and general operations.
- 3. **Decoupling inventory:** A manufacturer might use decoupling inventory, such as finished goods or work in progress, to buffer between different stages of the production process and reduce the risk of disruptions.
- 4. **Work In Progress (WIP) inventory:** A manufacturer might maintain an inventory of WIP, such as partially completed products, to allow for flexibility in the production process and to reduce the risk of delays.
- Finished goods inventory: A retailer might maintain an inventory of finished goods, such as clothing, electronics, or home goods, to sell to customers.
- 6. **Cycle Stock:** A retailer might maintain a small inventory of fast-moving items, known as cycle stock, to meet the frequent demand for these products.
- 7. **Pipeline Stock:** An organization might maintain pipeline stock, such as raw materials or finished goods in transit, to ensure a continuous flow of goods and reduce the risk of delays.
- 8. **Anticipation Inventory:** An organization might maintain anticipation inventory, such as raw materials or finished goods, in anticipation of future demand or to hedge against potential supply chain disruptions.

- 9. **Hedge Inventory:** An organization might maintain hedge inventory, such as raw materials or finished goods, as a hedge against price fluctuations or supply chain disruptions.
- 10. **Buffer/Safety Stock:** An organization might maintain a small inventory of buffer or safety stock, such as raw materials or finished goods, to protect against unexpected demand or supply chain disruptions.

#### 1.6 INVENTORY MANAGEMENT TECHNIQUES

Here are some examples of how different inventory management techniques might be used in different organizations:

- 1. **Economic order Quantity:** An organization might use the economic order quantity (EOQ) formula to determine the optimal order quantity that will minimize the total cost of inventory, including the cost of placing orders, the cost of holding inventory, and the cost of stockouts. For example, a retailer might use the EOQ formula to determine the optimal order quantity for each product based on factors such as demand, lead times, and holding costs.
- 2. **Minimum order Quantity:** An organization might set a minimum order quantity for certain items to reduce the cost of placing orders and to ensure that there is a sufficient quantity of the item on hand to meet demand. For example, a manufacturer might set a minimum order quantity for raw materials to reduce the cost of placing frequent small orders and to ensure that there is a sufficient quantity of the material on hand to meet production needs.
- 3. **ABC Analysis:** An organization might use ABC analysis to classify its inventory based on the value or importance of the item. For example, a retailer might use ABC analysis to identify its most valuable or fast-moving products and allocate more resources to managing these items.
- 4. **Just-in-time Inventory Management:** An organization might use just-in-time (JIT) inventory management to minimize inventory levels

by only ordering and stocking the minimum amount of inventory needed to meet current demand. For example, a manufacturer might use JIT inventory management to reduce storage costs and the risk of inventory becoming obsolete by only ordering and stocking the raw materials and components needed for current production runs.

- 5. **Safety Stock inventory:** An organization might maintain a small quantity of safety stock, also known as buffer stock, to protect against unexpected demand or supply chain disruptions. For example, a retailer might maintain a small quantity of safety stock for each product to ensure that there is a sufficient supply to meet customer demand in the event of unforeseen circumstances.
- 6. **Reorder point Formula:** An organization might use the reorder point formula to determine when to place an order for additional inventory based on factors such as lead time, demand, and safety stock. For example, a retailer might use the reorder point formula to determine when to place an order for additional stock of a particular product based on the expected demand for the product, the lead time for the supplier to fulfill the order, and the desired level of safety stock.
- 7. **Batch Tracking:** An organization might use batch tracking to track the movement of goods through the production process or supply chain. For example, a manufacturer might use batch tracking to track the movement of raw materials and components through the production process and to ensure that each batch of finished goods is traceable.
- 8. **Consignment Inventory:** An organization might use consignment inventory, also known as vendor-managed inventory, to have its suppliers manage its inventory of goods. For example, a retailer might use consignment inventory to have its suppliers manage the inventory of goods in its stores, allowing the retailer to reduce its inventory holding costs.

- 9. Perpetual Inventory Management: An organization might use perpetual inventory management to continuously track inventory levels in real-time using technologies such as barcode scanners and RFID tags. For example, a warehouse might use perpetual inventory management to track the movement of goods in and out of the warehouse and to adjust its ordering and stocking patterns accordingly.
- 10. Dropshipping: An organization might use dropshipping to have its suppliers ship goods directly to customers on its behalf. For example, an e-commerce retailer might use dropshipping to have its suppliers ship goods directly to customers, allowing the retailer to reduce its inventory holding costs.
- 11. **Lean Manufacturing:** An organization might use lean manufacturing principles to eliminate waste and streamline its operations. For example, a manufacturer might use lean manufacturing principles to reduce inventory levels and improve the flow of goods and materials throughout the production process.
- 12. **Six Sigma:** An organization might use Six Sigma principles and tools to improve the efficiency and effectiveness of its processes and reduce defects. For example, a manufacturer might use Six Sigma tools and techniques to reduce the risk of defects in its production process and to streamline its operations.
- 13. **Lean Six Sigma:** An organization might use a combination of lean manufacturing principles and Six Sigma tools and techniques to improve the efficiency and effectiveness of its processes.
- 14. **FIFO and LIFO:** An organization might use the first-in, first-out (FIFO) or last-in, first-out (LIFO) method to determine the order in which inventory is sold or used. For example, a retailer might use the FIFO method to ensure that the oldest inventory is sold or used first, while a manufacturer might use the LIFO method to ensure that the most recently produced inventory is used first.

- 15. **Demand Forecasting:** An organization might use demand forecasting to predict future demand for its products or services based on historical data, market trends, and other factors. For example, a retailer might use demand forecasting to predict demand for its products during the holiday season and to adjust its inventory levels accordingly.
- 16. **Cross Docking:** An organization might use cross docking to streamline the movement of goods through the supply chain by transferring them from inbound vehicles or containers directly to outbound vehicles or containers without intermediate storage. For example, a logistics company might use cross docking to reduce the time and cost of handling and storing goods and to improve the flow of goods through the supply chain.
- 17. **Bulk Shipments:** An organization might use bulk shipments to reduce the cost of transportation and handling by shipping larger quantities of goods at once. For example, a manufacturer might use bulk shipments to reduce the cost of shipping raw materials or finished goods to its customers.

#### 1.7 ADVANTAGES OF INVENTORY MANAGEMENT

There are several advantages of implementing an effective inventory management system:

- 1. **Improved Efficiency:** An inventory management system can help to streamline operations and reduce waste by ensuring that the right amount of inventory is available when and where it is needed. This can help to reduce the time and cost of handling and storing inventory and to improve the flow of goods and materials throughout the supply chain.
- 2. **Enhanced Customer Service:** An inventory management system can help to ensure that there is a sufficient supply of products to meet customer demand, which can improve customer satisfaction and loyalty.
- 3. **Reduced Costs:** An inventory management system can help to reduce the total cost of inventory by minimizing excess inventory, reducing the

risk of stock-outs, and reducing the cost of holding and managing inventory.

- 4. **Increased Profits:** By reducing the total cost of inventory and improving efficiency, an inventory management system can help to increase profits.
- 5. **Greater Control:** An inventory management system can provide greater visibility and control over inventory levels, allowing organizations to better plan and forecast demand, optimize ordering, and track the movement of goods and materials.
- 6. Improved Accuracy: An inventory management system can help to reduce errors and improve the accuracy of inventory records, which can help to reduce the risk of lost or damaged inventory and improve decision-making.

#### DISADVANTAGES OF INVENTORY MANAGEMENT

There are also some potential disadvantages of implementing an inventory management system:

- 1. **Increased Complexity:** An inventory management system can add complexity to an organization's operations, especially if it involves the use of new technologies or processes. This can require additional training and resources to implement and maintain.
- 2. **Limited flexibility:** An inventory management system can be inflexible and may not be able to adapt to changing demand patterns or other unexpected events. This can lead to stock-outs or excess inventory, which can impact customer satisfaction and profits.
- 3. **Implementation Costs:** Implementing an inventory management system can be expensive, especially if it involves the purchase of new software or hardware or the integration of existing systems.
- 4. **Resistance to Change:** There may be resistance to change from employees who are accustomed to the existing system, which can make it difficult to implement an inventory management system.

- 5. **Data accuracy:** An inventory management system relies on accurate data to function effectively. If the data is not accurate, it can lead to incorrect decisions and inefficiencies.
- Dependence on Technology: An inventory management system may rely on technology to function, which can be vulnerable to technical issues or failures. This can disrupt operations and impact customer service.

For example, if a retail company implements an inventory management system that relies on barcode scanners to track inventory levels, the system might be disrupted if the scanners malfunction or if there are errors in the barcodes. This can lead to incorrect inventory counts and potential stockouts, which can impact customer satisfaction and sales.

#### 1.8 CAUTIONS

There are several precautions that organizations should take when implementing an inventory management system:

- 1. Ensure that the system is tailored to the organization's specific needs: It is important to select an inventory management system that is suited to the organization's size, complexity, and industry. A system that is too complex or inflexible may not be effective, while a system that is too simple may not provide the necessary level of control.
- 2. **Test the System before Fully Implementing it:** It is important to test the inventory management system to ensure that it is functioning as intended and to identify any issues or challenges before fully implementing it. This can help to avoid disruptions to operations or customer service.
- 3. **Train Employees on the System:** It is important to ensure that employees are trained on how to use the inventory management system effectively. This can help to ensure that the system is used correctly and that there are no errors or misunderstandings.
- 4. Monitor and Adjust the System Regularly: An inventory management system should be monitored and adjusted regularly to

ensure that it is meeting the organization's needs and to identify any areas for improvement.

- Maintain Accurate Data: The accuracy of the data in the inventory management system is critical to its effectiveness. It is important to ensure that data is entered and maintained accurately to avoid errors or miscommunications.
- 6. **Have a Backup Plan in Place:** It is important to have a backup plan in place in case the inventory management system fails or experiences technical issues. This can help to minimize disruptions to operations and customer service.

# CHAPTER 2 INVENTORY CONTROL

#### **INVENTORY CONTROL**

- 2.1 Introduction
- 2.2 Importance of Effective inventory control
- 2.3 Methods that can be used to control inventory
- 2.4 CASE STUDY 1
- 2.5 CASE STUDY 2

Chapter - 2
Inventory Control

#### 2.1 INTRODUCTION

Inventory control is the process of managing the flow of goods into and out of an organization's inventory. This includes activities such as forecasting demand, setting reorder points, and maintaining an accurate record of inventory levels.

#### 2.2 IMPORTANCE OF EFFECTIVE INVENTORY CONTROL

**1. Minimize Carrying Costs:** Carrying costs refer to the expenses associated with holding inventory, such as storage, insurance, and taxes. By minimizing inventory levels, a company can reduce its carrying costs.

There are several strategies that a company can use to minimize its carrying costs, which are the expenses associated with holding inventory, such as storage, insurance, and taxes. Some of these strategies include:

- Reducing inventory levels: One way to reduce carrying costs is to minimize the amount of inventory that a company holds. This can be done by using just-in-time (JIT) production techniques to minimize the need for large inventory buffers, or by using techniques such as vendormanaged inventory (VMI) to shift some of the inventory management responsibility to the supplier.
- Using cost-effective storage solutions: Choosing the right storage solution can help to minimize carrying costs. For example, a company might use a smaller, more efficient warehouse or consider using offsite storage options such as public warehouses or cloud storage.
- Negotiating better terms with suppliers: A company can negotiate longer payment terms with its suppliers, which can reduce the amount of capital tied up in inventory.
- Optimizing inventory turnover: A company can aim to sell its inventory
  as quickly as possible in order to minimize carrying costs. This can be
  achieved by carefully forecasting demand and adjusting inventory levels
  accordingly.

- Reviewing insurance coverage: A company should review its insurance coverage regularly to ensure that it is not paying for coverage that is not needed.
- Managing inventory accurately: Accurate inventory management can help to minimize carrying costs by reducing the risk of excess or obsolete inventory, which can be costly to store and dispose of.

Here are a few examples of how companies have implemented strategies to minimize carrying costs:

Walmart: Walmart is known for its focus on efficiency and cost-cutting, and one of the ways it has been able to do this is by implementing a just-in-time (JIT) inventory management system. This involves only ordering and stocking the minimum amount of inventory needed to meet demand, which helps reduce carrying costs by minimizing the amount of inventory that needs to be stored and managed.

Amazon: Amazon uses a combination of advanced technology and data analytics to optimize its inventory management. This includes using algorithms to forecast demand and identify slow-moving or excess inventory, as well as utilizing automated systems for handling and moving inventory in its warehouses. All of these strategies help Amazon minimize carrying costs by reducing the amount of inventory it needs to hold and improving the efficiency of its inventory management.

Toyota: Toyota is another company that has implemented a JIT inventory management system to minimize carrying costs. This involves only producing and ordering the minimum amount of inventory needed to meet demand, which helps reduce the amount of inventory that needs to be stored and managed. Toyota has also implemented other strategies to minimize carrying costs, such as using consignment inventory and negotiating favorable payment terms with suppliers.

**2. Avoid Stock-Outs:** If a company runs out of a product that is in high demand, it may lose sales and damage its reputation. By carefully

managing its inventory, a company can ensure that it has the products customers want when they want them.

A stock-out, also known as a stock-outage or out-of-stock (OOS) event, refers to a situation in which a product is not available for purchase because it has run out of stock. Stock-outs can be costly for a company, as they can lead to lost sales and damage to the company's reputation. To avoid stock-outs, a company can implement the following strategies:

- Accurate Demand forecasting: By accurately forecasting demand for a product, a company can ensure that it has the right amount of inventory on hand to meet customer needs.
- **Setting Reorder Points**: A reorder point is the level of inventory at which a company should place a new order for a product. By setting reorder points based on past demand and lead times, a company can ensure that it has the right amount of inventory on hand to meet demand.
- Maintaining Safety Stock: Safety stock is a minimum level of inventory that a company maintains to protect against unexpected events, such as a sudden increase in demand or a disruption in the supply chain. By maintaining safety stock, a company can help to avoid stock-outs.
- Managing the Supply Chain: A company can work with its suppliers to improve the reliability of the supply chain and reduce the risk of stock-outs. This might involve establishing partnerships with multiple suppliers, implementing just-in-time (JIT) production techniques, or using inventory management software to track supplier performance.
- Communicating with Customers: If a stock-out is unavoidable, a company should communicate with its customers to let them know when the product will be back in stock and offer alternative products or solutions if possible. This can help to minimize the impact of the stock-out on customer satisfaction and loyalty.

Here are a few examples of how companies have implemented strategies to avoid stock-outs:

Amazon: Amazon uses a combination of advanced technology and data analytics to optimize its inventory management. This includes using algorithms to forecast demand and identify potential stock-outs, as well as implementing automated systems for reordering and restocking inventory.

Starbucks: Starbucks has implemented a real-time inventory management system that uses data from point-of-sale registers and customer orders to track inventory levels and identify potential stock-outs. This helps the company avoid running out of popular items and ensure that its stores are well-stocked.

Zara: Zara is known for its fast fashion model, which involves rapidly producing and restocking items based on customer demand. To avoid stock-outs, the company uses data from its sales and customer feedback to identify popular items and quickly produce more of them. It also uses data to identify slow-moving items and adjust its production and inventory levels accordingly.

Dell: Dell has implemented a just-in-time (JIT) inventory management system to avoid stock-outs. This involves only producing and ordering the minimum amount of inventory needed to meet demand, which helps reduce the risk of running out of stock. Dell also uses data analytics to forecast demand and optimize its inventory levels.

**3. Improve Efficiency:** Proper inventory control can help to streamline operations by ensuring that the right products are available at the right time, reducing the need for rush orders and unnecessary handling of inventory.

Proper inventory management can help to improve the efficiency of a company's operations in several ways:

• Streamlining order processing: By automating the process of receiving, reviewing, and fulfilling customer orders, a company can reduce the time and effort required to manage its inventory.

- Reducing unnecessary handling: By carefully organizing and managing
  its warehouse or storage facility, a company can reduce the amount of
  time and effort required to locate and retrieve items from inventory.
- Minimizing lead times: By optimizing the supply chain and using justin-time (JIT) production techniques, a company can reduce the time it takes to receive new inventory, which can help to improve efficiency.
- Reducing the risk of errors: Accurate inventory management can help to reduce the risk of errors, such as shipping the wrong product or running out of stock. This can help to minimize the impact of such errors on customer satisfaction and the company's operations.
- Improving inventory turnover: By carefully managing its inventory levels, a company can reduce the amount of time that products spend in storage, which can help to improve inventory turnover and increase efficiency.
- Reducing the need for rush orders: By accurately forecasting demand and maintaining appropriate inventory levels, a company can reduce the need for rush orders, which can be costly and inefficient.

#### **Example:**

Walgreens: Walgreens has implemented a centralized inventory management system that uses data from its stores to optimize inventory levels and reduce waste. This helps the company improve the efficiency of its inventory management by ensuring that its stores have the right amount of inventory to meet demand and minimizing excess inventory.

**4. Increase Profits:** By minimizing carrying costs and maximizing sales, effective inventory control can help to increase a company's profits.

Effective inventory management can help a company to increase its profits in several ways:

- Reducing carrying costs: By minimizing the amount of inventory that a
  company holds, it can reduce its carrying costs, such as storage,
  insurance, and taxes. This can help to increase profits.
- Increasing sales: By avoiding stock-outs and ensuring that the right products are available when customers want them, a company can increase its sales and profits.
- Optimizing pricing: By analyzing demand and competition, a company can set the optimal price for its products to maximize profits.
- Improving efficiency: By streamlining its operations and reducing the risk of errors, a company can increase its efficiency and profits.
- Reducing waste: By accurately forecasting demand and managing inventory levels, a company can reduce the risk of excess or obsolete inventory, which can be costly to store and dispose of. This can help to increase profits.
- Negotiating better terms with suppliers: A company can negotiate longer payment terms with its suppliers or secure discounts on bulk orders, which can help to reduce the cost of goods and increase profits.

#### **Example**

Bharat Petroleum Corporation Limited (BPCL): BPCL, an Indian stateowned oil and gas company, has implemented an effective inventory management system to increase profits. This includes using data analytics to optimize inventory levels and reduce waste, as well as implementing automation in its warehouses to improve efficiency.

#### 2.3 Methods that can be used to Control Inventory

First-in, first-out (FIFO): This method assumes that the first items to be received are the first ones to be used or sold.

1. Last-in, first-out (LIFO): This method assumes that the last items to be received are the first ones to be used or sold.

- 2. Average cost: This method assigns the same cost to all units in inventory, regardless of when they were received.
- 3. Just-in-time (JIT): This method involves only ordering inventory as it is needed, in order to minimize inventory levels.
- 4. Kanban: This method involves using a visual signal to trigger the production or movement of inventory.

#### 2.4 CASE STUDY 1

Here is a case study of inventory control at a retail company:

#### **COMPANY: XYZ RETAIL**

**Background:** XYZ Retail is a medium-sized retail company that sells a variety of products, including clothing, electronics, and home goods. The company has experienced some issues with its inventory management, including stock-outs of popular items and excess inventory of slow-moving items. As a result, XYZ Retail's profits have been lower than expected.

# Problem: XYZ Retail needs to improve its inventory management to increase profits.

Solution: XYZ Retail implements the following strategies to improve its inventory management:

- Implementing an effective inventory management system: XYZ Retail
  installs an inventory management software that enables it to track
  inventory levels, forecast demand, and identify slow-moving or excess
  inventory.
- Utilizing data analytics: XYZ Retail uses data from its sales and customer feedback to identify popular items and quickly restock them, as well as to identify slow-moving items and adjust its inventory levels accordingly.
- Implementing automated systems for handling and moving inventory: XYZ Retail installs conveyor belts and other automation systems in its warehouses to improve the efficiency of its inventory management.

 Negotiating favorable payment terms with suppliers: XYZ Retail negotiates longer payment periods with its suppliers to reduce the amount of working capital tied up in inventory.

**Result:** After implementing these strategies, XYZ Retail is able to reduce stock-outs and excess inventory, which leads to an increase in profits. The company's inventory management becomes more efficient, and its customers are happier with the availability of popular items.

#### 2.5 CASE STUDY 2

Here is a case study of inventory control at Tata Motors, an Indian multinational automobile manufacturer:

**Background:** Tata Motors is a leading automobile manufacturer in India that produces a range of vehicles, including cars, trucks, and buses. The company has experienced some issues with its inventory management, including excess inventory of slow-moving items and high carrying costs. As a result, Tata Motors' profits have been lower than expected.

# Problem: Tata Motors needs to improve its inventory management to increase profits.

Solution: Tata Motors implements the following strategies to improve its inventory management:

- Implementing an effective inventory management system: Tata Motors installs an inventory management software that enables it to track inventory levels, forecast demand, and identify slow-moving or excess inventory.
- Utilizing data analytics: Tata Motors uses data from its sales and customer feedback to identify popular vehicles and quickly restock them, as well as to identify slow-moving items and adjust its inventory levels accordingly.
- Implementing just-in-time (JIT) inventory management: Tata Motors implements a JIT inventory management system that involves only producing and ordering the minimum amount of inventory needed to

meet demand. This helps reduce the amount of inventory that needs to be stored and managed, as well as the carrying costs associated with it.

- Negotiating favorable payment terms with suppliers: Tata Motors negotiates longer payment periods with its suppliers to reduce the amount of working capital tied up in inventory.
- Utilizing consignment inventory: Tata Motors begins storing inventory
  at its suppliers' locations and only pays for items as they are sold. This
  helps reduce carrying costs by transferring the cost of holding inventory
  to the supplier.

**Result:** After implementing these strategies, Tata Motors is able to reduce excess inventory and carrying costs, which leads to an increase in profits. The company's inventory management becomes more efficient, and it is able to meet customer demand more effectively.

# CHAPTER 3 DEMAND FORECASTING

## DEMAND FORECASTING

- 3.1 Introduction
- 3.2 Importance of Demand Forecasting
- 3.3 Demand Forecasting Techniques
- 3.4 Types of Inventory Forecasting
- 3.5 Types of Inventory Demand Forecasting



Chapter - 3
Demand Forecasting

#### 3.1 INTRODUCTION

Demand forecasting is the process of predicting the future demand for a product or service. It is an important business function that helps companies plan for the future, make informed decisions about production, and manage their resources effectively. There are several methods for forecasting demand, including statistical methods, machine learning algorithms, and expert judgment.

There are several factors that can affect demand forecasting, including market trends, economic conditions, competition, and consumer behavior. Companies may use a variety of data sources to inform their forecasting, including sales data, market research, and economic indicators.

Accurate demand forecasting is essential for businesses to optimize their operations and make informed decisions about production, pricing, and inventory management. It can help companies avoid overproduction and excess inventory, while also ensuring that they have enough products or services to meet customer demand.

#### 3.2 IMPORTANCE OF DEMAND FORECASTING

The significance of anticipating demand in inventory management

Demand forecasting is essential for good stock management whether you are a manufacturer, wholesaler, or retailer. If you can reliably estimate demand, you may take steps to guarantee you have enough stock to meet high fulfilment rates or service standards. Correct demand forecasting reduces the danger of stockouts, manufacturing interruption, and/or lost revenues.

Accurate inventory planning enables you to satisfy consumption requirements or fulfil client demands while avoiding needless stock investments. This successfully aids in the reduction of total operational expenditures. For optimal inventory control, great forecasting allows you to keep the proper quantity of goods without overstocking or understocking.

However, reliable inventory forecasting is a difficult task. In this lesson, we'll go through eight essential demand forecasting techniques.

## 3.3 DEMAND FORECASTING TECHNIQUES

Demand forecasting is the process of estimating the future demand for a product or service. Accurate demand forecasting is important for businesses because it helps them to plan their production and inventory, allocate resources, and make informed decisions about pricing and marketing. There are several techniques that businesses can use to forecast demand, including:

## 1. Time Series Analysis

This technique involves analyzing past data to identify trends and patterns, and then using those trends and patterns to forecast future demand. For example, a company that sells snow shovels might use time series analysis to forecast demand for their product based on data on past sales and weather patterns.

Time series analysis is a technique used to forecast future demand by analyzing past data to identify trends and patterns. It is based on the assumption that the factors that have influenced demand in the past will continue to influence demand in the future.

To use time series analysis, businesses typically gather data on past demand for their product or service and plot it on a graph. They then look for patterns in the data, such as seasonality, trends, and cyclical patterns. They can then use these patterns to develop a forecast for future demand.

There are several statistical tools and techniques that can be used in time series analysis, including trend analysis, seasonality analysis, and autoregressive integrated moving average (ARIMA) models. Businesses can use these tools to identify and forecast trends, seasonality, and other patterns in the data.

Time series analysis is useful because it allows businesses to make informed decisions about production and inventory based on past demand patterns. It can also help businesses to identify and respond to changes in demand over time.

## 2. Causal Analysis

This technique involves identifying the factors that influence demand and using statistical models to predict how changes in those factors will affect demand. For example, a clothing retailer might use causal analysis to forecast demand for winter jackets based on factors such as the weather forecast, consumer income, and competitors' prices.

Causal analysis is a technique used to forecast demand by identifying the factors that influence demand and using statistical models to predict how changes in those factors will affect demand.

To use causal analysis, businesses typically gather data on past demand for their product or service, as well as data on the factors that influence demand, such as consumer income, competitors' prices, and external events. They then use statistical models, such as multiple regression analysis or structural equation modeling, to identify the relationships between these factors and demand.

Once the relationships between the factors and demand have been identified, businesses can use the model to forecast future demand by making assumptions about how the factors will change over time. For example, if a business expects consumer income to increase in the future, they can use their causal model to predict how this will affect demand for their product.

Causal analysis is useful because it allows businesses to understand the drivers of demand and to forecast how changes in those drivers will affect demand. It is particularly useful when there are clear relationships between demand and external factors, such as consumer income or competitors' prices.

## 3. Delphi Technique

This technique involves collecting forecasts from a panel of experts and then using those forecasts to generate a consensus forecast. For example, a software company might use the Delphi method to forecast demand for their product by collecting forecasts from a panel of experts in the industry, such as analysts and consultants.

The Delphi technique is a method for collecting and synthesizing the opinions of a panel of experts in order to generate a consensus forecast. The process typically involves several rounds of questioning, in which the experts are asked to provide their forecasts or opinions on a particular topic. The responses are then compiled and summarized, and the experts are asked to review and revise their forecasts based on the collective input of the group.

The Delphi technique is often used in situations where there is a lack of clear data or when there is a need to tap into the collective wisdom of experts in a particular field. It is useful because it allows experts to consider the perspectives of others and to refine their own forecasts based on the input of the group.

To use the Delphi technique, a facilitator selects a panel of experts and develops a set of questions or issues for them to consider. The experts are then asked to provide their forecasts or opinions in writing, either through a survey or through an online platform. The responses are then compiled and summarized, and the experts are asked to review and revise their forecasts based on the collective input of the group. This process is typically repeated several times until a consensus is reached or until the forecasts become more accurate.

## 4. Conjoint Analysis (Consumer Surveys)

This technique involves collecting data from consumers through surveys or focus groups to understand their purchasing habits and future intentions. For example, a car manufacturer might use consumer surveys to forecast demand for their vehicles by asking consumers about their future purchasing plans and the features they are most interested in.

Consumer surveys are a technique used to forecast demand by collecting data from consumers through surveys or focus groups. Surveys can be

conducted online, by phone, or in person, and they typically ask consumers questions about their purchasing habits, preferences, and future intentions.

To use consumer surveys to forecast demand, businesses typically develop a list of questions to ask consumers and then use a sampling method to select a representative group of consumers to participate in the survey. The responses are then analyzed to understand consumer preferences and purchasing habits, and this information is used to forecast future demand.

Consumer surveys are useful because they allow businesses to gather direct feedback from consumers about their purchasing plans and preferences. They can be particularly useful when the demand for a product or service is driven by consumer behavior, such as when consumer preferences or trends are changing rapidly.

However, consumer surveys have some limitations, including the potential for bias in the sample and the difficulty of accurately predicting consumer behavior. As such, businesses should be careful to design their surveys carefully and to consider other forecasting techniques in conjunction with consumer surveys.

#### 5. Market Research

This technique involves collecting data from a variety of sources, such as industry reports, trade associations, and competitors, to understand market trends and the potential demand for a product or service. For example, a company that sells outdoor gear might use market research to forecast demand for their products by studying trends in the outdoor industry and gathering data on competitors' sales.

Market research is a technique used to forecast demand by collecting data from a variety of sources, such as industry reports, trade associations, and competitors, to understand market trends and the potential demand for a product or service.

To use market research to forecast demand, businesses typically gather data on a range of factors that might influence demand, such as industry trends, competitors' sales, and market conditions. They can use this information to identify trends and patterns in the market and to make informed predictions about future demand.

Market research is useful because it allows businesses to gather a wide range of data from multiple sources and to understand the broader context in which their product or service operates. It can be particularly useful when the demand for a product or service is influenced by factors outside the business, such as industry trends or market conditions.

However, market research has some limitations, including the potential for bias in the data and the difficulty of accurately predicting future market conditions. As such, businesses should be careful to consider multiple sources of data and to use other forecasting techniques in conjunction with market research.

## 6. Econometric Forecasting

Econometric forecasting is a technique used to forecast demand for goods and services by using economic theory and statistical analysis to identify relationships between economic variables and demand. Econometric forecasting models typically incorporate a range of factors that can influence demand, such as consumer income, employment levels, inflation, and interest rates.

To use econometric forecasting, businesses typically gather data on past demand for their product or service, as well as data on the economic variables that influence demand. They then use statistical analysis, such as multiple regression analysis or structural equation modeling, to identify the relationships between these variables and demand. Once the relationships have been identified, businesses can use the model to forecast future demand by making assumptions about how the economic variables will change over time.

Econometric forecasting is useful because it allows businesses to consider a wide range of factors that can influence demand and to make more accurate forecasts than they could with other techniques. It is particularly useful in

situations where demand is influenced by macroeconomic factors, such as consumer income or employment levels.

However, econometric forecasting has some limitations, including the need for large amounts of data to develop the models and the difficulty of accurately predicting future economic conditions. As such, businesses should be careful to consider multiple sources of data and to use other forecasting techniques in conjunction with econometric forecasting.

## Here is an Example of Econometric Forecasting

A clothing retailer is trying to forecast demand for their winter jackets. To do this, they gather data on past demand for winter jackets, as well as data on economic variables that might influence demand, such as consumer income, unemployment rates, and inflation. They use multiple regression analysis to identify the relationships between these variables and demand for winter jackets.

The analysis shows that consumer income and unemployment rates are the most significant factors influencing demand for winter jackets. Based on this information, the retailer makes the following assumptions about how these variables will change over the coming winter season:

Consumer income: The retailer expects consumer income to increase slightly over the winter season due to an uptick in the economy.

Unemployment rates: The retailer expects unemployment rates to remain relatively stable over the winter season.

Using these assumptions, the retailer can use their econometric model to forecast demand for winter jackets over the coming season. For example, if the model predicts that demand for winter jackets will increase by 5% for every 1% increase in consumer income, and the retailer expects consumer income to increase by 2%, then they can forecast that demand for winter jackets will increase by 10% over the winter season.

This is just one example of how econometric forecasting can be used to forecast demand. The specific factors and assumptions will vary depending

on the product or service being forecasted and the economic conditions in the market.

## 7. Artificial intelligence and Machine Learning

These techniques involve using algorithms and data analysis to predict demand based on past data and trends. For example, a grocery store might use artificial intelligence and machine learning to forecast demand for their products by analyzing data on past sales, customer demographics, and weather patterns.

Artificial intelligence (AI) and machine learning are techniques used to forecast demand by using algorithms and data analysis to predict demand based on past data and trends.

To use AI and machine learning to forecast demand, businesses typically gather data on past demand for their product or service, as well as data on the factors that influence demand, such as consumer demographics and market conditions. They then use machine learning algorithms to analyze the data and identify patterns and trends. These algorithms can be trained to recognize patterns in the data and to make predictions about future demand based on those patterns.

AI and machine learning are useful because they allow businesses to analyze large amounts of data quickly and to make more accurate forecasts than they could with traditional techniques. They can also adapt to changes in the data and improve their forecasts over time.

However, AI and machine learning have some limitations, including the need for large amounts of data to train the algorithms and the risk of bias in the data. As such, businesses should be careful to ensure that their data is representative and to consider other forecasting techniques in conjunction with AI and machine learning.

Here are some examples of how artificial intelligence (AI) and machine learning can be used to forecast demand:

• A grocery store is trying to forecast demand for various products, such as milk, bread, and eggs. They gather data on past sales of these

products, as well as data on factors that might influence demand, such as weather patterns and customer demographics. They use a machine learning algorithm, such as a neural network, to analyze the data and identify patterns and trends. The algorithm is trained to recognize patterns in the data and to make predictions about future demand based on those patterns. For example, the algorithm might predict that demand for milk will increase on days when it is raining, or that demand for bread will be higher in neighborhoods with a higher percentage of young families.

- A transportation company is trying to forecast demand for their services, such as ride-hailing or car rentals. They gather data on past demand for their services, as well as data on factors that might influence demand, such as the time of day, the day of the week, and special events. They use a machine learning algorithm, such as a decision tree, to analyze the data and identify patterns and trends. The algorithm is trained to recognize patterns in the data and to make predictions about future demand based on those patterns. For example, the algorithm might predict that demand for ride-hailing services will be higher on Friday nights, or that demand for car rentals will be higher during the summer months.
- An e-commerce company is trying to forecast demand for their products, such as clothing, electronics, and home goods. They gather data on past sales of their products, as well as data on factors that might influence demand, such as consumer preferences, competitors' prices, and marketing campaigns. They use a machine learning algorithm, such as a gradient boosting model, to analyze the data and identify patterns and trends. The algorithm is trained to recognize patterns in the data and to make predictions about future demand based on those patterns. For example, the algorithm might predict that demand for a particular type of clothing will be higher during the holiday season, or that demand for a particular type of electronics will be higher in certain regions of the country.

#### 3.4 TYPES OF INVENTORY FORECASTING

Inventory forecasting is the process of estimating the future demand for a product or service and using that information to plan inventory levels. There are several types of inventory forecasting, including:

 Deterministic Forecasting: This type of forecasting involves using fixed assumptions about future demand to predict inventory needs. Deterministic forecasting is based on the assumption that demand will be consistent and predictable, and it does not account for uncertainty or variability.

**Example:** A clothing retailer is trying to forecast demand for their winter jackets. They use deterministic forecasting to predict that they will sell 1,000 winter jackets in the upcoming season, based on their fixed assumption that demand will be consistent with past years.

2. **Probabilistic Forecasting:** This type of forecasting involves using statistical models to estimate the likelihood of different demand scenarios occurring. Probabilistic forecasting accounts for uncertainty and variability in demand, and it provides a range of potential forecasts rather than a single fixed prediction.

**Example:** A toy manufacturer is trying to forecast demand for their new toy. They use probabilistic forecasting to estimate that there is a 60% chance that they will sell 500 units of the toy, a 30% chance that they will sell 1,000 units, and a 10% chance that they will sell 2,000 units.

3. **Qualitative Forecasting:** This type of forecasting involves using subjective judgment and expert opinions to estimate future demand. Qualitative forecasting is based on subjective factors, such as consumer preferences or market trends, and it is often used in situations where data is limited or unreliable.

**Example:** A restaurant is trying to forecast demand for their new menu items. They use qualitative forecasting to estimate that demand for the new items will be high based on their subjective judgment of consumer preferences and market trends.

4. **Quantitative Forecasting:** This type of forecasting involves using statistical analysis and mathematical models to estimate future demand. Quantitative forecasting is based on objective data, such as past sales or market trends, and it is often used in situations where data is abundant and reliable.

**Example:** A grocery store is trying to forecast demand for their products. They use quantitative forecasting to estimate future demand based on statistical analysis of past sales data and market trends.

5. **Hybrid Forecasting:** This type of forecasting involves combining multiple forecasting techniques, such as deterministic and probabilistic forecasting, to generate a more accurate forecast. Hybrid forecasting is often used in situations where different forecasting techniques provide complementary information.

**Example:** A clothing retailer is trying to forecast demand for their summer dresses. They use a hybrid approach, combining deterministic forecasting based on past sales data with probabilistic forecasting based on consumer surveys and market research. This allows them to consider both objective data and subjective factors in their forecast.

#### 3.5 TYPES OF INVENTORY DEMAND FORECASTING

Inventory demand forecasting involves estimating the future demand for a product or service and using that information to plan inventory levels. There are several types of inventory demand forecasting, including:

 Continuous Demand Forecasting: This type of forecasting is used when demand for a product or service is consistent and predictable over time. Continuous demand forecasting is based on the assumption that demand will remain stable and that inventory levels can be planned accordingly.

**Example:** A pharmaceutical company is trying to forecast demand for a popular over-the-counter medication. They use continuous demand forecasting to predict that they will sell a consistent number of units of the

medication each month, based on the assumption that demand will remain stable over time.

2. **Intermittent Demand Forecasting:** This type of forecasting is used when demand for a product or service is unpredictable and occurs in irregular intervals. Intermittent demand forecasting is based on the assumption that demand will vary over time and that inventory levels must be adjusted to meet changing demand.

**Example:** A restaurant is trying to forecast demand for their catering services. They use intermittent demand forecasting to estimate that demand for catering will vary from month to month based on the number of events and parties being held.

3. **Seasonal Demand Forecasting:** This type of forecasting is used when demand for a product or service follows a predictable pattern based on the time of year. Seasonal demand forecasting is based on the assumption that demand will vary over time and that inventory levels must be adjusted to meet changing demand.

**Example:** A clothing retailer is trying to forecast demand for their winter coats. They use seasonal demand forecasting to predict that demand for winter coats will be higher in the colder months and lower in the warmer months, based on the assumption that demand follows a predictable seasonal pattern.

4. **Cyclical Demand Forecasting:** This type of forecasting is used when demand for a product or service follows a predictable pattern based on economic cycles. Cyclical demand forecasting is based on the assumption that demand will vary over time and that inventory levels must be adjusted to meet changing demand.

**Example:** A furniture retailer is trying to forecast demand for their products. They use cyclical demand forecasting to predict that demand for furniture will be higher during the spring and summer months and lower during the fall and winter months, based on the assumption that demand follows a predictable cyclical pattern.

5. **Disruptive Demand Forecasting:** This type of forecasting is used when there are sudden and significant changes in demand for a product or service. Disruptive demand forecasting is based on the assumption that demand will vary dramatically over time and that inventory levels must be quickly adjusted to meet changing demand.

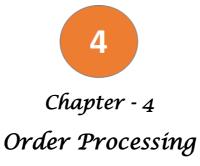
**Example:** Disruptive demand forecasting: A sporting goods store is trying to forecast demand for their products. They use disruptive demand forecasting to predict that demand for certain products, such as sports jerseys and hats, will spike dramatically during major sporting events, based on the assumption that demand will vary significantly due to disruptive events.

## CHAPTER 4

## **ORDER PROCESSING**

## **ORDER PROCESSING**

- 4.1 Introduction
- 4.2 Definitions of order processing from various sources:
- 4.3 Steps in order processing
- 4.4 Importance of Order Processing
- 4.5 Limitations Of order Processing



#### 4.1 INTRODUCTION

Order processing is the process of receiving and fulfilling customer orders for products or services. It is a crucial part of any business, as it ensures that customers receive the products or services they have ordered in a timely and efficient manner. Effective order processing can help improve customer satisfaction and loyalty, as well as increase the efficiency of the business overall.

There are many different steps involved in order processing, depending on the specific business and the products or services being offered. Some common steps include receiving the order, verifying the order, assigning inventory, processing payment, fulfilling the order, updating inventory, and providing confirmation and tracking information.

To effectively process orders, businesses may use a variety of tools and systems, such as online stores, inventory management software, and payment processing systems. They may also need to coordinate with logistics providers to handle shipping and delivery, and with customer service teams to handle any questions or issues that may arise.

## 4.2 DEFINITIONS OF ORDER PROCESSING FROM VARIOUS SOURCES

"Order processing is the process of receiving, verifying, and fulfilling customer orders for goods or services." (Entrepreneur)

"Order processing is the series of steps that a company takes to complete a customer's order. It includes receiving the order, verifying the order, assigning inventory, processing payment, and fulfilling the order." (Investopedia)

"Order processing is the procedure of receiving, verifying, and completing a customer's request for a product or service. It typically involves several steps, such as receiving the order, verifying the order, processing payment, assigning inventory, fulfilling the order, and providing confirmation and tracking information." (Business Dictionary)

"Order processing is the systematic handling of customer orders, from the moment the order is placed to the moment it is delivered. It involves receiving the order, verifying it, assigning inventory, processing payment, and fulfilling the order." (Shopify)

"Order processing is the process of receiving, verifying, and fulfilling customer orders for products or services. It involves a variety of tasks, such as reviewing the order to ensure it is complete and accurate, assigning inventory and processing payment, and coordinating with logistics providers to handle shipping and delivery." (The Balance Small Business)

Here are some common terms related to order processing:

- 1. Order: A request from a customer for a product or service, typically including details such as the type and quantity of items requested, delivery address, and payment information.
- 2. Customer: An individual or organization that purchases goods or services from a business.
- 3. Inventory: The goods or materials that a business has in stock, typically stored in a warehouse or other storage facility.
- 4. Fulfillment: The process of completing an order and delivering the requested product or service to the customer.
- 5. Payment processing: The process of accepting and verifying payment for an order, typically through a credit card or electronic payment system.
- Tracking information: Information provided to the customer about the status of their order, including the expected delivery date and any relevant tracking numbers.
- 7. Logistics: The management of the flow of goods, information, and other resources between the point of origin and the point of consumption in order to meet the requirements of customers.

8. Customer service: The support provided to customers by a business, including answering questions, addressing concerns, and handling complaints.

#### 4.3 STEPS IN ORDER PROCESSING

Here are some common steps in order processing, along with examples:

- Receiving the Order: This step involves capturing the customer's order in some way, such as through an online form, a physical store, or over the phone. For example, a customer might place an order online by adding items to their virtual shopping cart and completing the checkout process.
- 2. Verifying the order: This step involves checking that the order is complete, accurate, and authorized. This might include verifying the customer's payment information, checking that all required fields have been completed, and ensuring that the customer has the necessary permissions or authorization to place the order. For example, a business might verify that a customer's credit card has sufficient funds to cover the cost of their order before proceeding.
- 3. **Assigning inventory:** If the order is for a physical product, inventory will need to be pulled from a warehouse or storage location and reserved for the customer's order. This step may involve updating the inventory management system to reflect the changes. For example, if a customer orders a shirt from an online store, the store might check their inventory to ensure that the shirt is in stock and then mark it as "reserved" for the customer's order.
- 4. **Processing Payment:** Payment for the order must be processed and authorized. This might involve verifying the customer's payment information, charging their credit card, or completing some other form of payment. For example, if a customer pays for their order with a credit card, the business might send the payment information to a payment processor to confirm that the card is valid and has sufficient funds.

- 5. **Fulfilling the Order:** The product or service must be delivered to the customer, either by shipping it to their address or providing it to them in person. This might involve coordinating with a logistics provider or other third party to handle the delivery. For example, if a customer orders a shirt from an online store, the store might package the shirt and send it to the customer via a shipping company like UPS or FedEx.
- 6. **Updating inventory:** The inventory system must be updated to reflect the changes made during the order processing process. This might involve adjusting the quantity of a product in stock, marking items as "reserved" or "sold," or adding new products to the inventory. For example, if a customer orders a shirt from an online store, the store might update their inventory to reflect that one fewer shirt is available for sale.
- 7. **Providing Confirmation and Tracking Information:** The customer should be notified that their order has been received and is being processed, and provided with tracking information if applicable. This might involve sending an email confirmation or providing a tracking number that the customer can use to follow the status of their order. For example, if a customer orders a shirt from an online store, the store might send them an email confirmation with a tracking number that they can use to track the progress of their delivery.

## 4.4 Importance of Order Processing

Order processing is an essential part of any business, as it ensures that customers receive the products or services they have ordered in a timely and efficient manner. Effective order processing can improve customer satisfaction and loyalty, as well as increase the efficiency of the business overall. By streamlining the process and minimizing errors, a business can save time and money, and focus on other important tasks. Accurate order processing is also important to ensure that customers receive the correct products or services, and to manage inventory and cash flow effectively. Overall, order processing plays a crucial role in the smooth operation of a business and is essential for maintaining customer satisfaction and loyalty.

Here are some examples of the importance of order processing:

- 1. Customer Satisfaction: If a business has a well-organized order processing system in place, it is more likely to be able to fulfill orders quickly and accurately. For example, if a customer orders a shirt from an online store and receives it within a few days, they are likely to be satisfied with the business's service. On the other hand, if the order is delayed or the wrong product is sent, the customer is likely to be disappointed and may be less likely to order from the business again in the future.
- 2. **Business Efficiency:** An efficient order processing system can help a business save time and money by reducing errors and streamlining the process. For example, if a business uses an automated inventory management system, it can save time and reduce the risk of errors by accurately tracking orders and updating inventory records in real time.
- 3. **Order Accuracy:** Accurate order processing is important to ensure that customers receive the correct products or services. For example, if a customer orders a shirt from an online store and the store sends the wrong size or color, the customer is likely to be unhappy and may request a return or exchange. This can be costly and time-consuming for the business to handle.
- 4. **Inventory Management:** Effective order processing can help a business manage its inventory more effectively. For example, if a business uses an automated system to track orders and update inventory records in real time, it can avoid running out of stock on popular items or overstocking on less popular ones.
- 5. **Cash Flow:** Proper order processing can help a business manage its cash flow more effectively. For example, if a business processes orders and payments promptly, it can ensure that it has the necessary funds to cover its expenses and continue operating smoothly. On the other hand, if orders are delayed or payment processing is slow, it can cause cash flow problems and potentially disrupt the business's operations.

## 4.5 Limitations of order Processing

There are several limitations to order processing that businesses should be aware of. Time constraints may limit the ability of a business to fulfill orders, particularly for perishable goods or time-sensitive services. Limited capacity may also be an issue, as there may be limits to the number of orders a business can process at any given time due to factors such as inventory availability, staffing levels, or processing capacity. Human error is another potential limitation, as mistakes can occur despite the use of automation and other tools. Technical issues, such as system outages or data breaches, can also disrupt the order processing process. Finally, customer expectations can be a limitation, as customers may have certain expectations about the speed and quality of service that a business may not be able to meet.

## HERE ARE SOME EXAMPLES OF LIMITATIONS OF ORDER PROCESSING:

- 1. **Time Constraints**: If a business offers perishable goods or timesensitive services, there may be time constraints on the order processing process. For example, a bakery might only be able to process orders for same-day delivery, as baked goods have a limited shelf life.
- 2. **Limited Capacity:** There may be limits to the number of orders a business can process at any given time. For example, if a business has a small warehouse and only a few staff members, it may be able to process only a limited number of orders per day.
- 3. **Human Error:** Despite the use of automation and other tools, there is always a risk of human error in order processing. For example, a store employee might accidentally assign the wrong inventory to an order, or a payment processor might make an error in charging a customer's credit card.
- 4. **Technical Issues:** There may be technical issues that can disrupt the order processing process. For example, an online store might experience a system outage that prevents customers from placing orders, or a

payment processing system might experience a data breach that affects customer payment information.

5. Customer Expectations: Customers may have certain expectations about the order processing process, such as fast delivery or personalized service. If a business is unable to meet these expectations, it may negatively impact customer satisfaction. For example, if a customer expects to receive their order within 24 hours and it takes several days to arrive, they may be disappointed and less likely to order from the business again in the future.

### **CHAPTER 5**

## **SAFETY STOCK**

#### SAFETY STOCK

- 5.1 Introduction
- 5.2 Importance of Safety Stock
- 5.3 Types of Safety stock
- 5.4 Safety stock calculation
- 5.5 SAFETY STOCK ANALYSIS: Inventory Management Models
- 5.6 EOQ sums
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- 5.8 Solved examples of EOQ
- 5.9 Newsvendor model
- 5.10 Advantages Newsvendor model
- 5.11 Limitations of Newsyendor model
- 5.12 Solved examples of Newsvendor model
- 5.13 Safety stock optimization models
- 5.14 Simulation models: Inventory Management
- 5.15 Simulation models advantages
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#### 5.1 INTRODUCTION

Safety stock is a level of extra inventory that a company keeps on hand to mitigate the risk of stockouts (running out of stock) due to unexpected demand or supply chain disruptions. It acts as a buffer against uncertainty and helps ensure that a company can continue to meet customer demand even in the face of unexpected events. The determination of the optimal level of safety stock can be a complex process that takes into account factors such as lead time, demand variability, and the cost of stockouts.

#### 5.2 IMPORTANCE OF SAFETY STOCK

Safety stock is important for a number of reasons:

- 1. It helps ensure that a company can continue to meet customer demand even in the face of unexpected events such as higher-than-anticipated demand or supply chain disruptions.
- 2. It helps protect a company's reputation by preventing stockouts and the resulting customer dissatisfaction.
- 3. It can help reduce the overall cost of inventory by allowing a company to order larger quantities of inventory less frequently.
- 4. it can help maintain a steady cash flow by reducing the need to place rush orders and pay premium prices for expedited shipping.
- 5. It can also be used to capture unexpected sales opportunity by having stock readily available.
- 6. Overall, safety stock can help a company maintain a balance between the costs of carrying inventory and the risk of stockouts, and ultimately helps to ensure the continuity of the business operations.

## Safety stock importance with examples

- 1. Safety stock is important as it can help mitigate the risk of stockouts, which can have significant consequences for a business. Here are a few examples of how safety stock can help a company:
- 2. A fashion retailer has safety stock levels for their seasonal clothing lines. During an unexpected heat wave, the clothing items that are

suitable for the warmer weather sells out quickly. Thanks to the safety stock, the retailer was able to replenish the stock and meet the unexpected demand, avoiding a stockout and losing potential sales.

- 3. A consumer electronics company relies on a single supplier for a critical component. In case of supplier disruption, the company has safety stock on hand to keep their production line running and avoid stockouts.
- 4. A Pharmaceutical company with safety stock of certain drugs can ensure that they can meet patient needs even during a pandemic or natural disaster, avoiding stockouts and ensuring continuity of care.
- 5. In each of these examples, safety stock helps the company to meet unexpected demand, avoid stockouts, and maintain a steady supply chain. This can ultimately help the company maintain customer satisfaction, protect its reputation, and avoid lost revenue.

#### 5.3 TYPES OF SAFETY STOCK

There are several different types of safety stock that companies can use, depending on their specific needs and inventory management strategies. Some of the most common types of safety stock include:

Each type of safety stock has its own advantages and disadvantages, and the best choice depends on a company's specific needs and goals.

- 1. **Basic Safety Stock:** A company that sells a product with a long lead time might keep a basic safety stock on hand to ensure they can continue to meet customer demand even if there are unexpected delays in receiving new inventory. For example, a furniture manufacturer might keep a basic safety stock of a popular chair model that takes 12 weeks to produce.
- 2. **Reorder Point Safety Stock:** A company that sells a product with a high demand variability might use a reorder point safety stock strategy. For example, a sporting goods retailer might use a reorder point safety stock strategy for a popular brand of hiking boots. They might keep a certain level of stock and reorder when the stock falls below a certain level.

- 3. **Seasonal Safety Stock:** A company that sells products that are popular during specific seasons might use a seasonal safety stock strategy. For example, a company that sells winter coats might keep a higher level of safety stock on hand during the fall and early winter months to ensure they can meet increased demand during that time.
- 4. **Strategic Safety Stock:** A company that anticipates an unexpected event might use a strategic safety stock strategy. For example, a company that supplies emergency equipment such as generators, might keep a strategic safety stock to ensure they can meet the demand in case of a natural disaster.
- 5. Cyclical Safety Stock: A company that operates in an industry that experiences regular, predictable fluctuations in demand due to cyclical factors might use a cyclical safety stock strategy. For example, A construction company that experiences regular fluctuations in demand due to economic cycles, might use a cyclical safety stock strategy to ensure they can meet the demand when the market is good and have enough inventory when the market is slow.
- 6. **Anticipation Safety Stock:** A company that anticipates an increase in demand for a new product might use anticipation safety stock strategy. For example, a company launching a new phone model, might use anticipation safety stock strategy to ensure they have enough stock to meet the initial demand of the new product.

#### 5.4 SAFETY STOCK CALCULATION

There are several different methods that can be used to calculate safety stock. The most common methods include:

 The Basic Method: This method is also known as the fixed reorder point method. It calculates safety stock as the maximum expected demand during the lead time plus a safety factor. The formula is: Safety Stock = (Maximum Lead Time Demand + Safety Factor) - (Average Daily Demand x Lead Time).

- 2. **The Statistical Method:** This method is also known as the probabilistic method. It calculates safety stock as the sum of the standard deviation of demand during the lead time and the standard deviation of lead time, multiplied by a safety factor. The formula is: Safety Stock = (Standard Deviation of Demand x Lead Time) + (Standard Deviation of Lead Time x Average Demand) + Safety Factor.
- 3. **The Service Level Method:** This method calculates safety stock based on the desired service level, which is the percentage of time that a company wants to be able to meet customer demand without stockouts. The formula is: Safety Stock = (Maximum Lead Time Demand x Lead Time) / (Desired Service Level Normal Lead Time Demand)
- 4. **The Hybrid Method:** This method combines the basic and statistical methods, taking into account the company's specific needs and goals. It can be a good option for companies that want a more customized approach.

It's worth noting that the most accurate method for calculating safety stock for a particular company will depend on the nature of the product, the demand patterns, and the supply chain. In addition, it's important to regularly review and adjust safety stock levels as demand and supply conditions change.

## 5.5 SAFETY STOCK ANALYSIS: INVENTORY MANAGEMENT MODELS

Safety stock analysis is an important part of inventory management, as it helps companies determine the optimal level of safety stock to keep on hand to mitigate the risk of stockouts. There are several different inventory management models that can be used to analyze safety stock, including:

1. Economic Order Quantity (EOQ) Model: The EOQ model is used to determine the optimal order quantity for a product. It takes into account the fixed costs of ordering, such as administrative costs and the variable costs of carrying inventory, such as holding and ordering costs. The EOQ model can be used to determine the optimal safety stock level by

considering the trade-offs between the costs of stockouts and the costs of carrying extra inventory.

- 2. Newsvendor Model: The newsvendor model is used to determine the optimal order quantity for a product that has a limited demand window, such as a seasonal product. It takes into account the costs of stockouts and the costs of carrying extra inventory and helps the company to determine the optimal safety stock level to meet the expected demand.
- 3. **Safety Stock Optimization Models:** these models are more advanced and use more data, such as demand forecasting and lead time variability to calculate safety stock. These models are often used in industries with high variability in demand, such as retail and consumer goods.
- 4. **Simulation Models:** these models use computer simulations to model the inventory system and evaluate the performance of different inventory management policies, including safety stock policies.

Ultimately, the choice of inventory management model will depend on a company's specific needs and goals. By analyzing safety stock using these models, companies can make data-driven decisions to minimize the costs of carrying inventory while also minimizing the risk of stockouts.

## **5.6 EOQ SUMS**

The Economic Order Quantity (EOQ) model is a widely used inventory management model that helps companies determine the optimal order quantity for a product. The EOQ model calculates the optimal order quantity by minimizing the total inventory costs, which include the costs of ordering and the costs of carrying inventory. The EOQ formula is:

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

Where:

D = annual demand for the product

S = cost of placing an order

H = annual carrying cost per unit of inventory

The EOQ formula can be used to determine the optimal order quantity for a product, which can help companies reduce their inventory costs. When the EOQ is determined, companies can use this as a guide to determine the safety stock level. It is important to note that the EOQ formula assumes that demand, lead time, and costs are constant, which may not always be the case in real-world situations.

It's also worth noting that, when using the EOQ model, companies should also consider other factors such as lead time, demand variability, and the cost of stockouts, as these factors also impact safety stock levels.

## 5.7 LIMITATIONS OF EOO

The Economic Order Quantity (EOQ) model is a widely used inventory management model that can help companies determine the optimal order quantity for a product. However, there are a few limitations and problems with the EOQ model that companies should be aware of:

- The EOQ model assumes that demand, lead time, and costs are constant, which may not always be the case in real-world situations. In reality, these factors can change over time, which can impact the accuracy of the EOQ model.
- 2. The EOQ model also assumes that the entire order is received at once, which may not be the case in real-world situations. In reality, orders may be received in multiple shipments, which can impact the accuracy of the EOQ model.
- 3. The EOQ model does not take into account the impact of stockouts on customer satisfaction and company reputation, which can be significant costs. In reality, stockouts can lead to lost sales, decreased customer satisfaction, and damage to a company's reputation.
- 4. The EOQ model is based on a deterministic approach, it doesn't consider the uncertainty in the parameters, this can lead to an over or underestimation of the optimal order quantity.

5. The EOQ model doesn't take into account the impact of government regulations, such as minimum order requirements, which can impact the optimal order quantity.

These limitations and problems with the EOQ model highlight the importance of considering a wide range of factors when determining the optimal order quantity and safety stock levels. In addition, it's important to regularly review and adjust inventory management strategies as demand and supply conditions change.

## 5.8 SOLVED EXAMPLES OF EQQ

The Economic Order Quantity (EOQ) model is a widely used inventory management model that can help companies determine the optimal order quantity for a product. Here are a couple of examples of how the EOQ formula can be applied:

Example 1: A company that sells widgets has an annual demand of 10,000 widgets, a cost of \$50 to place an order, and an annual carrying cost of \$1 per widget.

$$EOQ = \sqrt{(2DS/H)} = \sqrt{(210,00050/1)} = \sqrt{(1,000,000)} = 1,000$$

So the EOQ for this company is 1,000 widgets. This means that the company should order 1,000 widgets at a time to minimize their inventory costs.

Example 2: A company that sells toys has an annual demand of 12,000 toys, a cost of \$30 to place an order, and an annual carrying cost of \$2 per toy.

EOQ = 
$$\sqrt{(2DS/H)} = \sqrt{(212,00030/2)} = \sqrt{(720,000)} = 840$$

So the EOQ for this company is 840 toys. This means that the company should order 840 toys at a time to minimize their inventory costs.

It's worth noting that these examples are based on the assumptions of the EOQ model, and that in real-world situations, companies should also consider other factors such as lead time, demand variability, and the cost of stockouts when determining the optimal order quantity and safety stock levels.

#### 5.9 NEWSVENDOR MODEL

The Newsvendor model is a widely used inventory management model that is used to determine the optimal order quantity for a product that has a limited demand window, such as a seasonal product. It takes into account the costs of stockouts and the costs of carrying extra inventory and helps the company to determine the optimal safety stock level to meet the expected demand.

### 5.10 ADVANTAGES NEWSVENDOR MODEL

- 1. **It Considers the Uncertainty of Demand:** The newsvendor model takes into account the uncertainty of demand by considering the probability distribution of demand. This allows companies to make more informed decisions about safety stock levels and order quantities.
- 2. **It Considers the Impact of Stockouts:** Unlike the Economic Order Quantity (EOQ) model, the Newsvendor model takes into account the impact of stockouts on customer satisfaction and company reputation, which can be significant costs.
- 3. **It's Easy to Understand:** The newsvendor model is simple to understand and can be easily implemented. This makes it accessible to companies of all sizes and industries.
- 4. **It's Flexible:** The model can be applied to a wide range of products, including those with seasonal demand patterns, perishable products, and new products that are being launched.
- 5. **It's Suitable for both Overage and Underage Costs:** The model considers both the costs of overage and underage, which means that it can be applied to both perishable and non-perishable products.

Overall, the Newsvendor model is a powerful tool that can help companies make better decisions about safety stock levels and order quantities. It is particularly useful for companies that sell products with limited demand windows, as it takes into account the uncertainty of demand and the impact of stockouts.

#### 5.11 LIMITATIONS OF NEWSVENDOR MODEL

The Newsvendor model is a widely used inventory management model that is used to determine the optimal order quantity for a product that has a limited demand window, such as a seasonal product. However, there are a few limitations and problems with the Newsvendor model that companies should be aware of:

- The Newsvendor model assumes that the demand and lead time are known and follows a normal distribution, which may not always be the case in real-world situations. In reality, demand and lead time can be uncertain and follow different distributions, which can impact the accuracy of the model.
- The model assumes that the entire order is received at once, which may not be the case in real-world situations. In reality, orders may be received in multiple shipments.
- 3. The model assumes that the costs are linear, this may not always be the case in real-world situations. In reality, some costs may increase or decrease based on the quantity of inventory or the level of stockouts.
- 4. The model does not consider the impact of supply chain disruptions, such as production delays or natural disasters, which can also impact the optimal order quantity.

An example of limitation is a company that produces perishable goods, such as fruits or vegetables. The demand for these products is uncertain, and the costs associated with overage and underage are non-linear, such as the spoilage costs of the goods. In this case, the Newsvendor model might not be the best fit, as it assumes a normal distribution and linear costs.

Another example is a company that sells a new product, the demand for which is uncertain and hard to predict, in this case, the Newsvendor model can not provide an accurate optimal order quantity, as it relies on historical demand data, which is not available for a new product.

In conclusion, it's important for companies to be aware of the limitations of the Newsvendor model and to consider other factors such as demand uncertainty, lead time variability, and non-linear costs when determining the optimal order quantity and safety stock levels.

### 5.12 SOLVED EXAMPLES OF NEWSVENDOR MODEL

The Newsvendor model is a widely used inventory management model that is used to determine the optimal order quantity for a product that has a limited demand window, such as a seasonal product. Here are a couple of examples of how the Newsvendor model can be applied:

Example 1: A company that sells umbrellas has an annual demand of 10,000 umbrellas, a cost of \$5 to place an order, and a cost of \$10 per umbrella for stockouts. The company has determined that the standard deviation of demand is 1,500 and the probability of demand falling between 6,000 and 14,000 is 0.8.

The optimal order quantity can be found by using the newsvendor model formula: x = d + z \* sqrt(d)

Where x = order quantity, d = demand, and z = the standard normal cumulative distribution function (z-score) that corresponds to the desired service level.

$$x = 10,000 + 1.28 * sqrt (10,000) = 12,800$$

So the company should order 12,800 umbrellas to minimize their inventory costs.

Example 2: A company that sells Christmas lights has an annual demand of 20,000 lights, a cost of \$2 to place an order, and a cost of \$5 per light for stockouts. The company has determined that the standard deviation of demand is 2,500 and the probability of demand falling between 15,000 and 25,000 is 0.9.

$$x = 20,000 + 1.645 * sqrt(20,000) = 23,290$$

So the company should order 23,290 lights to minimize their inventory costs.

It's worth noting that these examples are based on the assumptions of the Newsvendor model and that in real-world situations, companies should also consider other factors such as lead time, demand variability, and

### 5.13 SAFETY STOCK OPTIMIZATION MODELS

### **Advantages**

Safety stock optimization models are advanced inventory management models that use more data, such as demand forecasting and lead time variability, to calculate safety stock. These models have several advantages, including:

 They Take Into Account Demand Forecasting: These models use historical demand data and forecasting techniques to predict future demand, which allows companies to make more accurate safety stock calculations.

**Example:** A retail company uses historical data on the sales of a product to forecast demand during the holiday season. By using a safety stock optimization model, the company can take into account the forecasted demand and adjust the safety stock accordingly to avoid stockouts during the peak season.

2. They take into Account lead time Variability: These models take into account the variability of lead time, which is the time between placing an order and receiving the inventory. This allows companies to make more accurate safety stock calculations by considering the uncertainty of lead time.

**Example:** A manufacturing company uses a safety stock optimization model to calculate safety stock for a component that is procured from a supplier. The model takes into account the variability in lead time from the supplier, which can fluctuate due to factors such as weather, production schedules, and transportation delays.

3. **They Consider Multiple Factors:** Safety stock optimization models consider multiple factors such as demand forecasting, lead time

variability, and costs of stockouts and carrying inventory. This allows companies to make more informed decisions about safety stock levels.

**Example:** A healthcare company uses a safety stock optimization model to determine the safety stock levels for a critical medical device. The model takes into account the forecasted demand, the lead time variability from the supplier, and the costs of stockouts and carrying inventory to determine an optimal safety stock level.

4. **They can be customized:** These models can be customized to meet the specific needs of a company and its products, which allows for a more tailored approach to inventory management.

**Example:** A logistics company uses a safety stock optimization model to determine safety stock for a fleet of vehicles. The model is customized to take into account the company's specific needs such as usage patterns, lead time, and maintenance schedules.

5. **They Can Help to Reduce Costs:** Safety stock optimization models can help companies to reduce costs by minimizing the risk of stockouts and carrying extra inventory.

**Example:** A retail company uses a safety stock optimization model to minimize the costs of stockouts and carrying extra inventory. The model takes into account the cost of stockouts, such as lost sales, and the costs of carrying extra inventory, such as warehousing and insurance.

Overall, safety stock optimization models are a powerful tool that can help companies make better decisions about safety stock levels and order quantities. They are particularly useful for companies that have high variability in demand and lead time, as they take into account multiple factors and can be customized to meet the specific needs of a company and its products.

## **Safety Stock Optimization Models Limitations**

Safety stock optimization models are advanced inventory management models that use more data, such as demand forecasting and lead time variability, to calculate safety stock. However, there are a few limitations and problems with these models that companies should be aware of:

**1. Complexity:** Safety stock optimization models can be complex and require a significant amount of data and resources to implement, which can make them difficult and costly to use for some companies.

**Example:** A small retail store might not have the resources or expertise to implement a safety stock optimization model, as it would require significant data gathering and analysis, which might not be feasible for them.

**2. Dependence on accurate data:** Safety stock optimization models rely on accurate data, such as demand forecasting and lead time variability. Inaccurate data can lead to inaccurate safety stock calculations and result in stockouts or excess inventory.

**Example:** A company uses a safety stock optimization model to determine the safety stock for a product, but the demand forecasting data is inaccurate, as a result, the safety stock calculated is also inaccurate, leading to stockouts or overstocking.

**3. Limited Flexibility:** Safety stock optimization models are typically based on specific assumptions and constraints, which can limit their flexibility in dealing with different types of products, industries, and situations.

**Example:** A company that produces customized products and has unique inventory management needs might find that a safety stock optimization model is not suitable for them, as it might not be able to take into account their specific requirements.

**4. Assumptions on demand and lead time:** Safety stock optimization models may assume that demand and lead time follow specific probability distributions, which may not always be the case in real-world situations.

**Example:** A company that sells products that are affected by unexpected

### **Solved Examples**

Safety stock optimization models are advanced inventory management models that use more data, such as demand forecasting and lead time variability, to calculate safety stock. Here are a couple of examples of how these models can be applied:

**Example 1:** A company that sells smartphones has an annual demand of 100,000 smartphones, a cost of \$50 to place an order, and a cost of \$100 per smartphone for stockouts. The company has determined that the standard deviation of demand is 10,000 and the average lead time is 2 weeks. Using a safety stock optimization model, the company can determine the optimal safety stock level to minimize the total inventory costs.

**Example 2:** A company that sells seasonal clothing has an annual demand of 250,000 clothing, a cost of \$30 to place an order, and a cost of \$50 per clothing for stockouts. The company has determined that the standard deviation of demand is 20,000 and the average lead time is 3 weeks. Using a safety stock optimization model, the company can determine the optimal safety stock level to minimize the total inventory costs.

It's worth noting that these examples are based on the assumptions of the safety stock optimization models, and that in real-world situations, companies should also consider other factors such as lead time, demand variability, and the cost of stockouts when determining the optimal safety stock level and order quantities. These models are particularly useful for companies that have high variability in demand and lead time, as they take into account multiple factors and can be customized to meet the specific needs of a company and its products.

## **Safety Stock Optimization Models Limitations**

Safety stock optimization models are advanced inventory management models that use more data, such as demand forecasting and lead time variability, to calculate safety stock. However, there are a few limitations and problems with these models that companies should be aware of: **1. Complexity:** Safety stock optimization models can be complex and require a significant amount of data and resources to implement, which can make them difficult and costly to use for some companies.

**Example:** A small retail store might not have the resources or expertise to implement a safety stock optimization model, as it would require significant data gathering and analysis, which might not be feasible for them.

**2. Dependence on Accurate Data:** Safety stock optimization models rely on accurate data, such as demand forecasting and lead time variability. Inaccurate data can lead to inaccurate safety stock calculations and result in stockouts or excess inventory.

**Example:** A company uses a safety stock optimization model to determine the safety stock for a product, but the demand forecasting data is inaccurate, as a result, the safety stock calculated is also inaccurate, leading to stockouts or overstocking.

**3. Limited Flexibility:** Safety stock optimization models are typically based on specific assumptions and constraints, which can limit their flexibility in dealing with different types of products, industries, and situations.

**Example:** A company that produces customized products and has unique inventory management needs might find that a safety stock optimization model is not suitable for them, as it might not be able to take into account their specific requirements.

**4. Assumptions on Demand and Lead Time:** Safety stock optimization models may assume that demand and lead time follow specific probability distributions, which may not always be the case in real-world situations.

**Example:** A company that sells products that are affected by unexpected events like natural disasters, pandemics or political instability, they may find that the assumptions of the models are not valid in their case and the results might not be accurate.

### **5.14 Simulation Models: Inventory Management**

Simulation models are a type of inventory management model that use computer simulations to model and analyze different inventory management scenarios. These models are particularly useful for companies that have complex inventory systems and need to take into account multiple factors, such as demand forecasting, lead time variability, and the costs of stockouts and carrying inventory.

### 5.15 SIMULATION MODELS ADVANTAGES

Simulation models are a type of inventory management model that use computer simulations to model and analyze different inventory management scenarios. These models have several advantages, including:

1. They can Handle Complex Systems: Simulation models are able to handle complex systems that involve multiple variables, such as demand patterns, lead times, and inventory costs. This makes them particularly useful for companies that have complex inventory systems.

**Example:** A manufacturing company uses a simulation model to optimize their inventory management for multiple products with different demand patterns, lead times, and costs. The simulation model takes into account the interactions between these variables and helps the company to identify the optimal inventory management policy for each product.

**2.** They can test Multiple Scenarios: Simulation models can be used to test multiple scenarios and evaluate the impact of different inventory management decisions on the overall system. This allows companies to make more informed decisions about inventory management.

**Example:** A retail company uses a simulation model to test different safety stock levels and reorder points to identify the optimal inventory management policy for a product with high demand variability. By testing multiple scenarios, the company can identify the inventory management policy that minimizes costs while maintaining a high service level.

3. They can Account for Uncertainty: Simulation models can account for uncertainty in demand and lead time, which is important for

companies that have products with limited demand windows or high variability in demand.

**Example:** A company that sells perishable goods, such as fruits or vegetables, uses a simulation model to account for the uncertainty in demand and lead time. The model helps the company to determine the optimal safety stock level for each product and minimize the costs of spoilage.

**4. They can Optimize Performance:** Simulation models can be used to optimize inventory performance by identifying the best inventory management policies to minimize costs or maximize service level.

**Example:** A healthcare company uses a simulation model to optimize the inventory performance of critical medical devices. The model helps the company to identify the inventory management policies that minimize costs while maintaining a high service level and avoiding stockouts.

They can be used in different industries: Simulation models can be used in a wide range of industries, including retail, manufacturing, healthcare, and logistics.

### 5.16 SIMULATION MODELS LIMITATIONS

Simulation models are a powerful tool for inventory management, but they also have some limitations:

**1. Complexity:** Simulation models can be complex and require a significant amount of data and resources to implement, which can make them difficult and costly to use for some companies.

**Example:** A small retail store might not have the resources or expertise to implement a simulation model, as it would require significant data gathering and analysis, which might not be feasible for them.

**2. Dependence on Accurate Data:** Simulation models rely on accurate data, such as demand forecasting and lead time variability. Inaccurate data can lead to inaccurate results, and may affect the inventory decisions.

**Example:** A company uses a simulation model to determine the safety stock for a product, but the demand forecasting data is inaccurate, as a result, the results of the simulation model are also inaccurate, leading to stockouts or overstocking.

**3. Limited Flexibility:** Simulation models are typically based on specific assumptions and constraints, which can limit their flexibility in dealing with different types of products, industries, and situations.

**Example:** A company that produces customized products and has unique inventory management needs might find that a simulation model is not suitable for them, as it might not be able to take into account their specific requirements.

**4. Assumptions on Demand and Lead Time:** Simulation models may assume that demand and lead time follow specific probability distributions, which may not always be the case in real-world situations.

**Example:** A company that sells products that are affected by unexpected events like natural disasters, pandemics or political instability, they may find that the assumptions of the models are not valid in their case and the results might not be accurate.

**5. Time Consuming:** Simulation models can be time-consuming to set up and run. This can be a limitation for companies that need to make quick inventory decisions.

**Example:** A company that sells products in a fast-moving environment like fast fashion, the time required to set up

## **CHAPTER 6**

## STOCKLESS PRODUCTION

### STOCKLESS PRODUCTION

- 6.1 Introduction
- 6.2 Definations
- 6.3 Principles of Stockless Production
- 6.4 Companies that have implemented JIT production:
- 6.5 Numerical example of how a company might use Just- in-time (JIT) production:
- 6.6 Advantages of JIT
- 6.7 Disadvantages of Just-in-time (JIT) production



Chapter - 6 Stockless Production

#### 6.1 INTRODUCTION

Stockless production is a manufacturing method in which raw materials are only purchased and used as they are needed in the production process, rather than being stockpiled in advance. This approach helps to minimize waste and reduce costs, as companies only pay for what they use and do not have to store or maintain large inventories. It also allows for more flexibility in production, as companies can quickly respond to changes in demand or supply. However, it can also increase the risk of supply chain disruptions and make it more difficult to predict production costs.

### **6.2 DEFINATIONS**

Stockless production, also known as just-in-time (JIT) production or lean manufacturing, is a method of production that emphasizes the minimization of inventory and the efficient use of resources. The goal of stockless production is to minimize waste and increase efficiency by only producing what is needed, when it is needed.

According to **Womack, Jones, and Roos** in "The Machine That Changed the World", stockless production is a system of manufacturing that is based on the pull of customer demand, rather than the push of forecasts or schedules. It is characterized by the close coordination of all aspects of production, including design, procurement, production, and delivery.

According to **Liker**, in "The Toyota Way", stockless production is a system that focuses on minimizing waste, maximizing efficiency, and creating a culture of continuous improvement. It is based on the principles of "just in time" and "jidoka" (automation with a human touch) and emphasizes the importance of teamwork, flexibility, and communication in achieving production goals.

In summary, stockless production is a methodology that aims to minimize waste and optimize resources by producing only what is needed, when it is needed. It is characterized by the pull of customer demand, close coordination of production, minimizing inventory, maximizing efficiency, and creating a culture of continuous improvement.

### **6.3 PRINCIPLES OF STOCKLESS PRODUCTION**

Stockless production is a manufacturing method that emphasizes the minimization of inventory and the efficient use of resources. The goal of stockless production is to minimize waste and increase efficiency by only producing what is needed, when it is needed.

The key principles of stockless production include:

- 1. **Just-in-time** (**JIT**) **Production:** This principle involves producing goods only as they are needed, rather than producing them in advance and storing them in inventory. This helps to minimize waste and reduce costs, as companies only pay for what they use and do not have to store or maintain large inventories.
- 2. **Pull Production:** This principle involves producing goods based on customer demand, rather than forecasts or schedules. This helps to ensure that goods are produced only when they are needed and reduces the risk of overproduction and excess inventory.
- 3. **Continuous improvement:** This principle involves continuously identifying and eliminating waste and inefficiencies in the production process. This helps to increase efficiency and reduce costs over time.
- 4. **Total Quality Management:** This principle involves ensuring that all aspects of the production process meet the highest quality standards. This helps to ensure that the final product is of high quality and meets customer needs.
- Lean Manufacturing: This principle involves using a combination of JIT production, pull production, continuous improvement, and total quality management to create a streamlined and efficient production process.

Implementing stockless production can have several benefits, including:

**-Reduced Costs**: By minimizing inventory and only producing what is needed, companies can reduce costs associated with storing and maintaining inventory.

- **-Flexibility:** By producing goods based on customer demand, companies can quickly respond to changes in demand or supply.
- **-Efficiency:** By continuously identifying and eliminating waste and inefficiencies, companies can increase efficiency and reduce costs over time.
- **-Quality:** By ensuring that all aspects of the production process meet the highest quality standards, companies can produce high-quality goods that meet customer needs.

However, it can also have its own challenges such as:

- **-Supply Chain Disruptions:** If a supplier is unable to deliver raw materials on time, it can disrupt the production process.
- **-Predicting Production Costs:** It can be more difficult to predict production costs when using stockless production, as they can fluctuate based on demand and supply.
- -Implementation: Implementing stockless production can be challenging, as it requires a significant shift in the way a company operates and can take time to fully implement.

## 6.4 COMPANIES THAT HAVE IMPLEMENTED JIT PRODUCTION:

Toyota: Toyota is considered one of the pioneers of JIT production. The company's implementation of JIT principles has been credited with helping it become one of the world's largest and most successful automakers.

Dell: Dell is another company that has implemented JIT production. The company uses JIT principles to build custom-made computers for customers on demand, rather than producing them in advance and storing them in inventory.

McDonald's: McDonald's uses JIT production principles to ensure that its food items are prepared quickly and efficiently. The company's "Just-in-Time" system helps to ensure that food is prepared only when it is needed and that there is minimal waste.

Zara: Zara is a clothing retailer that has implemented JIT production in order to quickly respond to changes in fashion trends. The company produces clothes based on customer demand, rather than forecasts or schedules.

Starbucks: Starbucks is a coffee chain that uses JIT production in its supply chain. The company only roasts the beans it needs for the next few days to guarantee freshness and reduce waste.

These are just a few examples, but JIT production is used by many other companies in various industries such as pharmaceuticals, construction, and more. JIT production can be applied in any industry that produces goods or services and it can be tailored to the specific needs of each company.

## 6.5 NUMERICAL EXAMPLE OF HOW A COMPANY MIGHT USE JUST-IN-TIME (JIT) PRODUCTION:

A company that produces widgets has been using traditional manufacturing methods, producing widgets in batches of 1000 and storing them in inventory. This results in an average inventory of 5000 widgets and an inventory carrying cost of \$500 per month.

The company decides to implement JIT production, which involves producing widgets only when they are needed by customers. This results in a reduction of inventory from 5000 widgets to 500 widgets (only enough for the next order) and a corresponding reduction in inventory carrying costs from \$500 per month to \$50 per month.

In addition to reducing inventory costs, the company also benefits from increased efficiency and flexibility. By producing widgets only when they are needed, the company is able to reduce waste and inefficiencies, and it can quickly respond to changes in customer demand.

The company also benefits from improved quality, as it can focus on producing high-quality widgets rather than producing them in bulk and storing them in inventory.

The company's revenue increases as they can make the widgets faster, better and can reduce the price.

Keep in mind that these numbers are just examples and they can change depending on the company's characteristics, the product, and the inventory costs. The JIT production can have a positive impact on the company's bottom line by reducing costs and increasing efficiency and quality, but it is important to note that it can be challenging to implement and requires a significant change in the way the company operates.

### 6.6 ADVANTAGES OF JIT

Just-in-time (JIT) production is a manufacturing method that emphasizes the minimization of inventory and the efficient use of resources. It offers several advantages, including:

- 1. **Reduced inventory Costs:** JIT production reduces the need for large inventory levels, which in turn reduces inventory carrying costs, such as storage and insurance.
- 2. **Increased Efficiency:** By producing goods only when they are needed, JIT production reduces waste and inefficiencies in the production process, resulting in faster production times and lower costs.
- 3. **Improved Quality:** JIT production allows companies to focus on producing high-quality goods, rather than producing them in bulk and storing them in inventory.
- 4. **Increased Flexibility:** JIT production enables companies to quickly respond to changes in customer demand, which allows them to adapt to market changes and stay competitive.
- 5. **Better Supplier Relationships:** JIT production requires close collaboration between the company and its suppliers, which can lead to better supplier relationships and more reliable supply chains.
- 6. **Increased Customer Satisfaction:** JIT production ensures that goods are produced quickly and efficiently, which can lead to faster delivery times and higher customer satisfaction.

It is important to note that while JIT production offers many benefits, it can also be challenging to implement and requires a significant change in the way the company operates. It requires a high level of coordination and communication between different departments and suppliers, as well as a commitment to continuous improvement.

## 6.7 DISADVANTAGES OF JUST-IN-TIME (JIT) PRODUCTION

Just-in-time (JIT) production is a manufacturing method that emphasizes the minimization of inventory and the efficient use of resources, but it also has some disadvantages, including:

- 1. **Dependence on Suppliers:** JIT production relies on a steady and reliable flow of goods and materials from suppliers, which can be disrupted by supplier issues such as strikes, natural disasters, or quality problems.
- 2. **Limited Flexibility:** JIT production is designed to minimize inventory and respond quickly to customer demand, but it can be difficult to adapt to unexpected changes in demand or production issues.
- 3. **High Setup Costs:** JIT production requires significant investment in equipment and technology, as well as training and process changes, which can be costly.
- 4. **Risk of Stockouts:** JIT production reduces inventory, but it also increases the risk of stockouts, which can lead to production disruptions and lost sales.
- 5. **Quality Control Challenges:** JIT production requires close collaboration between the company and its suppliers, which can lead to quality control issues if suppliers are not able to meet the company's standards.
- 6. **High Operational Costs:** JIT production requires a high level of coordination and communication between different departments and suppliers, which can be costly to maintain.

It's important to note that JIT production can be successful if implemented properly, but it also comes with certain risks. A company needs to weigh the pros and cons before implementing JIT production and make sure they have the resources and capabilities to execute it properly.

### **CHAPTER 7**

### INVENTORY VALUATION

### INVENTORY VALUATION

- 7.1 Introduction
- 7.2 Inventory Valuation
- 7.3 First-In, First-Out (FIFO) method:
- 7.4 Advantages of First-In, First-Out (FIFO) method:
- 7.5 Disadvantages of First-In, First-Out (FIFO) method:
- 7.6 Problem sum on First-In, First-Out (FIFO) method
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- 7.9 Disadvantages of LIFO
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- 7.11 Weighted Average Cost (WAC) method
- 7.12 Advantages of Weighted Average Cost (WAC) method
- 7.13 Disadvantages of Weighted Average Cost (WAC) method



# Chapter - 7 Inventory Valuation

#### 7.1 INTRODUCTION

Inventory valuation refers to the process of determining the value of a company's inventory at a specific point in time. There are several methods of inventory valuation, each with its own advantages and disadvantages.

Some common methods of inventory valuation include:

- 1. **First-in, First-Out (FIFO) Method:** This method assumes that the first items purchased are the first items sold, and the most recent items purchased are the last items sold.
- Last-In, First-Out (LIFO) Method: This method assumes that the last items purchased are the first items sold. This method is used primarily in times of rising prices, as it results in a lower cost of goods sold and higher taxable income.
- 3. Weighted Average Cost (WAC) Method: This method calculates the cost of goods sold by taking the total cost of the inventory and dividing it by the total number of units. This method is useful when the inventory is highly perishable or when prices fluctuate frequently.
- 4. **Specific Identification Method:** This method identifies the cost of goods sold by identifying the specific item sold. This method requires the company to maintain detailed records of the cost of each item in inventory.
- Standard Costing Method: This method is used by companies that
  produce products with a known cost. This method is based on the
  estimated cost of production and not on the actual cost.

These are just a few examples of the many methods of inventory valuation. The method used will depend on the industry and specific business.

### 7.2 INVENTORY VALUATION

Inventory valuation is the process of determining the value of a company's inventory at a specific point in time. This value is used for financial reporting and tax purposes, and can affect a company's profitability, balance sheet, and income statement. There are several methods of

inventory valuation, including First-In, First-Out (FIFO), Last-In, First-Out (LIFO), Weighted Average Cost (WAC), Specific Identification, and Standard Costing. The method chosen will depend on the nature of the business, industry, and accounting principles.

### 7.3 FIRST-IN, FIRST-OUT (FIFO) METHOD

The First-In, First-Out (FIFO) method of inventory valuation assumes that the first items purchased are the first items sold. This method is based on the idea that goods that are purchased first are also consumed or sold first. This method is used to value inventory for financial reporting and tax purposes.

Under the FIFO method, the cost of goods sold is determined by taking the cost of the oldest items in inventory and matching them with the revenue from the sale of those items. The remaining inventory is then valued at the cost of the most recent purchases.

The FIFO method is useful in situations where the cost of goods is likely to increase over time, such as with perishable goods or goods subject to price inflation. This method results in a higher cost of goods sold and a lower ending inventory value, which can result in a lower taxable income.

However, FIFO method may not always be a good representation of the true cost of goods sold, as it does not take into account changes in prices over time, it is not always suitable for all types of businesses.

## 7.4 ADVANTAGES OF FIRST-IN, FIRST-OUT (FIFO) METHOD

There are several advantages to using the First-In, First-Out (FIFO) method of inventory valuation:

- Reflects Real-World Situations: The FIFO method assumes that the first items purchased are the first items sold, which is often the case in real-world situations.
- Provides Accurate Cost of Goods Sold: Because the FIFO method matches the cost of the oldest inventory with the revenue from the sale of those items, it provides an accurate representation of the cost of goods sold.

- 3. **Suitable for Rising Prices:** The FIFO method is particularly useful in situations where the cost of goods is likely to increase over time, such as with perishable goods or goods subject to price inflation. This method results in a higher cost of goods sold, which can result in a lower taxable income.
- 4. **Easy to Implement:** The FIFO method is relatively easy to implement and does not require detailed record keeping.

Compliance with Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards (IFRS): The FIFO method is widely accepted as an appropriate method of inventory valuation and is in compliance with Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards (IFRS)

Please note that while FIFO method has its advantages, it may not always be the best method for all types of businesses, it's always important to analyze the nature of the business, industry, and accounting principles before choosing the method of inventory valuation.

## 7.5 DISADVANTAGES OF FIRST-IN, FIRST-OUT (FIFO) METHOD

There are also several disadvantages to using the First-In, First-Out (FIFO) method of inventory valuation:

- 1. **May not Reflect Actual cost of Goods Sold:** In situations where prices fluctuate frequently, the FIFO method may not provide an accurate representation of the actual cost of goods sold.
- 2. **May Result in Higher Taxes:** When the cost of goods is rising, the FIFO method can result in a higher cost of goods sold, which can lead to a higher taxable income.
- 3. May not be Suitable for Businesses with Stable Prices: The FIFO method may not be the best choice for businesses that have stable prices, as it does not take into account changes in prices over time.

- 4. Could be difficult to implement for companies that do not maintain detailed inventory records: The FIFO method requires detailed records of the cost of each item in inventory, so it may be difficult to implement for companies that do not maintain such records.
- 5. Could Lead to Higher Inventory Carrying costs: Because the FIFO method assumes that the oldest items in inventory are sold first, it may lead to higher inventory carrying costs if the cost of goods has increased since the time of purchase.
- 6. Could be Difficult to Match Inventory and Cost: If there is a significant gap between the time of purchase and the time of sale, it could be difficult to match the inventory and the cost.

It's important to note that the FIFO method may not be suitable for all types of businesses, and it's always important to analyze the nature of the business, industry, and accounting principles before choosing the method of inventory valuation.

### 7.6 PROBLEM SUM ON FIRST-IN, FIRST-OUT (FIFO) METHOD

Here is a problem sum that demonstrates the use of the First-In, First-Out (FIFO) method of inventory valuation:

A company has the following inventory transactions:

January 1: Purchased 100 units at a cost of \$5 per unit

January 10: Purchased 200 units at a cost of \$6 per unit

January 15: Sold 150 units

January 20: Purchased 150 units at a cost of \$7 per unit

January 25: Sold 100 units

Using the FIFO method, we can calculate the cost of goods sold and the ending inventory value as follows:

January 15: Sold 150 units

100 units sold at \$5 per unit = \$500

50 units sold at \$6 per unit = \$300

Total cost of goods sold = \$800

January 25: Sold 100 units

100 units sold at \$6 per unit = \$600

Total cost of goods sold = \$600

Ending inventory value:

100 units at \$7 per unit = \$700

50 units at \$6 per unit = \$300

Total ending inventory value = \$1,000

So, The cost of goods sold for the above scenario would be 800+600 = \$1400 and the ending inventory value would be \$1000

It's important to note that this is just an example, and the actual calculations will depend on the specific circumstances of the business and inventory transactions.

## 7.7 LAST-IN, FIRST-OUT (LIFO) METHOD

The Last-In, First-Out (LIFO) method of inventory valuation is an accounting method in which the most recent items purchased are assumed to be the first items sold. This method is the opposite of the First-In, First-Out (FIFO) method, in which the oldest items purchased are assumed to be the first items sold.

The LIFO method is often used when the cost of goods is increasing over time, as it results in a lower cost of goods sold and a higher taxable income. This method is particularly useful when prices are rising, as it allows businesses to reduce their reported income and taxes.

When prices are stable, LIFO method is not the best choice, because it doesn't take into account changes in prices over time. It's important to note that LIFO method is not widely accepted internationally, it's not compliant

with Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards (IFRS).

It's always important to analyze the nature of the business, industry, and accounting principles before choosing the method of inventory valuation.

### 7.8 ADVANTAGES OF LIFO

The Last-In, First-Out (LIFO) method of inventory valuation has several advantages, including:

- 1. **Reflects Current cost of Goods:** The LIFO method assumes that the most recent items purchased are the first items sold, which can provide a more accurate representation of the current cost of goods sold.
- 2. **Reduces Taxes:** When prices are rising, the LIFO method can result in a lower cost of goods sold, which can lead to a lower taxable income.
- 3. **Better Matches Revenue and Expenses:** The LIFO method can help to better match revenue and expenses, as it assumes that the most recent items purchased are the first items sold.
- 4. **Reflects inflation:** The LIFO method can reflect inflation by assuming that the most recent items purchased are the first items sold.
- 5. **Better Matches Inventory and Cost:** If there is a significant gap between the time of purchase and the time of sale, it could be better match by using LIFO method

It's worth noting that the use of LIFO method may not be suitable for all types of businesses, and it's always important to analyze the nature of the business, industry, and accounting principles before choosing the method of inventory valuation.

#### 7.9 DISADVANTAGES OF LIFO

The Last-In, First-Out (LIFO) method of inventory valuation has several disadvantages, including:

1. **Not widely Accepted Internationally:** LIFO is not compliant with Generally Accepted Accounting Principles (GAAP) and International

Financial Reporting Standards (IFRS), which means it is not widely accepted internationally.

- Not suitable for Stable Prices: LIFO is not the best choice when prices are stable, because it doesn't take into account changes in prices over time.
- 3. **Difficult to Maintain Records:** Maintaining accurate records for the LIFO method can be difficult and time-consuming, as it requires businesses to track the cost of each item of inventory separately.
- 4. **Can lead to Overstatement of Inventory:** Because LIFO assumes that the most recent items purchased are the first items sold, it can lead to an overstatement of the value of inventory.
- Can lead to lower net Income: The LIFO method can result in a lower net income, as it can result in a higher cost of goods sold and a lower gross profit.
- Can Create Fluctuations in gross Margin: The LIFO method can create fluctuations in gross margin, depending on the prices of goods and services.

It's worth noting that the use of LIFO method may not be suitable for all types of businesses, and it's always important to analyze the nature of the business, industry, and accounting principles before choosing the method of inventory valuation.

#### 7.10 SOLVED EXAMPLE OF LIFO

Here is a simple example of how the Last-In, First-Out (LIFO) method works:

Let's say a business, XYZ Inc., sells widgets. The business buys 1000 widgets at \$5 each and later buys another 1000 widgets at \$6 each. The business then sells 2000 widgets.

Using the FIFO method, the cost of goods sold would be:

1000 widgets at \$5 each = \$5,000

1000 widgets at \$6 each = \$6,000 Total cost of goods sold = \$11,000

Using the LIFO method, the cost of goods sold would be:

1000 widgets at \$6 each = \$6,000

1000 widgets at \$5 each = \$5,000 Total cost of goods sold = \$11,000

As you can see, the cost of goods sold is the same regardless of the method used. However, the LIFO method assumes that the most recent items purchased (1000 widgets at \$6 each) were the first items sold, while the FIFO method assumes that the oldest items purchased (1000 widgets at \$5 each) were the first items sold.

It's important to note that this is a simple example, in a real scenario the number of items purchased, sold and the cost of goods would be different. Also, it's important to consider the accounting principles and the nature of the business before choosing the inventory valuation method.

### 7.11 WEIGHTED AVERAGE COST (WAC) METHOD

The Weighted Average Cost (WAC) method is a method of inventory valuation that calculates the cost of goods sold by determining the average cost of all items in inventory. It is calculated by taking the total cost of all items in inventory and dividing it by the total number of items in inventory.

Here is an example of how the WAC method works:

Let's say a business, XYZ Inc., sells widgets. The business buys 1000 widgets at \$5 each and later buys another 1000 widgets at \$6 each. The business then sells 2000 widgets.

To calculate the WAC:

Total cost of all items in inventory:  $(1000 \times \$5) + (1000 \times \$6) = \$10,000$ 

Total number of items in inventory: 1000 + 1000 = 2000

WAC = \$10,000 / 2000 = \$5

When the business sells 2000 widgets, it would use a cost of \$5 per widget to calculate the cost of goods sold.

The advantage of WAC method is that it gives a more accurate picture of the overall cost of goods, rather than assuming that the oldest or most recent items were the first sold. The disadvantage of this method is that it does not reflect changes in prices over time, which can lead to an understated cost of goods sold.

It's worth noting that the use of WAC method may not be suitable for all types of businesses, and it's always important to analyze the nature of the business, industry, and accounting principles before choosing the method of inventory valuation.

## 7.12 ADVANTAGES OF WEIGHTED AVERAGE COST (WAC) METHOD

Here are some advantages of using the Weighted Average Cost (WAC) method for inventory valuation:

- Accurate Picture of Overall cost of Goods: The WAC method takes
  into account the total cost of all items in inventory and the total number
  of items in inventory, giving a more accurate picture of the overall cost
  of goods.
- 2. **Reflects Changes in Prices over Time:** The WAC method uses an average cost per item, which takes into account changes in prices over time. This can be useful for businesses that experience fluctuations in the cost of goods.
- 3. **Simplicity:** The WAC method is relatively easy to calculate and understand, making it a straightforward method for businesses of all sizes.
- 4. **Provides a Consistent cost:** As the WAC method uses an average cost, it gives a consistent cost of goods sold.
- 5. **Suitable for Businesses with low Turnover:** This method is suitable for businesses with low turnover, where the cost of goods sold is not affected by the timing of purchases and sales.

It's worth noting that while the WAC method has some advantages, it may not be suitable for all types of businesses, and the suitability of the method should be assessed based on the nature of the business, industry, and accounting principles.

## 7.13 DISADVANTAGES OF WEIGHTED AVERAGE COST (WAC) METHOD

Here are some disadvantages of using the Weighted Average Cost (WAC) method for inventory valuation:

- Can lead to understated cost of Goods Sold: The WAC method does
  not take into account the most recent purchase prices, and thus it can
  lead to an understated cost of goods sold, which can in turn lead to an
  overstated gross profit and an overstated net income.
- 2. **Not Suitable for Businesses with High Turnover:** This method is not suitable for businesses with high turnover, where the cost of goods sold is affected by the timing of purchases and sales.
- 3. **May Not Reflect the Actual cost of Goods:** The WAC method gives an average cost which may not reflect the actual cost of goods and can be misleading, especially for businesses that experience fluctuations in the cost of goods.
- 4. **Not Suitable for Highly Inflationary Environment**: The WAC method can be less accurate for businesses that operate in highly inflationary environments where the cost of goods fluctuates significantly.
- 5. **May not comply with GAAP or IFRS:** The WAC method may not be in compliance with Generally Accepted Accounting Principles (GAAP) or International Financial Reporting Standards (IFRS) in some cases.

As always, it's important to consider the nature of the business, industry, and accounting principles before choosing an inventory valuation method. The WAC method may be suitable for some businesses, but it may not be the best option for others.

### **CHAPTER 8**

## **INVENTORY TURNOVER**

### INVENTORY TURNOVER

- 8.1 Introduction
- 8.2 what is inventory ratio?
- 8.3 Importance of inventory turnover
- 8.4 Importance of inventory turnover with examples
- 8.5 Advantages of Inventory turnover
- 8.6 Disadvantages of Inventory turnover
- 8.7 Solved problems of inventory turnover
- 8.8 Types of inventory turnover
- 8.9 What's the Inventory Turnover Ratio Average in the Retail Industry?
- 8.10 Inventory Turnover by Industry
- 8.11 Inventory Turnover Software
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Chapter - 8 Inventory Turnover

#### 8.1 INTRODUCTION

Inventory refers to the raw materials, finished goods, and partially completed products that a company holds for sale. It is the stock of goods and materials that a company has on hand for the purpose of meeting customer demand and generating revenue. Inventory can include everything from raw materials used to manufacture products to finished goods that are ready for sale. The management of inventory is a crucial aspect of a company's operations, as it affects both the cost structure and the ability to meet customer demand. Effective inventory management involves finding the right balance between having enough inventory to meet demand and avoiding excessive inventory levels, which can tie up capital and increase storage costs.

### 8.2 WHAT IS INVENTORY RATIO?

Inventory ratio is a financial metric that measures the amount of a company's inventory relative to its sales or its current assets. There are several different types of inventory ratios, each designed to provide a different perspective on a company's inventory management performance.

Some common inventory ratios include:

- 1. **Inventory Turnover Ratio:** Measures the number of times a company's inventory is sold and replaced in a given period of time.
- 2. **Days Sales in Inventory (DSI):** Measures the number of days it takes for a company to sell its entire inventory.
- 3. **Gross Margin Return on Investment (GMROI):** Measures the return on investment in inventory after taking into account the cost of goods sold and the gross profit margin.
- 4. **Safety Stock Ratio:** Measures the amount of inventory a company holds as a safety buffer to ensure that it can meet customer demand even in the event of supply chain disruptions.

In conclusion, inventory ratios are important tools for measuring the efficiency and effectiveness of a company's inventory management. They can help a company identify areas for improvement and make informed

decisions about inventory levels, ordering processes, and other aspects of inventory management.

### 8.3 IMPORTANCE OF INVENTORY TURNOVER

The importance of inventory turnover can be summarized as follows:

- 1. **Evaluates Operational Efficiency:** Inventory turnover measures the speed at which a company is able to sell its products and replace its inventory, providing an indication of its operational efficiency.
- 2. **Indicator of Financial Health:** A high inventory turnover rate is a positive indicator of a company's financial health, as it suggests strong sales and efficient use of assets.
- 3. **Optimizes Cash Flow:** By reducing the amount of inventory a company needs to hold, a high inventory turnover can help to free up cash flow and improve the company's overall financial position.
- 4. **Prevents Obsolescence:** A high inventory turnover rate helps to prevent inventory from becoming obsolete, reducing the risk of financial losses due to inventory write-downs.
- 5. **Supports Decision-Making:** Inventory turnover is an important metric that helps management make informed decisions regarding inventory levels, production planning, and supply chain management.

In conclusion, monitoring and understanding inventory turnover is a key aspect of effective inventory management and is crucial for the long-term success of a business.

## 8.4 IMPORTANCE OF INVENTORY TURNOVER WITH EXAMPLES

The importance of inventory turnover can be better understood with the following examples:

 Company A has a high inventory turnover rate compared to Company B. This indicates that Company A is selling its products faster and more efficiently than Company B. This may suggest that Company A has a more effective sales and marketing strategy, a better understanding of customer demand, or a more efficient supply chain.

- 2. A company with a low inventory turnover rate may be holding too much inventory, tying up valuable financial resources and increasing the risk of obsolescence. In this case, improving inventory turnover could free up cash flow and improve the company's financial performance.
- 3. Inventory turnover can also impact a company's ability to respond to changes in consumer demand. For example, a company with a low inventory turnover rate may struggle to quickly pivot its product mix in response to shifting consumer preferences, leading to lost sales and decreased competitiveness.
- 4. Inventory turnover is also important for investors and analysts. A high inventory turnover rate can indicate strong sales, efficient operations, and a solid financial position, making the company more attractive to potential investors.

In conclusion, inventory turnover is a valuable metric that provides insight into a company's operational efficiency, financial health, and competitiveness. Monitoring and understanding inventory turnover is crucial for effective inventory management and long-term business success.

### 8.5 ADVANTAGES OF INVENTORY TURNOVER

## **Advantages of a High Inventory Turnover**

- 1. Reduced storage and carrying costs
- 2. Increased cash flow
- 3. Better sales and customer satisfaction
- 4. Improved financial performance and profitability
- 5. Reduced risk of obsolescence or spoilage.

A high inventory turnover is generally considered a positive indicator of a company's performance and efficiency. However, a high turnover rate could also indicate a lack of inventory, leading to stockouts and lost sales.

A balance between high inventory turnover and adequate inventory levels is important for a business's success.

### 8.6 DISADVANTAGES OF INVENTORY TURNOVER

## **Disadvantages of High Inventory Turnover**

- 1. Difficulties in forecasting demand
- 2. Possibility of stockouts and lost sales
- 3. Increased pressure on supply chain operations
- 4. Limited ability to offer promotions or discounts
- 5. Difficulty in managing inventory levels and tracking product movement.

### **Disadvantages of Low Inventory Turnover**

- 1. High storage and carrying costs
- 2. Increased risk of obsolescence or spoilage
- 3. Reduced cash flow
- 4. Decreased financial performance and profitability
- 5. Difficulty in tracking product movement and managing inventory levels.

A low inventory turnover rate can be a sign of inefficiencies in a company's operations or a lack of demand for its products. Maintaining an appropriate balance between inventory turnover and inventory levels is important for a company's success.

### 8.7 SOLVED PROBLEMS OF INVENTORY TURNOVER

Sure, here are two examples of inventory turnover problems:

**Example 1:** A company has a cost of goods sold of \$500,000 and an average inventory value of \$100,000. What is the company's inventory turnover?

Inventory Turnover = Cost of Goods Sold / Average Inventory = \$500,000 / \$100,000 = 5

In this case, the company's inventory turnover is 5, meaning that its inventory is sold and replaced 5 times in a given period of time.

**Example 2:** A company has a cost of goods sold of \$600,000 and an average inventory value of \$200,000. What is the company's inventory turnover?

Inventory Turnover = Cost of Goods Sold / Average Inventory = \$600,000 / \$200,000 = 3

In this case, the company's inventory turnover is 3, meaning that its inventory is sold and replaced 3 times in a given period of time.

Note: The time period used to calculate inventory turnover (e.g. monthly, quarterly, annually) should be consistent and specified.

### 8.8 TYPES OF INVENTORY TURNOVER

There are several types of inventory turnover that a company can calculate, including:

- 1. **Raw Material Inventory Turnover:** Measures the speed at which raw materials are transformed into finished products.
- 2. **Work-in-Process Inventory Turnover:** Measures the speed at which raw materials are transformed into partially finished products.
- 3. **Finished Goods Inventory Turnover:** Measures the speed at which finished goods are sold to customers.
- 4. **Gross Inventory Turnover:** Measures the speed at which the entire inventory is sold, including raw materials, work-in-process, and finished goods.
- 5. **Net Inventory Turnover:** Measures the speed at which the net inventory value is sold, taking into account the cost of goods sold, average inventory value, and any sales discounts or returns.
- 6. **Inventory Turns per Year:** Expresses the inventory turnover rate as the number of times the inventory is sold and replaced in a given year.

In conclusion, the type of inventory turnover that a company calculates will depend on its specific needs and goals. Understanding and monitoring the different types of inventory turnover can provide valuable insights into a company's operations and performance.

### **Types of inventory Turnover with Examples**

Here are some examples of the different types of inventory turnover with examples:

- 1. Raw Material Inventory Turnover: For example, a company that manufactures bicycles might calculate its raw material inventory turnover to understand how quickly it is using steel and rubber to make bike frames and tires.
- 2. Work-in-Process Inventory Turnover: For example, a bakery might calculate its work-in-process inventory turnover to understand how quickly it is transforming raw ingredients into partially baked goods.
- Finished Goods Inventory Turnover: For example, a clothing retailer might calculate its finished goods inventory turnover to understand how quickly it is selling its finished products, such as shirts and pants, to customers.
- 4. Gross Inventory Turnover: For example, a company that sells both raw materials and finished products might calculate its gross inventory turnover to understand the overall speed at which it is selling all of its inventory, including raw materials, work-in-process, and finished goods.
- 5. Net Inventory Turnover: For example, a company that sells products with a warranty might calculate its net inventory turnover to understand the speed at which it is selling its products after taking into account any returns or discounts.
- 6. Inventory Turns per Year: For example, a company that calculates its gross inventory turnover of 6 could express this as 6 inventory turns per year, meaning that its entire inventory is sold and replaced 6 times in a given year.

In conclusion, the type of inventory turnover that a company calculates will depend on its specific needs and goals. Understanding and monitoring different types of inventory turnover can provide valuable insights into a company's operations and performance.

# 8.9 WHAT'S THE INVENTORY TURNOVER RATIO AVERAGE IN THE RETAIL INDUSTRY?

The average inventory turnover ratio in the retail industry varies depending on the type of retail business and the specific product categories being sold. However, a typical retail company's inventory turnover ratio can range from 4 to 8 times per year.

For example, grocery stores generally have a higher inventory turnover ratio, with an average of 8-10 turns per year, as they sell a high volume of perishable goods that need to be regularly replenished. On the other hand, department stores and furniture stores may have a lower inventory turnover ratio, with an average of 4-6 turns per year, as they sell a lower volume of less perishable goods with a longer shelf life.

It's important to note that these are just general averages, and individual retail companies may have significantly higher or lower inventory turnover ratios depending on various factors such as product mix, sales volume, and inventory management practices.

### 8.10 INVENTORY TURNOVER BY INDUSTRY

Inventory turnover varies widely across different industries, reflecting the unique challenges and characteristics of each industry. Here are some examples of inventory turnover by industry:

1. Retail: Inventory turnover in the retail industry varies widely depending on the type of retail business and the specific product categories being sold. Grocery stores generally have a higher inventory turnover ratio, with an average of 8-10 turns per year, while department stores and furniture stores may have a lower inventory turnover ratio, with an average of 4-6 turns per year.

- 2. Manufacturing: Inventory turnover in the manufacturing industry also varies widely depending on the type of goods being produced and the production process. For example, companies that manufacture fast-moving consumer goods (FMCG) such as food and personal care products, typically have higher inventory turnover ratios, while companies that manufacture heavy machinery or specialized equipment may have lower inventory turnover ratios.
- 3. Wholesale: Inventory turnover in the wholesale industry can vary depending on the type of goods being sold and the target market. Wholesale companies that sell fast-moving goods to retailers or distributors may have higher inventory turnover ratios, while companies that sell slow-moving or specialty goods may have lower inventory turnover ratios.
- 4. Pharmaceuticals: Inventory turnover in the pharmaceutical industry can be relatively low compared to other industries, as many pharmaceutical products have a long shelf life and are subject to strict regulation and quality control measures.
- 5. Technology: Inventory turnover in the technology industry can be relatively high, as new products and technologies are frequently introduced and older products become obsolete. Companies in this industry may have to manage inventory of both physical products, such as smartphones and laptops, and digital products, such as software and apps.

In conclusion, inventory turnover can vary widely by industry, and companies need to consider their specific industry characteristics when analyzing and improving their inventory turnover.

### 8.11 INVENTORY TURNOVER SOFTWARE

Inventory turnover software is a type of software that helps companies manage their inventory and monitor inventory turnover. The software provides tools for tracking and analyzing inventory levels, sales data, and other key metrics, enabling companies to improve their inventory management and achieve a more efficient inventory turnover.

Some common features of inventory turnover software include:

- Inventory Tracking and Management: Ability to track and manage inventory levels, reordering points, and other key metrics, enabling companies to optimize their inventory levels and avoid overstocking or stockouts.
- Sales data Integration: Integration with sales data, allowing companies
  to track the movement of inventory, understand the sales trends of
  specific products, and make data-driven decisions about inventory
  levels.
- Inventory Reporting: Ability to generate real-time reports on inventory levels, inventory turnover, and other key metrics, providing valuable insights into inventory performance and enabling companies to make informed decisions.
- 4. **Stock Optimization:** Tools to optimize inventory levels, including forecasting, demand planning, and other advanced inventory management techniques.
- 5. **Mobile Compatibility:** Mobile compatibility, allowing companies to access inventory information and reports on the go, making it easier to manage inventory and monitor inventory turnover.

In conclusion, inventory turnover software can help companies improve their inventory management, reduce waste, and achieve a more efficient inventory turnover. The software provides tools for tracking and analyzing inventory data, enabling companies to make data-driven decisions about inventory levels and optimize their inventory performance.

### 8.12 POPULAR INVENTORY SOFTWARES

Here are some popular names of inventory software:

1. QuickBooks Inventory: An inventory management solution designed for small to medium-sized businesses.

- 2. Fishbowl Inventory: A cloud-based inventory management solution that integrates with QuickBooks.
- 3. Zoho Inventory: A cloud-based inventory management solution that includes features such as order tracking, barcode scanning, and real-time inventory updates.
- 4. SAP Business One: An enterprise resource planning (ERP) solution that includes inventory management, procurement, and supply chain management capabilities.
- 5. Brightpearl: A cloud-based inventory management solution designed for retail and wholesale businesses.
- Unleashed Software: A cloud-based inventory management solution that provides real-time inventory updates and integrates with popular ecommerce platforms.
- 7. Infor Nexus Inventory Management: A cloud-based inventory management solution designed for the supply chain and logistics industries.
- 8. Stock&Buy: A cloud-based inventory management solution that integrates with popular e-commerce platforms.

These are just a few examples of inventory software, and there are many other solutions available that vary in terms of features, pricing, and target market. When choosing an inventory software, it's important to consider your specific business needs and choose a solution that provides the right balance of features and cost.

### 8.13 INVENTORY TURNOVER VS. INVENTORY DAYS

Inventory Turnover and Inventory Days are two key metrics used to measure the performance of a company's inventory management.

Inventory Turnover is a measure of how many times a company's inventory is sold and replaced in a given period of time, typically a year. It is calculated by dividing the cost of goods sold by the average inventory

value. A higher inventory turnover indicates that a company is efficiently managing its inventory and generating good sales.

Inventory Days, on the other hand, measures the number of days it takes a company to sell its entire inventory. It is calculated by dividing the number of days in a year by the inventory turnover ratio. A lower number of inventory days means that a company is able to sell its inventory more quickly, reducing the amount of time that inventory is tied up as an investment.

In conclusion, Inventory Turnover and Inventory Days are both important metrics for measuring the performance of a company's inventory management. Inventory Turnover provides a measure of how efficiently a company is selling its inventory, while Inventory Days provides a measure of how quickly a company is able to sell its inventory. Both metrics should be considered together to get a complete picture of a company's inventory performance.

### **CHAPTER 9**

### INVENTORY ACCURACY

### INVENTORY ACCURACY

- 9.1 What Is Inventory Accuracy?
- 9.2 Why combating inaccurate inventory is so important?
- 9.3 Real inventory vs. Electronic records
- 9.4 The Inventory Accuracy Formula
- 9.5 What Is a Good Inventory Accuracy Rate?
- 9.6 Delayed product orders can cost you customers
- 9.7 How a Distribution Company Used Modern Solutions to Get 99.99% Inventory Accuracy
- 9.8 New WMS with real-time tracking
- 9.9 Automations reduce human errors
- 9.10 Tracking improved the efficiency of picking, packing, and shipping
- 9.11 Accuracy From Warehouse to Doorstep Is Just as Important
- 9.12 Track packages in real time
- 9.13 Use analytics to solve problems
- 9.14 Plan better routes to improve efficiency and ensure packages are on-time



Chapter - 9 Inventory Accuracy

### 9.1 WHAT IS INVENTORY ACCURACY?

Inventory accuracy refers to the degree to which a company's recorded inventory matches its actual physical inventory. It measures the reliability and correctness of a company's inventory records. A high level of inventory accuracy is important for effective inventory management and can help a company reduce waste, minimize stockouts, and optimize inventory levels.

# 9.2 WHY COMBATING INACCURATE INVENTORY IS SO IMPORTANT?

Combating inaccurate inventory is important because it can have several negative consequences, including:

Increased costs: Inaccurate inventory can lead to overstocking, which increases holding costs and ties up valuable capital. It can also result in stockouts, which can lead to lost sales and damage to customer relationships.

Inefficient operations: Poor inventory accuracy can cause disruptions to production and supply chain processes, leading to increased lead times, delayed shipments, and decreased productivity.

Loss of credibility: Inaccurate inventory data can impact the credibility of a company with suppliers, customers, and stakeholders.

Missed business opportunities: Inaccurate inventory can result in lost sales and missed opportunities to upsell or cross-sell.

Regulatory compliance issues: Inaccurate inventory records can also result in compliance issues, such as failing to meet tax or regulatory reporting requirements.

In conclusion, maintaining accurate inventory is crucial for a company's financial performance, operational efficiency, and overall reputation.

### 9.3 REAL INVENTORY VS. ELECTRONIC RECORDS

Real inventory refers to the actual physical stock of goods that a company holds. This can be measured by physically counting the items in a warehouse or stockroom.

Electronic records, on the other hand, refer to the information about a company's inventory that is stored in a computer system or software. This information can include the number of items in stock, their location, and the date they were received or sold.

It's important for a company to regularly reconcile its real inventory with its electronic records to ensure that the information in the system is up-to-date and accurate. Inaccurate electronic records can lead to poor decision-making, waste, and inefficiencies, whereas real-time, accurate inventory information helps a company make informed decisions and optimize its operations.

### 9.4 THE INVENTORY ACCURACY FORMULA

The inventory accuracy formula is used to measure the degree to which a company's recorded inventory matches its actual physical inventory. The formula is:

Inventory Accuracy = (Number of accurate inventory units / Total number of inventory units) x 100

This formula calculates the percentage of accurate inventory units in a company's stock. A high percentage indicates a high level of inventory accuracy, while a low percentage indicates the opposite. An inventory accuracy rate of 100% means that the recorded inventory exactly matches the physical inventory, while an accuracy rate of less than 100% indicates some discrepancy between the two.

### 9.5 WHAT IS A GOOD INVENTORY ACCURACY RATE?

A good inventory accuracy rate depends on various factors such as industry, type of products, and the company's size. Generally, a rate of 95-98% is considered good for most businesses. A rate above 98% is considered excellent, while a rate below 95% may indicate significant discrepancies and the need for improvement.

It's important to note that achieving a high inventory accuracy rate requires continuous monitoring and improvement efforts. Companies should regularly conduct physical inventory counts, analyze discrepancies, and implement processes to reduce errors. A good inventory accuracy rate not only helps a company improve operational efficiency and reduce waste but also demonstrates a commitment to effective inventory management and customer satisfaction.

According to **Auburn University's RFID Lab**, average inventory accuracy for companies?

According to Auburn University's RFID (Radio Frequency Identification) Lab, the average inventory accuracy rate for companies is around 65%. This indicates that many companies struggle with maintaining accurate records of their inventory, and there is significant room for improvement. The low accuracy rate can result in several problems, including overstocking, stockouts, wasted resources, and lost sales. Improving inventory accuracy requires a systematic approach, including regular physical inventory counts, reconciliation of electronic records, and ongoing analysis and improvement of processes.

# 9.6 DELAYED PRODUCT ORDERS CAN COST YOU CUSTOMERS

Yes, delayed product orders can cost a company customers. When a customer places an order and experiences a delay in receiving the product, it can result in frustration and dissatisfaction. This can negatively impact the customer's perception of the company and may result in lost sales or reduced loyalty.

In addition, delayed orders can also impact a company's reputation, as customers may share their negative experiences with others, affecting the company's ability to attract new business. Furthermore, delayed orders can lead to stockouts, resulting in lost sales and missed opportunities to upsell or cross-sell.

To minimize the impact of delayed orders, companies should prioritize accuracy and efficiency in their inventory management processes. This can help ensure that products are in stock and readily available when customers place their orders. Regular physical inventory counts, reconciliation of

electronic records, and ongoing process improvement can help companies maintain accurate inventory and minimize the risk of stockouts and delayed orders.

# 9.7 HOW A DISTRIBUTION COMPANY USED MODERN SOLUTIONS TO GET 99.99% INVENTORY ACCURACY

A distribution company can use modern solutions to achieve 99.99% inventory accuracy in the following ways:

- 1. **Implementing RFID Technology:** Radio Frequency Identification (RFID) technology can be used to automatically track inventory in real-time, reducing the risk of errors and increasing accuracy. RFID tags can be attached to individual items, and the data can be automatically captured and updated as the items move through the warehouse or supply chain.
- 2. **Utilizing Barcoding and Scanning**: Barcoding and scanning systems can be used to accurately track inventory and reduce the risk of errors during the receiving, picking, and shipping processes.
- 3. Adopting Real-time Inventory Management Software: Inventory management software can provide real-time visibility into inventory levels and can help prevent stockouts and overstocking. The software can be integrated with barcoding and scanning systems for even greater accuracy.
- 4. **Regular Physical Inventory Counts:** Physical inventory counts can be conducted regularly to reconcile the physical inventory with the electronic records and identify and correct any discrepancies.
- 5. **Continuous Process Improvement:** Companies should continuously analyze their inventory processes and identify areas for improvement. This can include reducing the number of manual processes, automating workflows, and using technology to minimize errors.

By implementing these modern solutions, a distribution company can achieve a high level of inventory accuracy, which can lead to increased efficiency, reduced costs, improved customer satisfaction, and a stronger reputation.

### 9.8 NEW WMS WITH REAL-TIME TRACKING

A new Warehouse Management System (WMS) with real-time tracking can bring several benefits to a company:

- 1. Increased accuracy: Real-time tracking of inventory movements helps ensure that the electronic records of inventory levels are up-to-date and accurate.
- 2. Improved efficiency: A WMS with real-time tracking can help streamline warehouse operations, reducing the time and effort required to manage inventory.
- 3. Reduced stockouts and overstocking: Accurate inventory tracking helps prevent stockouts and overstocking, reducing waste and increasing profitability.
- 4. Enhanced customer satisfaction: Accurate inventory levels and faster order fulfillment can improve customer satisfaction, leading to increased sales and repeat business.
- 5. Improved visibility: Real-time tracking provides greater visibility into inventory levels, enabling companies to make informed decisions and optimize operations.

A new WMS with real-time tracking can help companies improve the accuracy, efficiency, and profitability of their inventory management processes. It can provide real-time visibility into inventory levels, enabling companies to make informed decisions and optimize operations.

### 9.9 AUTOMATIONS REDUCE HUMAN ERRORS

Yes, automations can significantly reduce human errors in inventory management processes. Human errors can arise from manual data entry, miscommunication, or other factors. Automations can help minimize these errors by removing the need for manual data entry, standardizing processes, and ensuring that tasks are completed consistently and accurately.

For example, automated inventory tracking systems can use barcoding, scanning, or RFID (Radio Frequency Identification) technology to accurately track inventory movements in real-time. This eliminates the need for manual data entry and reduces the risk of errors. Automated inventory management software can also be integrated with these systems, providing real-time visibility into inventory levels and reducing the risk of overstocking or stockouts.

By automating inventory management processes, companies can improve accuracy, reduce costs, and improve customer satisfaction. Automations can help ensure that inventory levels are accurately tracked, enabling companies to make informed decisions and optimize operations.

# 9.10 TRACKING IMPROVED THE EFFICIENCY OF PICKING, PACKING, AND SHIPPING

Yes, tracking inventory can improve the efficiency of the picking, packing, and shipping processes. Accurate tracking of inventory levels can help ensure that the right products are in the right place at the right time, reducing the time and effort required to pick, pack, and ship orders.

For example, with real-time tracking, companies can easily see which products are in stock and which are not, enabling them to quickly fulfill customer orders. This can reduce the risk of stockouts and improve order fulfillment times. Automated picking systems can also be used to optimize the picking process, reducing the time required to pick orders and improving accuracy.

In addition, tracking inventory movements can help companies identify areas for improvement in their processes. For example, they may identify bottlenecks in the picking or shipping processes that can be addressed to improve efficiency.

Overall, tracking inventory can bring numerous benefits to the picking, packing, and shipping processes, including improved accuracy, increased efficiency, and reduced costs. It can help companies meet customer

expectations, improve their reputation, and increase their competitiveness in the market.

# 9.11 ACCURACY FROM WAREHOUSE TO DOORSTEP IS JUST AS IMPORTANT

Yes, accuracy from the warehouse to the customer's doorstep is just as important as accuracy within the warehouse. Poor accuracy in any part of the supply chain can lead to stockouts, overstocking, customer dissatisfaction, and lost sales.

Inaccurate tracking of inventory movements can cause delays in order fulfillment, leading to frustrated customers who may look elsewhere for the products they need. This can also result in missed opportunities for cross-selling and upselling, as customers may not be able to purchase additional products they need if they are not available.

To ensure accuracy from the warehouse to the doorstep, companies need to implement tracking systems that provide real-time visibility into inventory movements. This can help ensure that inventory levels are accurate, that orders are fulfilled on time, and that customers receive the products they need.

In addition, companies should work closely with their carriers to ensure that deliveries are made on time and that products are handled and stored properly. This can help reduce the risk of damage or loss in transit, further improving accuracy and customer satisfaction.

In conclusion, accuracy from the warehouse to the customer's doorstep is just as important as accuracy within the warehouse. Ensuring accuracy in all parts of the supply chain is essential for improving customer satisfaction, increasing sales, and building a strong reputation in the market.

### 9.12 TRACK PACKAGES IN REAL TIME

Yes, tracking packages in real-time is an important aspect of supply chain management. Real-time tracking can help companies keep their customers informed about the status of their deliveries, reducing the risk of customer dissatisfaction and increasing customer trust.

With real-time tracking, companies can see exactly where their packages are at any given time, helping them to quickly identify and resolve any issues that may arise during transit. This can help reduce the risk of lost or damaged packages, improving delivery times and reducing the cost of resolving customer complaints.

In addition, real-time tracking can help companies identify bottlenecks in their shipping processes, enabling them to make improvements that can increase efficiency and reduce costs. It can also provide valuable data that can be used to improve shipping routes and delivery schedules.

There are a number of ways that companies can track packages in real-time, including the use of shipping carriers' tracking systems, GPS-enabled devices, and real-time visibility platforms. These systems can be integrated with inventory management software to provide a complete view of the supply chain, enabling companies to make informed decisions and improve their operations.

In conclusion, tracking packages in real-time is an essential aspect of supply chain management. It helps companies keep their customers informed, reduces the risk of lost or damaged packages, and provides valuable data for improving operations.

### 9.13 USE ANALYTICS TO SOLVE PROBLEMS

Yes, using analytics to solve problems is a powerful tool for improving supply chain management. Analytics can provide valuable insights into the performance of a company's supply chain, enabling it to identify areas for improvement and make data-driven decisions.

By analyzing data on inventory levels, order fulfillment times, shipping costs, and customer satisfaction, companies can identify trends, patterns, and areas of inefficiency. This can help them make informed decisions about how to improve their operations and reduce costs.

For example, analytics can be used to optimize shipping routes, reduce shipping costs, and improve delivery times. It can also help companies identify bottlenecks in their processes, such as slow order fulfillment times or high rates of stockouts, and implement solutions to address these issues.

In addition, analytics can be used to monitor the performance of suppliers, carriers, and other partners in the supply chain. This can help companies identify areas for improvement in their relationships with these partners and ensure that their operations are aligned with their goals and objectives.

In conclusion, using analytics to solve problems is a key aspect of modern supply chain management. It provides valuable insights into the performance of a company's operations and enables it to make data-driven decisions that can improve efficiency, reduce costs, and increase customer satisfaction.

# 9.14 PLAN BETTER ROUTES TO IMPROVE EFFICIENCY AND ENSURE PACKAGES ARE ON-TIME

Yes, planning better routes can improve efficiency and help ensure that packages are delivered on-time. Optimizing shipping routes can reduce shipping costs, reduce transit times, and improve delivery times.

By analyzing data on shipping volumes, delivery schedules, and delivery locations, companies can identify the most efficient shipping routes. This can help reduce the time and distance that packages need to travel, reducing shipping costs and improving delivery times.

In addition, companies can use real-time tracking systems to monitor the progress of deliveries in real-time. This can help them quickly identify and resolve any issues that may arise during transit, ensuring that packages are delivered on-time and in good condition.

There are a number of tools and technologies available to help companies plan better routes, including transportation management systems, route optimization software, and GPS-enabled devices. These systems can be integrated with inventory management software to provide a complete view of the supply chain, enabling companies to make informed decisions and improve their operations.

In conclusion, planning better routes is an essential aspect of supply chain management. It can help companies reduce shipping costs, improve delivery times, and increase customer satisfaction by ensuring that packages are delivered on-time and in good condition.

### **CHAPTER 10**

### INVENTORY OPTIMIZATION

### INVENTORY OPTIMIZATION

- 10.1 What is Inventory Optimization?
- 10.2 Discuss main elements of inventory optimization with suitable examples
- 10.3 Why is inventory optimization important for ecommerce?
- 10.4 How ShipBob can help with inventory optimization
- 10.5 Advantages of inventory optimization
- 10.6 Limitations of inventory optimization
- 10.7 Schneider Electric Inventory Optimization Journey Case Study
- 10.8 Optimizing MRO Inventory
- 10.9 Twelve Best Practices Of Inventory Optimization



# Chapter - 10 Inventory Optimization

### 10.1 WHAT IS INVENTORY OPTIMIZATION?

Inventory optimization is the process of balancing inventory levels and service level to minimize costs such as holding costs, stock-out costs and shortage costs.

Inventory optimization is a method of ensuring that a business holds enough inventory to meet demand while minimizing excess inventory and associated costs.

Inventory optimization is the practice of balancing inventory levels and service level to minimize costs and maximize efficiency in the supply chain. It involves using data analysis and mathematical models to determine the optimal amount of inventory to keep on hand and when to order more.

Inventory optimization is the process of finding the right balance between holding too much inventory, which incurs unnecessary costs, and not having enough inventory, which results in stock-outs and lost sales. It involves analyzing demand patterns and inventory levels to determine the most cost-effective way to manage inventory and minimize waste.

# 10.2 DISCUSS MAIN ELEMENTS OF INVENTORY OPTIMIZATION WITH SUITABLE EXAMPLES

The main elements of inventory optimization include:

- 1. **Data collection and Analysis:** Gathering data on demand patterns, inventory levels, and lead times. For example, analyzing sales data to identify trends and patterns in customer demand for a product.
- 2. **Inventory Metrics:** Calculating inventory metrics such as safety stock, reorder point, and economic order **Inventory metrics:** quantity (EOQ). For example, calculating the reorder point as the level at which inventory should be replenished to avoid stock-outs.
- 3. **Mathematical modeling:** Using mathematical models to determine the optimal inventory levels and reorder points. For example, using the

EOQ model to determine the most cost-effective order size for a product.

- 4. **Safety stock calculation:** Establishing the minimum amount of inventory to keep on hand to avoid stock-outs. For example, determining the safety stock level for a product based on its demand volatility and lead time.
- 5. **Lead time analysis:** Analyzing lead times to determine the best time to reorder inventory. For example, considering factors such as supplier lead time and transportation time to determine the ideal time to place an order.
- 6. **Cost analysis:** Evaluating the costs associated with holding inventory, stock-outs, and ordering. For example, comparing the cost of holding excess inventory to the cost of stock-outs to determine the optimal inventory levels.
- 7. **Continuous monitoring and adjustment:** Regularly monitoring inventory levels and demand patterns and adjusting inventory levels as needed to maintain optimal inventory levels. For example, regularly reviewing sales data and inventory levels to ensure inventory levels are aligned with customer demand.

# 10.3 WHY IS INVENTORY OPTIMIZATION IMPORTANT FOR ECOMMERCE?

Inventory optimization is important for ecommerce for several reasons:

- 1. **Cost savings:** By optimizing inventory levels, ecommerce businesses can minimize the costs associated with holding too much inventory, such as storage and obsolescence costs, while also avoiding the costs of stock-outs, such as lost sales and damaged customer relationships.
- 2. **Increased efficiency:** Inventory optimization helps ecommerce businesses make the most of their available storage space and reduces the time and resources required to manage inventory.

- 3. **Improved customer satisfaction:** Keeping the right amount of inventory on hand helps ecommerce businesses ensure that products are always available when customers want to buy them, leading to improved customer satisfaction and loyalty.
- 4. **Better inventory management:** Inventory optimization helps ecommerce businesses make informed decisions about when to order more inventory and how much to order, leading to better inventory management and reduced waste.

Overall, inventory optimization is critical for the success of ecommerce businesses as it enables them to maximize profitability and competitiveness while providing a positive customer experience.

# 10.4 HOW SHIPBOB CAN HELP WITH INVENTORY OPTIMIZATION

ShipBob is a third-party logistics (3PL) provider that helps ecommerce businesses with inventory optimization in several ways:

- 1. **Multi-Location Fulfillment:** ShipBob enables ecommerce businesses to store inventory in multiple fulfillment centers, which can help reduce shipping times and minimize the risk of stock-outs. This also enables businesses to store inventory closer to customers, reducing shipping costs and improving delivery times.
- 2. **Real-time Inventory Tracking:** ShipBob provides real-time tracking of inventory levels, allowing ecommerce businesses to see exactly how much inventory they have on hand at any given time. This information can be used to make informed decisions about when to reorder inventory and how much to order.
- 3. **Automated Inventory Management:** ShipBob's inventory management system allows ecommerce businesses to automate many of the manual processes involved in inventory management, such as reordering and restocking. This saves time and helps ensure that inventory levels are always optimized.

4. **Inventory Forecasting:** ShipBob provides inventory forecasting tools that help ecommerce businesses anticipate future demand for their products. This information can be used to make informed decisions about inventory levels, enabling businesses to avoid stock-outs and minimize the costs associated with holding too much inventory.

Overall, ShipBob provides a comprehensive solution for inventory optimization, enabling ecommerce businesses to streamline their supply chain and improve the accuracy and efficiency of their inventory management.

### 10.5 ADVANTAGES OF INVENTORY OPTIMIZATION

The advantages of inventory optimization include:

- 1. **Cost savings:** Optimizing inventory levels can reduce the costs associated with holding too much inventory, such as storage costs, and can help avoid the costs of stock-outs, such as lost sales and damaged customer relationships.
- 2. **Improved Customer Satisfaction:** By ensuring that products are always available when customers want to buy them, inventory optimization can improve customer satisfaction and loyalty.
- 3. **Better Inventory Management:** Inventory optimization helps businesses make informed decisions about when to order more inventory and how much to order, leading to better inventory management and reduced waste.
- 4. **Increased Efficiency:** Optimizing inventory levels can reduce the time and resources required to manage inventory and make the most of available storage space.
- 5. **Reduced Stock-Outs:** By keeping the right amount of inventory on hand, businesses can reduce the risk of stock-outs and ensure that products are always available to meet customer demand.

Improved Cash Flow: Optimizing inventory levels can help businesses
reduce their overall investment in inventory, freeing up cash for other
purposes.

Overall, inventory optimization can have a positive impact on a business's bottom line, improving profitability and competitiveness while providing a positive customer experience.

### 10.6 LIMITATIONS OF INVENTORY OPTIMIZATION

The limitations of inventory optimization include:

- 1. **Data Quality:** Inventory optimization requires accurate and up-to-date data about demand and inventory levels. Poor data quality can lead to incorrect decisions about inventory levels and negatively impact the effectiveness of inventory optimization.
- 2. **Difficulty in Predicting Demand:** Inventory optimization relies on accurate predictions of demand for products, but demand can be unpredictable, especially in fast-changing market conditions. This can make it challenging to maintain optimized inventory levels.
- 3. **Changing Market Conditions:** Inventory optimization is designed to respond to changes in demand, but sudden changes in market conditions, such as pandemics, can have a significant impact on demand that is difficult to predict.
- 4. **Complexity of the Supply Chain:** Inventory optimization is more complex in businesses with multiple suppliers, distributors, and customers. This can make it difficult to coordinate inventory levels across different parts of the supply chain.
- 5. **Resistance to Change:** Implementing inventory optimization can require changes to established processes and systems, and some employees may resist these changes.
- 6. **Cost of implementation:** Implementing inventory optimization can be expensive, especially if new technology or software is required.

Overall, while inventory optimization can bring many benefits to businesses, there are also limitations that must be considered and overcome in order to realize these benefits

# 10.7 SCHNEIDER ELECTRIC INVENTORY OPTIMIZATION JOURNEY CASE STUDY

Schneider Electric, a multinational energy management and automation company, implemented inventory optimization as part of a wider supply chain transformation program. The objective was to improve customer satisfaction, reduce inventory levels, and increase efficiency.

The journey started with a detailed analysis of the company's supply chain, which revealed significant inefficiencies in the inventory management process. Schneider Electric then adopted a lean inventory management approach, which involved reducing inventory levels, improving inventory accuracy, and streamlining processes.

The company implemented real-time inventory tracking and automated inventory management systems, which helped to reduce inventory levels by up to 20%. This resulted in improved cash flow, as the company was able to invest less in inventory and more in other areas of the business.

Schneider Electric also improved inventory accuracy, which reduced the risk of stock-outs and improved customer satisfaction. By using real-time data, the company was able to make informed decisions about inventory levels, leading to improved inventory management and reduced waste.

Overall, Schneider Electric's inventory optimization journey was a success, delivering improved customer satisfaction, reduced inventory levels, increased efficiency, and improved cash flow. The company's supply chain transformation program served as a model for other businesses looking to optimize their inventory management processes.

### 10.8 OPTIMIZING MRO INVENTORY

MRO (Maintenance, Repair, and Operations) inventory optimization refers to the process of optimizing the levels of spare parts and supplies used for maintenance and repair operations. The main objective of MRO inventory optimization is to strike a balance between having sufficient inventory to meet maintenance requirements and minimizing the costs associated with holding too much inventory.

Here are some key steps to optimize MRO inventory:

- 1. **Inventory Analysis:** This involves a thorough analysis of current MRO inventory levels, usage patterns, and demand forecasts to identify areas for improvement.
- 2. Classification of inventory: MRO inventory should be classified into different categories, such as critical, non-critical, and slow-moving, to prioritize inventory optimization efforts.
- 3. **Min-Max and Reorder Point Method:** This method involves setting minimum and maximum inventory levels for each item and determining when to reorder to maintain optimal inventory levels.
- 4. **Cycle Counting:** This involves regularly counting a portion of MRO inventory to ensure accuracy and identify discrepancies.
- 5. **Use of Technology:** Implementing a computerized maintenance management system (CMMS) or enterprise resource planning (ERP) system can help automate MRO inventory management, improve accuracy, and reduce manual effort.
- 6. **Continuous improvement:** Ongoing monitoring and analysis of MRO inventory levels and usage patterns can help identify opportunities for further optimization and continuous improvement.

By optimizing MRO inventory, businesses can reduce costs associated with holding excess inventory, minimize the risk of stock-outs, and improve maintenance and repair operations.

# 10.9 TWELVE BEST PRACTICES OF INVENTORY OPTIMIZATION

- Accurate Forecasting: This involves using historical sales data, market trends, and demand signals to predict future demand for products.
- 2. **Regular inventory Review:** This involves regularly reviewing inventory levels, demand patterns, and stock-outs to identify areas for improvement.
- 3. **Inventory Classification:** Classifying inventory into different categories, such as A, B, and C items, can help prioritize inventory optimization efforts.
- 4. **Safety Stock Calculation:** This involves determining the optimal level of safety stock to maintain, taking into account demand variability, lead times, and desired service levels.
- 5. **Use of Technology:** Implementing a computerized inventory management system can help automate inventory management and improve accuracy.
- 6. **Cycle Counting:** This involves regularly counting a portion of inventory to ensure accuracy and identify discrepancies.
- 7. **Collaboration with Suppliers:** Working closely with suppliers to coordinate deliveries and manage inventory levels can help improve inventory optimization efforts.
- 8. **Vendor-Managed Inventory (VMI):** VMI involves having suppliers manage inventory levels and restocking, which can help reduce the costs of holding inventory.
- 9. **Cross-Functional Teams:** Involving teams from different departments, such as sales, marketing, and operations, can help improve decision-making and coordination in inventory optimization efforts.

- 10. **Continuous improvement:** Ongoing monitoring and analysis of inventory levels and usage patterns can help identify opportunities for further optimization and continuous improvement.
- 11. **Data Analysis:** Analyzing inventory data to identify trends, usage patterns, and demand signals can help inform inventory optimization efforts.
- 12. **Employee Training:** Providing training and resources to employees can help improve their understanding of inventory optimization and the role they play in the process.

Overall, by following these best practices, businesses can improve their inventory optimization efforts and achieve better outcomes, such as reduced costs, improved customer satisfaction, and increased efficiency.

### **CHAPTER 11**

# HOW AI IS TRANSFORMING INVENTORY MANAGEMENT?

# HOW AI IS TRANSFORMING INVENTORY MANAGEMENT?

- 11.3 AI inventory management for demand forecasting
- 11.4 Warehouse management that is more intelligent
- 11.5 Safety management of inventories
- 11.6 Supply chain management
- 11.7 Data mining
- 11.8 Using AI in Inventory Management to Increase Productivity
- 11.9 Improved customer service with AI-powered inventory management
- 11.10 Manage inventory successfully in a fast-paced setting.
- 11.11 Marketing techniques that have been improvised
- 11.12 Artificial intelligence-powered robots
- 11.13 Systems of reinforcement learning for full-inventory management



# Chapter - 11 How AI is Transforming Inventory Management?

Artificial Intelligence in Inventory Management has emerged as one of the most prominent business approaches nowadays.

Artificial intelligence (AI) refers to computers and machines, as well as computer-controlled robots, that attempt to execute typical activities associated with human-level intellect.

AI has become one of the most prominent technologies in recent years.

This machine examines massive volumes of data, identifies various data patterns, and performs jobs using human experiences and intellect.

It is the artificial stimulation of natural intelligence in computers that have been built to learn and emulate human activities.

This revolution is raising people's standard of living. Many companies are also using AI into their ERP software in order to boost efficiency and quality.

Inventory management includes functions such as ordering, storing, utilising, and selling a company's stock.

It keeps track of merchandise from purchase to sale. It also assists businesses in determining which stocks to purchase, how much to order, and when to order them.

Inventory management also covers the handling of raw materials, various components, completed items, warehousing, and processing.

It helps to guarantee that there is always adequate stock to meet client needs and that there is never a shortage.

Let us now look at how these fields may interact and how AI can assist businesses improve inventory management:

- 1. AI inventory management for demand forecasting
- 2. Warehouse management that is more intelligent
- 3. Safety management of inventories
- 4. Supply chain management

- 5. Data mining
- 6. Using AI in Inventory Management to Increase Productivity
- 7. Improved customer service with AI-powered inventory management
- 8. Manage inventory successfully in a fast-paced setting.
- 9. Marketing techniques that have been improvised
- 10. Artificial intelligence-powered robots
- 11. Systems of reinforcement learning for full-inventory management

The above points are discussed in detailed below.

# 11.1 AI INVENTORY MANAGEMENT FOR DEMAND FORECASTING

Demand forecasting is the act of analysing data to provide forecasts or future projections for a company's demand for goods and services. It is also known as demand forecasting. The process of demand forecasting is reviewing historical data and trends to determine a product's demand. It aids in the company's planning process by establishing future goals and targets, as well as allowing manufacturers to use their resources to maximise the return on their product. The traditional way of determining requests is extremely time-consuming.

Artificial intelligence evaluates additional aspects that influence interest and discover designs in your data. Unfortunately, natural eyes and other quantifiable techniques cannot see these objects. As a result, AI encourages more precise expectations, allowing for more informed decisions.

Artificial intelligence increases interest in predicting and may reduce errors by 30% to 50% in retail network enterprises.

As a result, companies may efficiently manage their stock management for the development, storage, and conveyance of products based on the information they anticipate.

# 11.2 WAREHOUSE MANAGEMENT THAT IS MORE INTELLIGENT

Automation simplifies the process of managing stocks for businesses to hold till needed. Al improves the effectiveness of warehouse management. It saves a lot of time that could be spent on other tasks and boosts the company's productivity. It also makes communication around the warehouse more simpler than previously. Reduces operating costs and resource use. All of these elements also provide you a competitive edge, since 12% of respondents in the MHI Annual Industry Report 2020 are now adopting AI technology. This appears to be a modest figure, but the benefits of AI in warehousing surpass it. And if you are able to implement that technology, you will undoubtedly have an advantage over your competition.

### 11.3 SAFETY MANAGEMENT OF INVENTORIES

Companies must have methods for dealing with various clients. They must base their inventory levels on the demands of their consumers. This procedure makes inventory management simple for them. With computerised realignment, discoloured brands unwaveringly from promising stock to clients that can't be communicated, or the fear of overselling then over-buying stock and neglecting cash, are two enormous concerns that may be dealt with.

To get effective omnichannel outcomes, businesses must have the ability to intelligently manage satisfaction expenses versus administration to improve profit from speculation, further expand client experience, and increase repeat purchase behaviour.

### 11.4 SUPPLY CHAIN MANAGEMENT

A supply chain is the long process and travel of a product from basic ingredients to end-user consumption. This supply chain includes various processes such as B2B producers, raw material manufacturing, raw material distribution, B2C producers, utilising raw materials to build the end product, keeping them till needed, selling to consumers, or selling through mediators.

Between these phases, there is a lot of planning to do, such as product planning, demand planning, warehouse planning, distribution planning, and so on. A manufacturing ERP also aids in taking control of entire supply chain planning, making forecasting and dry runs easier. Now, how AI fits into this aspect of stock management is that AI-led inventory network streamlining programming enhances meaningful choices by employing intellectual predictions and suggestions on optimal actions. This can help with inventory network execution and updating. It also assists decision-makers with potential repercussions in terms of time, cost, and revenue. Furthermore, it improves the competency of a variety of stages and increases clarity in working things.

### 11.5 DATA MINING

AI technology demonstrates a high level of proficiency in translating data into actions that can help a firm evolve or respond appropriately to a specific scenario.

Data is a significant tool for businesses in order to properly manage their inventory. Businesses gather data to learn more about the market in which they operate. Companies collect this data to understand more about their customers' wants, rivals' plans, product difficulties, product satisfaction, and how they can improve if necessary. Such information allows them to prepare ahead.

With the support of AI, information mining becomes a more easy path of social event data. As a result, companies build a superior image of shopper wants and plan their commercial improvement by following and documenting the interests of each consumer using calculations. Organizations gain a pre-plan of future customer demands, allowing them to store necessary supplies.

Information mining may also assist you learn more about weather, events, financial situations, product popularity, and much more. It also creates a variety of scenarios that allow the personnel to forecast accurate results.

# 11.6 USING AI IN INVENTORY MANAGEMENT TO INCREASE PRODUCTIVITY

Many sectors rely on artificial intelligence on a regular basis to carry out important business activities. Producing raw materials, storing them, locating essential data for planning, manufacturing the finished product, and so forth.

AI has affected and made it easier for businesses to manage their inventory than ever before. Of course, there is a cost to investing more in such technology that not every organisation can afford. In most situations, only enterprises that operate throughout the year can afford this expenditure, but on the plus side, it has given them benefits. AI has largely supplanted the conventional labour, saving time and increasing productivity.

They are designed to run continuously without interruption, resulting in continuous output.

# 11.7 IMPROVED CUSTOMER SERVICE WITH AI-POWERED INVENTORY MANAGEMENT

Chatbots, which are artificial intelligence features, make it simple to engage with clients. Only production and sales are insufficient in business. Knowing your clients and soliciting their feedback on your product is equally critical. Furthermore, chatbots enable customers to rapidly contact vendors or manufacturers if they have a problem with a product. Chatbots are capable of handling 80% of all customer obligations. It also assists the inventory management department in reordering essential products, ensuring that inventory levels are constantly optimal. It also keeps track of multiple orders and their changes.

Chatbots, for example, have been used by businesses to obtain information on expected deliveries, despatched parcels, and their contents. It also assists in the performance of surveys that allow the firm to learn what consumers think about their products and services, so assisting in the formation of strong client connections.

## 11.8 MANAGE INVENTORY SUCCESSFULLY IN A FAST-PACED SETTING.

After production, selling is not the point at which the corporation can sit back and rest. Many firms nowadays register on internet platforms in order to reach out to more clients. As a result, inventory management is critical for every organisation that has to deliver items securely to customers. The great majority of today's course planning challenges are influenced by various time-changing elements, for example, gear disappointments, vehicle crashes, congestion, and flaws in street organisations. AI ensures that your items are delivered to the stockroom, retailers, and even the client's door. The finest feature is that AI constructs courses with reinforcement plans in case of errors. Furthermore, it builds smart roadway networks that assure good delivery.

### 11.9 MARKETING TECHNIQUES THAT HAVE BEEN IMPROVISED

Developing marketing strategies is critical since they help you to establish yourself as a market leader in your sector. AI also aids in the discovery of more detailed information, allowing marketers to develop far better and more precise inventory management marketing plans. AI and machine learning can assist in identifying short-term product and market demands.

It also aids novel inventory technologies such as ML-based anomaly identification and AI in detecting irregular changes in item interest as well as characteristics of who is likely to purchase them. You can also find a sophisticated organisation of data sets. This information therefore allows retailers to maintain control over buyer drifts and respond quickly to explicit pockets of interest that keep them on top of the customer's psychology. It also displays methods that are in line with current market trends and client preferences.

#### 11.10 ARTIFICIAL INTELLIGENCE-POWERED ROBOTS

Robots are automated machines that function and behave like humans. Robotics is becoming increasingly widespread in a variety of businesses. Whether it's transportation, food, beverages, or vehicles, corporations employ cutting-edge technology to manufacture, package, store, and distribute their products.

AI has been implemented in many aspects of inventory management, allowing businesses to plan and create their items with far greater efficiency than manual labour. This has aided in increasing company productivity and manufacturing capacity. Many automobile businesses in India and throughout the world, for example, employ robots to make vehicles. Robots only assemble the engine, bolts, and other components that comprise the finished product. They are automatically programmed by an algorithm to do specified functions at precise times and in specific ways in order to generate the product without trouble.

Although automation has eliminated the need for labourers and workers to accomplish these activities, it has also made it simpler for businesses to exist. It is a one-time investment that minimises the cost of paying compensation to employees, among other things. However, with those robots in the field, inventory production and management have been simplified.

#### 11.11 SYSTEMS OF REINFORCEMENT LEARNING FOR FULL-INVENTORY MANAGEMENT

A reinforcement learning framework is a reasoning process that creates inventory management models with balanced human governance. Support Learning is a branch of computerised reasoning in which the models not only produce forecasts or commands, but also follow up on these predictions. It is also linked to providing this man-made machine with the ability to reflect on what it has forecast.

It is accomplished by rewarding or penalising the computer for displaying faults.

There are conditions for which the model imposes penalties by displaying inventories that are running low on stock. Items are ordered before demand in the case of prizes. This reinforcement system is difficult to create for

someone with no prior training; you must learn about simulation models and RL to go anywhere with Inventory.

However, when done correctly, they may provide astonishing outcomes.

#### CONCLUSION

The issues raised above demonstrate that technology has had a wideranging influence on the planet.

Artificial intelligence (AI) is altering the world in every aspect, including inventory management.

It also aids with inventory management by establishing a solid infrastructure for planning, marketing, manufacturing, storage, and distribution.

Furthermore, it enables businesses to take a more methodical approach to outperform competition and grow their consumer base.

As a result, AI is progressively developing as a useful technology in a variety of commercial fields.

# Appendix

Accounting Standard (As) 2\*
(Revised 2016)

#### VALUATION OF INVENTORIES

[This Accounting Standard includes paragraphs set in bold italic type and plain type, which have equal authority. Paragraphs in bold italic type indicate the main principles. This Accounting Standard should be read in the context of its objective, the Preface to the Statements of Accounting Standards1 and the 'Applicability of Accounting Standards to Various Entities' (See Appendix 1 to this Compendium).]

#### **OBJECTIVE**

A primary issue in accounting for inventories is the determination of the value at which inventories are carried in the financial statements until the related revenues are recognised. This Standard deals with the determination of such value, including the ascertainment of cost of inventories and any write-down thereof to net realisable value.

#### SCOPE

This Standard should be applied in accounting for inventories other than:

work in progress arising under construction contracts, including directly related service contracts (see Accounting Standard (AS) 7, Construction Contracts); work in progress arising in the ordinary course of business of

\* The Standard was originally issued in June 1981. The Standard was revised by the Ministry of Corporate Affairs, Government of India, vide Notification dated 30th March, 2016, which was relevant for companies following Companies (Accounting Standards) Rules, 2006, and which should be used for preparation of accounts for accounting periods commencing on or after the date of notification. The Standard was revised for entities other than companies in 2016 by the Council of the ICAI and is mandatory for accounting periods commencing on or after April 1, 2017 (see Announcement XLV). Consequent to this revision, paragraphs 4 and 27 of AS 2 were revised. The Standard has been notified as part of Companies (Accounting Standards) Rules, 2021, under Companies Act, 2013.

1 Attention is specifically drawn to paragraph 4.3 of the Preface, according to which Accounting Standards are intended to apply only to items which are material.

service providers; shares, debentures and other financial instruments held as stock-in-trade; and producers' inventories of livestock, agricultural and forest products, and mineral oils, ores and gases to the extent that they are measured at net realisable value in accordance with well established practices in those industries.

The inventories referred to in paragraph 1(d) are measured at net realisable value at certain stages of production. This occurs, for example, when agricultural crops have been harvested or mineral oils, ores and gases have been extracted and sale is assured under a forward contract or a government guarantee, or when a homogenous market exists and there is a negligible risk of failure to sell. These inventories are excluded from the scope of this Standard.

#### **DEFINITIONS**

The following terms are used in this Standard with the meanings specified:

Inventories are assets:

held for sale in the ordinary course of business;

in the process of production for such sale; or

in the form of materials or supplies to be consumed in the production process or in the rendering of services.

Net realisable value is the estimated selling price in the ordinary course of business less the estimated costs of completion and the estimated costs necessary to make the sale.

4 Inventories encompass goods purchased and held for resale, for example, merchandise purchased by a retailer and held for resale, computer software held for resale, or land and other property held for resale. Inventories also encompass finished goods produced, or work in progress being produced, by the enterprise and include materials, maintenance supplies, consumables and

loose tools awaiting use in the production process. Inventories do not include spare parts, servicing equipment and standby equipment which meet the definition of property, plant and equipment as per AS 10, Property, Plant and Equipment. Such items are accounted for in accordance with Accounting Standard (AS) 10, Property, Plant and Equipment.

#### MEASUREMENT OF INVENTORIES

Inventories should be valued at the lower of cost and net realisable value.

#### COST OF INVENTORIES

The cost of inventories should comprise all costs of purchase, costs of conversion and other costs incurred in bringing the inventories to their present location and condition.

#### COSTS OF PURCHASE

The costs of purchase consist of the purchase price including duties and taxes (other than those subsequently recoverable by the enterprise from the taxing authorities), freight inwards and other expenditure directly attributable to the acquisition. Trade discounts, rebates, duty drawbacks and other similar items are deducted in determining the costs of purchase.

#### COSTS OF CONVERSION

The costs of conversion of inventories include costs directly related to the units of production, such as direct labour. They also include a systematic allocation of fixed and variable production overheads that are incurred in converting materials into finished goods. Fixed production overheads are those indirect costs of production that remain relatively constant regardless of the volume of production, such as depreciation and maintenance of factory buildings and the cost of factory management and administration. Variable production overheads are those indirect costs of production that vary directly, or nearly directly, with the volume of production, such as indirect materials and indirect labour.

The allocation of fixed production overheads for the purpose of their inclusion in the costs of conversion is based on the normal capacity of the

production facilities. Normal capacity is the production expected to be achieved on an average over a number of periods or seasons under normal circumstances, taking into account the loss of capacity resulting from planned maintenance. The actual level of production may be used if it approximates normal capacity. The amount of fixed production overheads allocated to each unit of production is not increased as a consequence of low production or idle plant. Unallocated overheads are recognised as an expense in the period in which they are incurred. In periods of abnormally high production, the amount of fixed production overheads allocated to each unit of production is decreased so that inventories are not measured above cost. Variable production overheads are assigned to each unit of production on the basis of the actual use of the production facilities.

A production process may result in more than one product being produced simultaneously. This is the case, for example, when joint products are produced or when there is a main product and a by-product. When the costs of conversion of each product are not separately identifiable, they are allocated between the products on a rational and consistent basis. The allocation may be based, for example, on the relative sales value of each product either at the stage in the production process when the products become separately identifiable, or at the completion of production. Most by-products as well as scrap or waste materials, by their nature, are immaterial. When this is the case, they are often measured at net realisable value and this value is deducted from the cost of the main product. As a result, the carrying amount of the main product is not materially different from its cost.

#### OTHER COSTS

Other costs are included in the cost of inventories only to the extent that they are incurred in bringing the inventories to their present location and condition. For example, it may be appropriate to include overheads other than production overheads or the costs of designing products for specific customers in the cost of inventories.

Interest and other borrowing costs are usually considered as not relating to bringing the inventories to their present location and condition and are, therefore, usually not included in the cost of inventories.

#### **EXCLUSIONS FROM THE COST OF INVENTORIES**

In determining the cost of inventories in accordance with paragraph 6, it is appropriate to exclude certain costs and recognise them as expenses in the period in which they are incurred. Examples of such costs are:

abnormal amounts of wasted materials, labour, or other production costs;

storage costs, unless those costs are necessary in the production process prior to a further production stage;

administrative overheads that do not contribute to bringing the inventories to their present location and condition; and selling and distribution costs.

#### COST FORMULAS

The cost of inventories of items that are not ordinarily interchangeable and goods or services produced and segregated for specific projects should be assigned by specific identification of their individual costs.

Specific identification of cost means that specific costs are attributed to identified items of inventory. This is an appropriate treatment for items that are segregated for a specific project, regardless of whether they have been purchased or produced. However, when there are large numbers of items of inventory which are ordinarily interchangeable, specific identification of costs is inappropriate since, in such circumstances, an enterprise could obtain predetermined effects on the net profit or loss for the period by selecting a particular method of ascertaining the items that remain in inventories.

The cost of inventories, other than those dealt with in paragraph 14, should be assigned by using the first-in, first-out (FIFO), or weighted average cost formula. The formula used should reflect the fairest possible approximation to the cost incurred in bringing the items of inventory to their present location and condition.

A variety of cost formulas is used to determine the cost of inventories other than those for which specific identification of individual costs is appropriate. The formula used in determining the cost of an item of inventory needs to be selected with a view to providing the fairest possible approximation to the cost incurred in bringing the item to its present location and condition. The FIFO formula assumes that the items of inventory which were purchased or produced first are consumed or sold first, and consequently the items remaining in inventory at the end of the period are those most recently purchased or produced. Under the weighted average cost formula, the cost of each item is determined from the weighted average of the cost of similar items at the beginning of a period and the cost of similar items purchased or produced during the period. The average may be calculated on a periodic basis, or as each additional shipment is received, depending upon the circumstances of the enterprise.

#### TECHNIQUES FOR THE MEASUREMENT OF COST

Techniques for the measurement of the cost of inventories, such as the standard cost method or the retail method, may be used for convenience if the results approximate the actual cost. Standard costs take into account normal levels of consumption of materials and supplies, labour, efficiency and capacity utilisation. They are regularly reviewed and, if necessary, revised in the light of current conditions.

The retail method is often used in the retail trade for measuring inventories of large numbers of rapidly changing items that have similar margins and for which it is impracticable to use other costing methods. The cost of the inventory is determined by reducing from the sales value of the inventory the appropriate percentage gross margin. The percentage used takes into consideration inventory which has been marked down to below its original selling price. An average percentage for each retail department is often used.

#### NET REALISABLE VALUE

The cost of inventories may not be recoverable if those inventories are damaged, if they have become wholly or partially obsolete, or if their

selling prices have declined. The cost of inventories may also not be recoverable if the estimated costs of completion or the estimated costs necessary to make the sale have increased. The practice of writing down inventories below cost to net realisable value is consistent with the view that assets should not be carried in excess of amounts expected to be realised from their sale or use.

Inventories are usually written down to net realisable value on an item-byitem basis. In some circumstances, however, it may be appropriate to group similar or related items. This may be the case with items of inventory relating to the same product line that have similar purposes or end uses and are produced and marketed in the same geographical area and cannot be practicably evaluated separately from other items in that product line. It is not appropriate to write down inventories based on a classification of inventory, for example, finished goods, or all the inventories in a particular business segment.

Estimates of net realisable value are based on the most reliable evidence available at the time the estimates are made as to the amount the inventories are expected to realise. These estimates take into consideration fluctuations of price or cost directly relating to events occurring after the balance sheet date to the extent that such events confirm the conditions existing at the balance sheet date.

Estimates of net realisable value also take into consideration the purpose for which the inventory is held. For example, the net realisable value of the quantity of inventory held to satisfy firm sales or service contracts is based on the contract price. If the sales contracts are for less than the inventory quantities held, the net realisable value of the excess inventory is based on general selling prices. Contingent losses on firm sales contracts in excess of inventory quantities held and contingent losses on firm purchase contracts are dealt with in accordance with the principles enunciated in Accounting Standard (AS) 4, Contingencies and Events Occurring After the Balance Sheet Date<sup>2</sup>.

Materials and other supplies held for use in the production of inventories are not written down below cost if the finished products in which they will be incorporated are expected to be sold at or above cost. However, when there has been a decline in the price of materials and it is estimated that the cost of the finished products will exceed net realisable value, the materials are written down to net realisable value. In such circumstances, the replacement cost of the materials may be the best available measure of their net realisable value.

An assessment is made of net realisable value as at each balance sheet date.

<sup>2</sup>All paragraphs of AS 4 that deal with contingencies are applicable only to the extent not covered by other Accounting Standards prescribed by the Central Government. For example, the impairment of financial assets such as impairment of receivables (commonly known as provision for bad and doubtful debts) is governed by AS 4

#### DISCLOSURE

The financial statements should disclose:

the accounting policies adopted in measuring inventories, including the cost formula used; and

the total carrying amount of inventories and its classification appropriate to the enterprise.

Information about the carrying amounts held in different classifications of inventories and the extent of the changes in these assets is useful to financial statement users. Common classifications of inventories are:

Raw materials and components

Work-in-progress

Finished goods

Stock-in-trade (in respect of goods acquired for trading)

Stores and spares

Loose tools

Others (specify nature)

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#### ABOUT THE BOOK

This Book deliberates on inventory management especially in the modern complex business world. It dwells upon various aspects of inventory control as well as stockless production. It discusses importance of valuation of inventories and how fast the inventory is turn around. In addition the book also deals with how artificial intelligence is changing the landscape of inventory management. The book has a great value both for academicians and practioners.

