

# **CHAPTER I**

## **INTRODUCTION AND COMPANY PROFILE**

### **INTRODUCTION**

Finance is the force that drives every organization as the backbone of it. It deals with how money is managed and the actual process of acquiring needed funds as individuals, businesses and government entities all need funding to operate. It is required to meet the daily requirements of the organization and helps in allocating the financial needs of every function. Finance is thus the driving force that keeps a firm active throughout the time.

A managerial accounting strategy focusing on maintaining efficient levels of both components of working capital, current assets and current liabilities, with respect to each other, is referred to as working capital management. Working capital management ensures a company has sufficient cash flow in order to meet its short-term debt obligations and operating expenses. Implementing an effective working capital management system is an excellent way for many companies to improve their earnings. The two main aspects of working capital management are ratio analysis and management of individual components of working capital. Ratio analysis will lead management to identify areas of focus such as inventory management, cash management, accounts receivable and payable management.

#### **Inventory Management:**

Inventory management refers to the process of ordering, storing, using, and selling a company's inventory. This includes the management of raw materials, components, and finished products, as well as warehousing and processing of such items. Inventory management helps companies identify which and how much stock to order at what time. It tracks inventory from purchase to the sale of goods. The practice identifies and responds to trends to ensure there's always enough stock to fulfill customer orders and proper warning of a shortage.

Once sold, inventory becomes revenue. Before it sold, inventory (although reported as an asset on the balance sheet) tied up cash. Therefore, too much stock.

One measurement of good inventory management is inventory turnover. An accounting measurement, inventory turnover, reflects how often stock is sold in a period. A business does not want more stock than sales. Poor inventory turnover can lead to dead stock, or unsold stock.

### **Importance of Inventory Management:**

Inventory management is vital to a company's health because it helps make sure there is rarely too much or too little stock on hand, limiting the risk of stock outs and inaccurate records.

Public companies must track inventory as a requirement for compliance with Securities and Exchange Commission (SEC) rules and the Sarbanes-Oxley (SOX) Act. Companies must document their management processes to prove compliance.

### **Benefits of Inventory Management:**

The two main benefits of inventory management are that it ensures you're able to fulfill incoming or open orders and raises profits. Inventory management also:

Understanding stock trends means you see how much and where you have something in stock, so you're better able to use the stock you have. This also allows you to keep less stock at each location (store, warehouse), as you're able to pull from anywhere to fulfill orders — all of this decreases costs tied up in inventory and decreases the amount of stock that goes unsold before it's obsolete.

With proper inventory management, you spend money on inventory that sells, so cash is always moving through the business.

One element of developing loyal customers is ensuring they receive the items they want without waiting.

## COMPANY PROFILE:

The company “SURYA HOME CARE PRODUCTS” was started in the year 2008 at Patthukannu and thereafter over a period of growth time had moved to a bigger facility at Thutthipet during the year 2016. It excels in manufacturing of Mosquito coils and Liquidators. **MAX PRO** was the brand name finalized for this company. Under this manufacturing unit the Mosquito coil and Liquidators are made under the brand name “MAX PRO”. It also engages to manufacture and pack the Mosquito coils for other brands staying as a sub-contractor.

LEGAL STATUS	:PARTNERSHIP FIRM
DELIVERY LOCATIONS	:LOCAL
SELLER TYPE	:MANUFACTURER
NUMBER OF EMPLOYEES	:500 EMPLOYEES
TURNOVER	:45 LACS PER MONTH
REGISTERED ADDRESS	:No. 120/PT, VOC Street, Thuthipet,Villianur Commune,Puducherry-605502.

The turnover of 45 lacs per month is divided in two parts, where the Mosquito coil earns 90% of the turnover and the remaining 10% of the turnover is earned by the liquidator. It deals with upto 27 employees who have a defined roles and responsibilities to accomplish. The company was started in 2008 by two persons in a Partnership way at patthukannu and as the business had increased and developed they started to manufacture the coils and liquidator in a more expanded area in the location named Thutipet. As their business was increasing and there were multiple progressing responses and it resulted in good turnover, it started to **Export** the Mosquito Coil to **Africa**. Other than manufacturing part of the Mosquito coils and Liquidator it also completes the Packing of the Product. On the Other hand, the Outer Carton is nothing but the Cardboards in the thick manner which are again, bought from suppliers by giving them order to make the cartons of our choice and measurements.

## **MISSION AND VISION:**

To conduct business with ethical practices and WALK THEIR TALK and also offer consistent products and services with uncompromising quality supported by continuous improvements and innovations, thereby exceeding the customers' expectations, ensure the culture of utmost respect and empowerment to individuals and be a catalyst in enhancing their competencies.

## **MANUFACTURING PRODUCTS:**

**SURYA HOME CARE PRODUCTS** is a Manufacturing unit which handles the manufacturing and packaging of two products namely

- Mosquito Coil
- Liquidator.

### **MOSQUITO COIL:**

A **mosquito coil** is a mosquito repelling incense, usually made into a spiral, and typically made using dried paste of pyrethrum powder. The coil is usually held at the center of the spiral, suspending it in the air, or wedged by two pieces of fireproof netting to allow continuous smoldering. Burning usually begins at the outer end of the spiral and progresses slowly toward the center of the spiral, producing a mosquito-repellent smoke. A typical mosquito coil measures around 15 centimetres (6 in) in diameter and lasts around seven to twelve hours. Mosquito coils are widely used in **Asia, Africa, South America, Canada, Mexico and Australia.**



manufacturing of the mosquito coil deals with heavy machineries. The Mosquito coil of the MAX PRO product lasts till 12 hours (per coil).

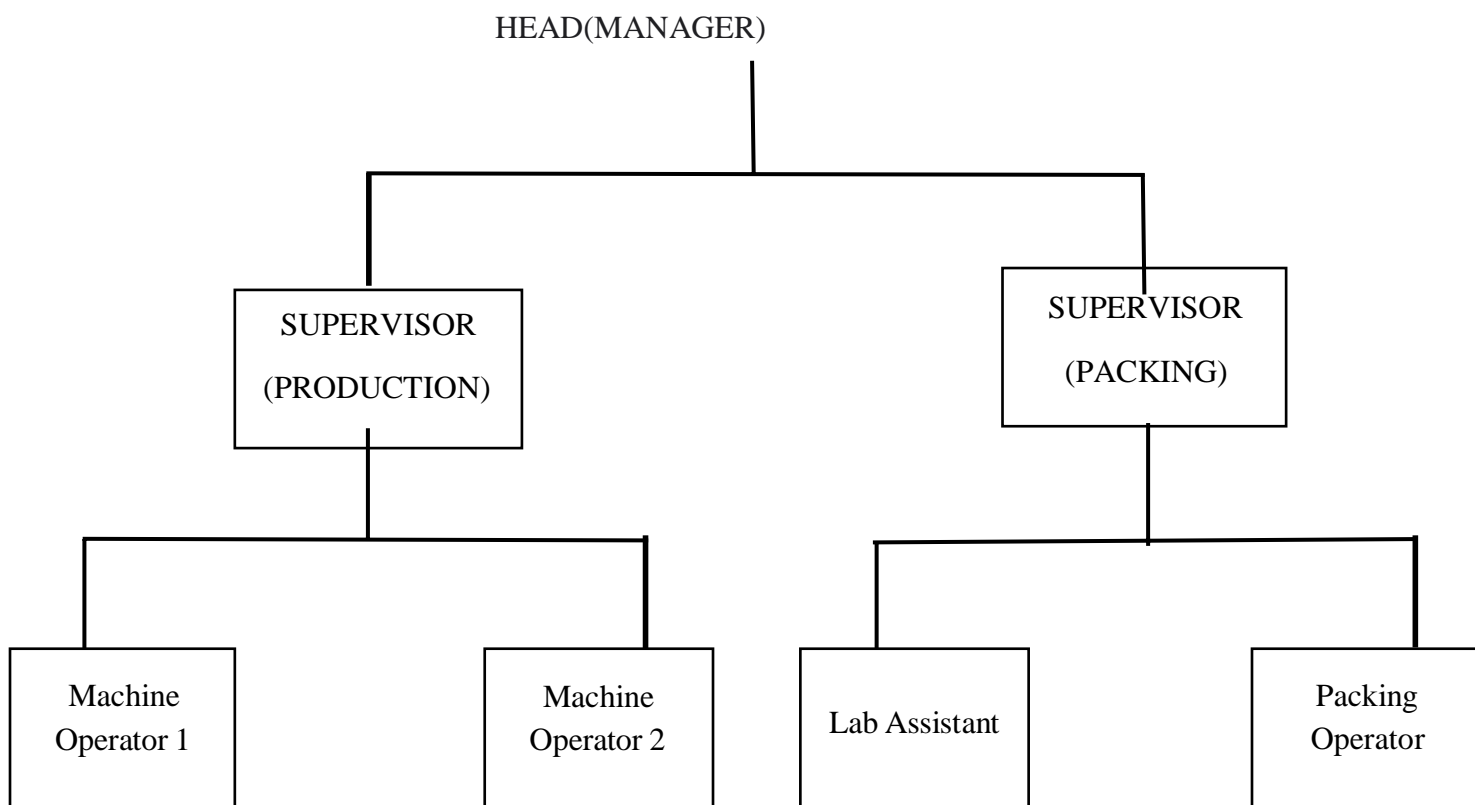
### **LIQUIDATOR:**

The Liquidator mosquito repellent has a graphite rod in the middle and the bottle is filled with the repellent. There is a heater coil in the liquidator. The repellent chemical when comes in to contact with the heated rod turns into fume which disables the sensors of the mosquitoes.



The liquidator consists of three things. They are the liquid, which is the main force to drive away the mosquitoes, second one is the graphite rod which is held in the middle of the bottle and the cap, the third is the bottle and the cap in which the liquid is filled and utilized.

### **ORGANISATION STRUCTURE:**



## **RAW MATERIALS MIXTURE:**

The Raw Materials used are

- i) Saw Dust
- ii) Coconut Shell Powder
- iii) Tamarind Seed Powder
- iv) Guar gum
- v) Color Dye
- vi) Emulsifier
- vii) Active Chemical

### **1. SAW DUST:**

**Sawdust** (or **wood dust**) is a by-product or waste product of woodworking operations such as sawing, sanding, milling, planing, and routing. It is composed of small chippings of wood. These operations can be performed by woodworking machinery, portable power tools or by use of hand tools.



### **2. COCONUT SHELL POWDER:**

Solid waste like coconut shell is one of the potential material to be used as filler in this composites. Coconut shell in powder form is usually used together with cement **to produce high strength, more durability and lightweight concrete for structural component in coil.**



Coconut husk, because it is extremely environmental friendly, is a natural mosquito repellent. In villages and several rural areas, coconut husks are burnt at homes just before bed time to shoo mosquitoes and other insects away.

### 3. TAMARIND SEED POWDER:

Tamarind seed powder is used as a core binder in foundries & mosquito coils industries.



### 4. GUARGUM:

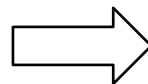
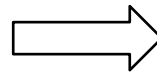
Guar Gum Powder is obtained from guar seed it is widely used in different industries and is also used in the manufacturing of mosquito coils as well as incense sticks or agarbatti. It has more viscosity, more strength & binding power that gives a smooth finishing to the coils.



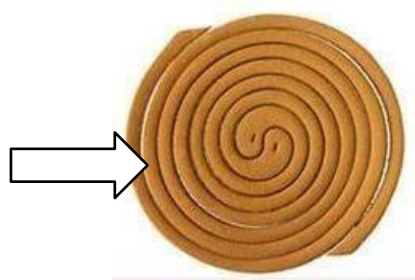
Guar Gum powder acts as a binding agent in the manufacturing of mosquito coils. It is a polysaccharide made up of sugar galactose and mannose that comes from the endosperm of the seed of legume plant *Cyamopsis tetragonolobus*.

#### 5. COLOR DYE:

If a product needs to be colored in a particular way, the **dyes for mosquito coil** should offer a solution.







## 6. EMULSIFIER:

The invention relates to storage stable insect repellent emulsion formulations containing N,N-Diethyl-m-toluamide, together with water, a film-forming polymer and an emulsifier-emulsion stabilizer. Emulsions based on garlic and asafoetida essential oils are highly toxic to mosquito larvae and could be an effective and ecofriendly strategy for controlling vector mosquitoes.



## 7. ACTIVE CHEMICAL:

Mosquito control professionals use **natural pyrethrins**, often referred to as **pyrethrum**, to kill adult mosquitoes using ULV spraying. Synthetic pyrethroids are similar to natural pyrethrins.



## **HEAD (MANAGER):**

Manufacturing managers **oversee the daily operations of a manufacturing facility**. They coordinate, plan, and direct all the activities that go into the production process. Manufacturing managers can run an entire plant or oversee a specific area of the manufacturing process.

Thus, their job description may vary based on the title and scope of work. However, most manufacturing managers will help to:

- Set up the machines and a safe environment for production
- Manage the workflow for a production project
- Ensure efficiency during the process
- Oversee the quality assurance of produced materials or goods.

## ➤ **SUPERVISOR (PRODUCTION DEPARTMENT):**

Some of the **roles** of the supervisor to be performed in the production department are:

Guide and coach employees, monitoring their productivity. Oversee safe use of equipment and schedule regular maintenance. Perform verification of production output according to specifications. Prepare reports on performance and progress and present them to senior managers.

## ➤ **SUPERVISOR (PACKING DEPARTMENT):**

A packaging supervisor typically has a wide range of **responsibilities**, which can include:

- Maintaining inventory of supplies such as tape, labels, boxes, and other packaging materials
- Supervising a team of packers to ensure that products are packaged correctly and efficiently
- Ensuring that all packaging is done in accordance with federal, state, and local laws regarding materials.
- Ensuring that all packaging is done in accordance with brand standards and requirements set by customers
- Developing standard operating procedures for the packaging department to ensure efficient operations
- Coordinating with shipping and receiving staff to ensure that orders are received on time and that items are shipped out accurately.
- Ensuring that all packaging materials are stored properly and safely to prevent damage or spoilage.

## **MACHINE OPERATORS:**

Machine operators take care of all machine-specific functions such as configuring the equipment, loading and operating the machines, and optimizing the machine capability. They need to ensure that the machine works at its **full capacity**, **oversee its maintenance**, and **perform timely quality checks**. They should be a self - starter and should be willing to undergo training if need be, to understand the operations of new equipment.



## **RESPONSIBILITIES:**

- Calibrate the machine before the production begins.
- Ensure the machines are regularly checked and cleaned.
- Monitor and control the machine performance and settings.
- Regularly conduct tests of the machines performance and operating capacity.
- Inspect machinery with appropriate tools.
- Feed raw materials into semi-automated machines and help the assembly line.
- Fix any issues or malfunctions that may occur.
- Check the output of the machines and identify any issues.

- Keep an updated database on all of the machines information, defective units and final products.

### **LAB ASSISTANTS:**

A packaging technician is responsible for planning the packaging design of various products, creating attractive outputs by utilizing software tools and applications, and ensuring that the deliverables adhere to the product's features.



They discuss their product samples to the management team and adjust plans based on the requirements and suggestions. A packaging technician also considers the sales performance of the products to develop outputs that show high innovations, attracting customers to purchase the items, and generating more resources for revenues.

### **PACKING OPERATORS:**

A Packaging Operator is responsible for taking the finished product of a manufacturing process and ensuring that it is packaged in line with company and industry standards, making it ready for sale or distribution.



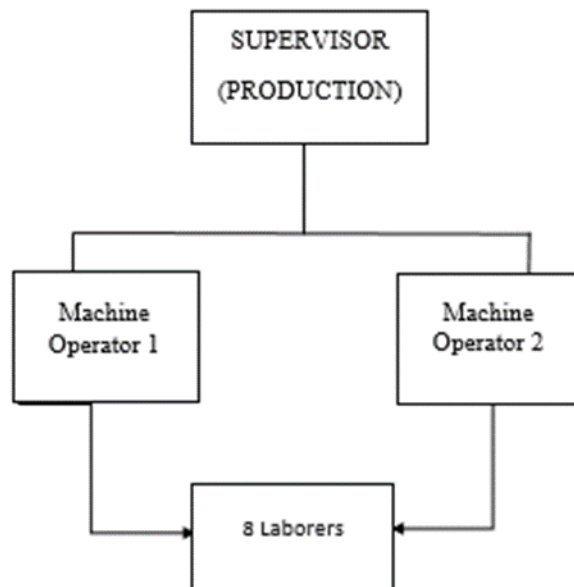
A Packaging Operator may work in a warehouse, or any business that sends packages to customers or clients. Packaging Operator **responsibilities** include checking product quality,

packing items into containers, running packaging machines, and reporting faults. Packaging Operators usually report to a Supervisor, Warehouse Manager, or Logistics Manager.

## **VARIOUS DEPARTMENTS:**

### **PRODUCTION DEPARTMENT:**

As we already saw that the Production Department has 1 Supervisor, Machine Operator 1, Machine Operator 2. Other than these employees of Production Department There exists some more employees/ laborer who work for in the Production Department. Let us Discuss the Production Department:



The **Production Department** therefore has total number of **11 employees**.

The Production department has a head known as the supervisor in production who has to guide the 2 machine operators under him, and the supervisor is responsible to report the information and updates to the manager or the head.



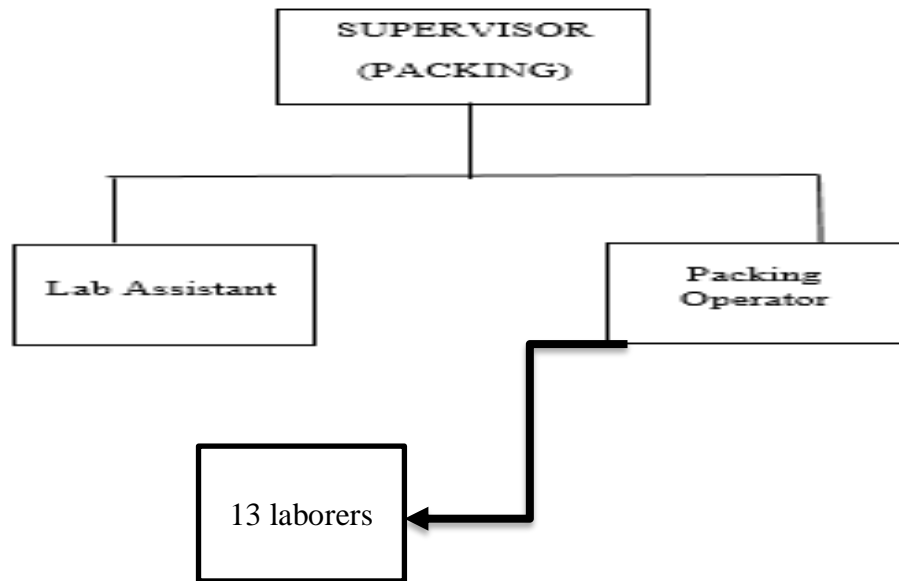
A production Department is a group of functions within a business that is responsible for the manufacture of goods. It is a process or technique that is used to convert the raw materials or semi-finished goods into finished products.

Each detailed project reports cover all the aspects of business, from analysing the market, confirming availability of various necessities such as plant & machinery, raw materials to forecasting the financial requirements. The scope of the report includes assessing market potential, negotiating with collaborators, investment decision making, corporate diversification planning etc. in a very planned manner by formulating detailed manufacturing techniques and forecasting financial aspects by estimating the cost of raw material, formulating the cash flow statement, projecting the balance sheet etc.

#### **PACKING DEPARTMENT:**

The Packing department as seen earlier has 1 supervisor in Packing Department, 1 Lab Assistant, 1 Packing Operator. It also has other 13 laborers who work under the operator person.









Packing Supervisor supervises a team of operators responsible for the setup and operation of packaging machines that fill, secure, and label containers according to SOP and Customer specifications. Being a packaging supervisor inspects and verifies finished packaged goods.

#### **ROLES AND RESPONSIBILITIES OF THE PRODUCTION TEAM:**

The production Department monitors daily productions and quality control performance records, identifying inefficiencies and taking responsive and corrective actions where necessary assisting in all aspects of the production floor.

Coordinates and monitors flow of production orders for the floor; able to forecast work and notice potential problems in workflow.

Production Supervisors keep their knowledge up to date in the areas of current standards, good manufacturing practices, and industry trends, through: - monitoring of technological developments and trends; - attending external training programs; - taking part in in-house training sessions and meetings.

#### **ROLES AND RESPONSIBILITIES OF THE PACKING DEPARTMENT:**

The packing supervisor ensures the team meets all production targets and quality standards. It has the responsibility to report to a manager or head of a unit/department. The packing supervisor assigns works to the Lab assistant, and the packing operator. The Lab Assistant ensures that the cardboards or the cartons, both the inner carton and the outer carton are non-defective. He tests

the samples and ensures if it is suitable for further movement of packing process thus approved by the Packing Operator. They assign the packing process to the 13 laborers under them who put each coil in the transparent cover, followed by the inner carton which has a label MAX PRO written on it, and finally the multiple boxes of Coils are arranged in the Outer Carton and are sealed.

## **OUTPUT AND COMPANY FACILITIES:**

Let's first discuss about the Output. Every company has its own range or count of Output to be achieved in duration of time say, Output in a day, weekly output, monthly output etc.

### **OUTPUT:**

The amount of something produced by a person, machine, or industry.

The details of the daily output of the company is discussed below:

- Per tray when sent to heating consists of 32 coils.
- And per tray which consists of 32 coils in each say 1 tray, likewise 42 trays are arranged one above the other.
- The same way is done for another 42 trays and repeated again.
- They are sent in 1 trolley to the heating chamber.
- Per trolley has 3 columns, each column containing 42 trays.
- No. of trays in one column= 42
- No. of columns= 3
- So, the total number of trays in 1 trolley –  $42 \times 3 = 126$ .
- Hence the total number of coils in trolley is calculated as  $-126(\text{trays}) \times 32(\text{coils}) = 4032$ .

## **CHAPTER 11**

### **OBJECTIVES OF THE STUDY**

#### **PRIMARY OBJECTIVE:**

- To study the Managing of Inventory at SURYA HOME CARE PRODUCTS PrivateLtd.

#### **SECONDARY OBJECTIVE:**

- To study the inventory levels and find a way to reduce carrying cost.
- To analyze the various demand forecasting techniques adopted by “SURYA HOMECARE PRODUCTS”.
- To Ensure product availability to meet customer demand and enhance satisfaction.
- To analyze the use of resources like warehouse space and working capital.
- To provide valuable suggestions and recommendations to enhance the effectiveness of inventory at M/S “SURYA HOMECARE PRODUCTS”.

## **NEED OF THE STUDY**

- Every organization needs to manage their inventory for smooth running of its activities.
- The study has been conducted for gaining practical knowledge about inventory management & activities of “SURYA HOME CARE PRODUCTS” Private Ltd.
- Inventory management enhances cash flow by minimizing tied-up capital in excess inventory.
- Effective inventory management supports accurate financial reporting and compliance with accounting standards.
- In order to understand the nature of inventory management of the organization, I took this inventory management as a topic for my project, to give findings and suggestions by adopting and analyzing different inventory management techniques.

## **SCOPE OF THE STUDY**

- Inventory management is necessary for optimizing stock levels, reducing costs, and ensuring efficient supply chains in various industries, from retail to manufacturing
- This study also helps the researcher to know the deep meaning on” A Study on inventory management in “SURYA HOME CARE PRODUCTS” Private Ltd.
- Its scope includes demand forecasting, procurement, storage, and distribution to meet customer demands while minimizing excess inventory.
- The scope of the study is identified after and during the study is conducted.
- The study of inventory management is based on tools like EOQ(Economic Order Quantity),ABC Analysis,Inventory Turnover Ratio,etc.

## **LIMITATIONS OF THE STUDY**

- The entire analysis applies only to “SURYA HOME CARE PRODUCTS”Private ltd
- The project study is mainly based on the secondary data.
- The study is limited for a period of 5year only.
- The company executives were able to give valuable time only for a few days a week,hence the required information could not be obtai

## **CHAPTER III**

### **REVIEW OF LITERATURE**

#### **Edward A Silver**

The objectives of inventory management, including the relevant related costs, are examined in this paper. A brief review of standard problems, that have been effectively solved, is presented. However, we point out that a serious gap exists between theory and practice in many organizations. Suggestions are made for bridging this gap. Finally, a list is provided of a number of research problems whose implementable solution would have a major beneficial impact on the practice of inventory management.

#### **Henrik Andersson a, Arild Hoff b, Marielle Christiansen (2010)**

This paper describes industrial aspects of combined inventory management and routing in maritime and road-based transportation, and gives a classification and comprehensive literature review of the current state of the research. The literature is contrasted with aspects of industrial applications from a constructive, but critical, viewpoint. Based on the status and trends within the field, future research is suggested with regard to both further development of the research area and industrial needs. By highlighting the industrial aspects, practitioners will hopefully see the benefit of using advanced decision support systems in complex situations related to combined inventory management and routing in their business. In addition, a classification and presentation of the research should help and motivate researchers to further focus on inventory management and routing challenges.

#### **Esha Saha, Pradip Kumar Ray(2019)**

Inventory management in a healthcare system needs to be compatible with its operations and critical characteristics ensuring minimization of inventory-related cost as well as maximization of service level with a significant reduction in the price of treatment and wastage of resources. Over the years, numerous approaches and methodologies have been developed by the researchers and practitioners for modelling and analysis of varieties of inventory management systems in the healthcare sector considering these aspects. In this paper, the existing modelling approaches and solution methods concerning inventory systems in healthcare are classified and



**Serhii Ziukov(2015)**

Inventories are raw materials, work-in-process goods and completely finished goods that are considered to be the portion of business's assets that are ready or will be ready for sale. Formulating a suitable inventory model is one of the major concerns for an industry. The earliest scientific inventory management researches date back to the second decade of the past century, but the interest in this scientific area is still great. Again considering the reliability of any process is an important feature in the research activities. Values of some factors are very hard to define or almost unreal. In such cases, fuzzy models of inventory management take an important place. This paper analyzes possible parameters of existing models of inventory control. An attempt is made to provide an up-to-date review of existing literature, concentrating on descriptions of the characteristics and types of inventory control models that have been developed.

**Deepesh Singh, Ajay Verma(2018)**

The Purpose of this paper is to overview the Inventory management in supply chain and their current Inventory related issue in a present day business and present a conceptual methodology for related issue. The methodology based on the inventory, which are inputs for the methodology and benefits which are output of methodology.

A literature review is conducted on management or control of inventory and also issues related to inventory in industry, and its various parameters. A conceptual methodology for inventory issues in present business.

**Ozgun Caliskan Demirag, et al., (2017)** analysed inventory ordering policies for products that attract demand at a decreasing rate as they approach the end of their usable lifetime, for example, perishable items nearing expiration. It consider the product freshness, or equivalently, the time until expiration as a factor influencing the customer demand. In a profit-maximizing framework, it build on the Economic Order Quantity (EOQ) replenishment model and formulate the inventory ordering problem using adeterministic demand function that is concave decreasing in the age of the product. It provide analytical results on the optimal ordering policy, including an explicit characterization of the decisions in the linear-demand case, and it develop and easy-to- implement adaptive heuristic policy for the general case. Numerical examples show that the optimal policy generates significant profit gains compared to the traditional cost- based policies and the adaptive heuristic policy performs highly satisfactory in the testedinstances.

Ozgun Caliskan Demirag, Sanjay Kumar, K.S. Mallikarjuna Rao (2017) “A note on inventory policies for products with residual-life-dependent demand” *Applied Mathematical Modelling*, Volume 43, Pages 647-658

**M. G. Matsebatlela & K. Mpofu (2015)** explored on there is a problem of excessive inventory in a Manufacturing company, situated in South Africa. In this study an Inventory Management Framework(IMF) was developed. Quantiative content analysis was used to collect data. Statistical tools were used to select the fiscal year with the vast data variation for data analysis for this study. The results reeal that uncertainties and lot sizing inventory results in excessive inventory and not having a collaborated and integrated Supply chain Management also results in mismatch of supply and Demand. IMF is proposeed in this paper to minimize the impact of the mismatch.

M.G. Matsebatlela, K. Mpofu (2015) “Inventory management framework to minimize supply and demand mismatch on a manufacturing organization” *IFAC PapersOnline*, Volume 48, Issue 3, Pages260-265

**Taofeng Ye (2014)** studied it focus on inventory management issues under simultaneously horizontal and vertical substitution. The analysis is divided into two distinct scenarios: centralized inventory management, where all brands are managed by a central decision maker; and decentralized inventory management, where each brand is managed by an independent decision maker. For the two situations, the optimal and the equilibrium order quantities are developed. Moreover, it find that there exist situations when the order quantities are greater in the centralized setting than in the competitive setting for some products.

Taofeng Ye (2014) "Inventory management with simultaneously horizontal and vertical substitution" International Journal of production economics.

**Canan Uckun, et al., (2008)** studied it is known that inaccurate inventory records can lead to profit losses in a supply chain. Inventory records may not be correct due to various reasons such as transaction errors, misplacement, shrinkage, etc. In order to eliminate inventory inaccuracy, companies may invest in new information technologies such as radio frequency identification(RFID). In this paper, it consider a supply chain consisting of a retailer and a supplier. It assume a single-period newsvendor-type setting where the retailer purchases the items from the supplier and distributes them to the regional warehouses. The paper focuses on the problem of finding the optimal investment levels that maximize profit by decreasing inventory inaccuracy.

Canan Uckun, Fikri Karaesmen, Selcuk Savas (2008) "Investment in improved inventory accuracy in a decentralized supply chain" International Journal of Production Economics, Volume 113, Issue2, Pag

**Denise Emerson, et al., (2009)** investigated information visibility is generally useful for decesion makers distributed across supply chains. Availability of information on inventory levels, price, lead times, demand, etc. Can help reduce uncertainties as well as alleviate problems associated with bullwhip effect. A majority of extant literature in this area assume a static suppl chain network configuration. While this was sufficient a few decades ago, advances in e-commerce and the case withwhich order processing ccan be performed over the Internet neccessities appropriate dynamic reconfiguration of supplychains over time. Each node in the supply chain is modeled as an actor who makes independent decisions based on information gathered from the next level upstream.

supply chain management" European Journal of Operational Research.

**Qiu hong Zhao, et al.,(2010)** studied of this paper addresses some of the challenges faced by a company which is responsible for delivering coal to its four subsidiaries situated along a river, through river hired or self-owned vessels. It propose to adopt a vendor managed inventory concept that involves establishment of a central warehouse at the port, and apply the Markov Decision Progress(MDP) to formulate both ordering and delivery problems, considering different transportation modes, costs, and inventory issues. An efficient algorithm is developed for solving the MDP models. Their computationaltestsshow that the proposed strategy can significantly reduce the overall system costs while maintaining smooth Just-in-Time supplies jof coal to the subsidiaries.

Qiu hong Zhao, Shuang Chen, Stephen C.H. Leung, K.K. Lai (2010) "Integration of inventory and transportation decision in logistics system" Transportation Research Part E: Logistics and Transportation Review.

**N. Mahdi Tajbakhsh, et al.,(2011)** analyzed consider an inventory model in which a supplier makes deal offers with random discount prices at random points in time. Assuming that discount offerings follow a Poisson progressand discount price is a discrete random variable with a known distribution, it propose a continuous-review control policy for the model and derive optimality conditions for the policy parameters. The model is then extended to the case of multiple suppliers that offer discount deals with supplier-specific Poisson processes and discount prices. Numerical examples are presented to demonstrategcost savings due to discount offers.

**Barry R. Cobb, et al., (2013)** explored is on paper examines optimal policies in a continuous review inventory management system when demand in each time period follows a log-normal distribution. In this scenario, the distribution for demand during the entire lead time period has no known form. The proposed procedure uses the Fenton- Wilkinson method to estimate the parameters for a single log-normal distribution that approximates the probability density function(PDF) for leaad time demand, conditional on a specific lead time. Once these parameters are determined, a mixture of truncated exponentials(MTE) function that approximates the lead time demand distribution is constructed. The objective is to include is to include the log-normal distribution in a robust decision support system where the PDF that best fits the historical period

demand data is used to construct the lead time demand distribution.

Barry R. Cobb, Rafael Rumi, Antonio Salmeron (2013) , "Inventory management with log-normal demand per unit time" *Computers & Operations Research*, Volume 40, Issue 7, pages 1842-1851.

**Euthemia Stavroulaki (2011)** examined a retailer's inventory policy for two products. The products are substitutable and have inventory dependent demand, so a higher inventory level of a product increases its sales. It models the joint effect of demand stimulation and product substitution on inventory decision by considering a single-period. Stock demand setting, it provides the first order optimality conditions for the profit maximizing order quantities and interprets them using marginal analysis. It also considers two heuristic solutions that separately account for either demand stimulation or product substitution. Their numerical analysis reveals that the optimal policy by appropriately using sales information that quantifies substitution and demand stimulation can produce significantly higher profits.

**Choong Heon Yang, et al., (2014)** This paper presents a method for estimating road management equipment inventory needs and associated purchase costs. The primary feature of this method is to consider historical operations records by road management equipment type and weights by work type based on subjective preferences of the public agencies. The Analytical Hierarchy Process (AHP) is employed as the main tool to reflect the relative importance of a day-to-day road management activity. In order to examine the appropriateness of our method, we performed a case study with 18 regional transportation offices in South Korea. The estimated cost of equipment purchases across these offices was approximately 41 million US dollars based on the 2011 year (when applying average unit cost by equipment), while the actual equipment purchase costs during the same one-year period were about 44 million US dollars. The main reason for the differences of estimates across offices is due to unit cost by equipment, road conditions.

**Christopher S. Jones & Selale Tuzel (2013)** We examine the relation between inventory investment and the cost of capital in the time series and the cross section. We find consistent evidence that risk premiums, rather than real interest rates, are strongly negatively related to future inventory growth at the aggregate, industry, and firm levels. The effect is stronger for firms in industries that produce durables rather than nondurables, exhibit greater cyclicalities in sales, require longer lead times.

**David J. Robb, et al., (2012)** We review inventories in mainland China by evaluating the trajectory of aggregate inventories in recent decades, and then modelling the relationship of inventories in some 300,000 manufacturers with respect to volume (using cost of goods sold), industry (using SIC codes), and geographical location (using the 31 regions of China). We find that inventories generally exhibit economies of scale (in terms of cost of goods sold) in all but one industry (tobacco), and differ widely by province, with relatively high inventories in remote regions.

## **INVENTORY MANAGEMENT**

Management of inventory assumes importance due to the fact that investment in inventory constitutes one of the major investments in current assets.

The term inventory refers to the stockpile of the products a firm is offering for sale and the components that make up the product. The assets which firms store as inventory in anticipation of need are:

### **(i) Raw Materials:**

These represent inputs purchased and store to be converted into finished products in future by making certain manufacturing process on the same.

### **(ii) Work in Process:**

These represent semi-manufactured products which need further processing before they can be treated as finished products.

### **(iii) Finished Goods:**

These represent the finished products ready for sale in the market.

### **(iv) Stores and Supplies:**

These represent that part of the inventory, which does not become a part of final product but are required for production process. They may be in the form of cotton waste, oil and lubricants.

## **MEANING OF INVENTORY**

Inventory generally refers to the materials in stock. It is also called the idle resource of a company. Inventories represent those items which are either stocked for sale or they are in the process of manufacturing or they are in the form of materials which are yet to be utilized.

It also refers to the stockpile of the products a firm would sell in future in the normal course of business operations and the components that make up the product. Inventory is a detailed list of those movable items which are necessary to manufacture a product and to maintain the equipment and machinery in good working order.

## **TYPES OF INVENTORIES**

A manufacturing firm generally carries the following types of inventories:

- Raw Materials.
- Bought out parts.
- Work-in-process inventory (WIP).
- Finished goods inventories.
- Tools inventory.
- Miscellaneous inventory.
- Goods in transit.
- Goods for resale.
- Maintenance, repair and operating stores.
- Scrap Material.

## **REASONS FOR HOLDING INVENTORY**

- To stabilize production.
- To prevent loss of orders.
- To keep pace with changing market conditions.
- To take advantage of price discounts.
- To meet the demand during the replenishment period.

## **MOTIVES OF HOLDING INVENTORIES**

- The Transaction Motive which facilitates continuous production and timely execution of sales orders.
- The Precautionary Motive which necessitates the holding of inventories for meeting the unpredictable changes in demand and supplies of materials.
- The Speculative Motive which induces to keep inventories for taking advantage of price fluctuations, saving in re-ordering costs and quantity discounts etc...

## **COSTS ASSOCIATED WITH INVENTORY**

- Production cost.
- Capital cost.
- Ordering cost.
- Carrying cost.
- Shortage cost.

## **INVENTORY CONTROL**

The main objective of inventory control is to achieve maximum efficiency in production & sales with minimum investment in inventory.

Inventory control is a planned approach of determining what to order, when to order and how much to order and how much to stock, so that costs associated with buying and storing are optimal without interrupting production and sales.

## **BENEFITS OF INVENTORY CONTROL**

The benefits of inventory control are:

- Improvement in customers' relationship because of the timely delivery of goods and services.
- Smooth and uninterrupted production and hence, no stock out.
- Efficient utilization of working capital.
- Economy in purchasing.
- Eliminating the possibility of duplicate ordering.



## **PRINCIPLES OF INVENTORY CONTROL**

- Inventory is only created by spending money for materials and the labor and overhead to process the materials.
- Inventory is reduced through sales and scrapping.
- Accurate sales & production schedule forecasts are essential for efficient purchasing.
- handling & investment in inventory.
- Management policies which are designed to effectively balance size and variety of inventory with cost of carrying that inventory are the greatest factor in determining inventory investment.
- Forecasts help determine when to order materials, Controlling inventory is accomplished through scheduling production.
- Records do not produce control.
- Control is comparative & relative, not absolute. It is exercised through people with varying experiences and judgment rules & procedures establish a base from which the individuals can make evaluation and decision.

With the consistent practices being followed, inventory control can become predictable and properly related to production and sales activity.

Inventory control is vitally important to almost every type of business, whether product or service oriented. Inventory control touches almost every facet of operations. A proper balance must be struck to maintain proper inventory with the minimum financial impact on the customer. Inventory control is the activities that maintain stock keeping items at desired levels. In manufacturing since the focus is on physical product, inventory control focus on material control.

"Inventory" means physical stock of goods, which is kept in hands for smooth and efficient running of future affairs of an organization at the minimum cost of funds blocked in inventories. The fundamental reason for carrying inventory is that it is physically impossible and economically impractical for each stock item to arrive exactly where it is needed, exactly when it is needed.

Inventory control is the most important function of inventory management and it forms the nerve center in any inventory management organization. An Inventory Management System is an essential element in an organization. It is comprised of a series of processes, which provide an assessment of the organization's inventory.

### **INVENTORY CONTROL - TERMINOLOGY**

- Demand: It is the number of items required per unit of time. The demand may be either deterministic or probabilistic in nature.
- Order cycle: The time period between two successive orders is called order cycle.
- Lead time: The length of time between placing an order and receipts of items is called lead time.
- Safety stock: It is also called buffer stock or minimum stock. It is the stock or inventory needed to account for delays in materials supply and to account for sudden increase in demand due to rush orders.
- Inventory turnover: If the company maintains inventories equal to 3 months consumption. It means that inventory turnover is 4 times a year i.e., the entire inventory is used up and replaced 4 times a year.

### **INVENTORY COST RELATIONSHIPS**

There are two major cost associated with inventory. Procurement cost and carrying cost. Annual procurement cost varies with the numbers of orders. This implies that the procurement cost will be high, if the item is procured frequently in small lots. The annual procurement cost is directly proportional to the quantity in stock. The inventory carrying cost decreases, if the quantity ordered per order is small. The two costs are diametrically opposite to each other. The right quantity to be ordered is one that strikes a balance between the two opposition costs. This quantity is referred to as "Economic Order Quantity".

## **OPERATING CYCLE OF INVENTORY MANAGEMENT**

Operating Cycle is the time duration to convert sales after the conversion of resources into invention, into sales there is difference between current assets and fixed assets. A firm required many years to recover initial invests in fixed assets such plant and machinery or land buildings or furniture and fixtures etc. On the contrary, investment in current assets such as inventory and books debts are realized during the firms operating cycle, which in usually less than a year.

The operation cycle can be said to be the heart of the working capital. The need for working capital or current assets cannot be over emphasized as already observed. The main motive of many business firms is to achieve maximum profits, which can be earned depending upon the magnitude of the sales among other things. However, sales do not convert in to cash instantly. There is invariable time lag between sale of goods and receipts of cash. Therefore the need of working capital in the form of current assets to deal with the problem arising good sold.

Therefore, sufficient working capital requires sustaining sales activity. Technically this is refer to as the operating the cash cycle. The continuous flow form cash to supplies to inventory to accounts receivable and back into cash what is called operating cycle.

1. Cash
2. Debtor's Raw material
3. Sales Work in Progress
4. Finished Goods

## **THE OPERATING CYCLE OF MANUFACTURING COMPANY HAS THREE PHASES NAMELY**

1. Acquisition of resources
2. Manufacturing products
3. Sale of product

In the phase first operating cycle, include phases of raw materials, fuel & power etc., which are totally required for manufacturing product.

### **MANUFACTURING PRODUCTS:-**

In the phase 2 of the operating cycle includes conversion of raw material into work-in-progress and the work in progress is converted into finished goods.

### **SALE OF PRODUCT:-**

In the phase 3 of the operating cycle may sell the product either for credit or made to customers.

### **ESSENTIALS OF INVENTORY CONTROL**

The important requirements of inventory control are:

- A firm needs inventory control system to effectively manage its inventory.
- Proper classification of materials with codes, material standardization and simplification.
- The operation of a system of internal check to ensure that all transactions involving material and equipment are checked by properly authorized and independent persons. The operation of a system of perpetual inventory so that it is possible to determine at any time, the amount and value of each kind of material in stock.
- A suitable method of valuation of materials is essential because it affects the cost of jobs and the value of closing stock of materials.

### **OBJECTIVES OF INVENTORY CONTROL**

The main objectives of inventory control are:

- To study the level of inventory management
- To maintain sufficient finished goods inventory for smooth sales operation and efficient customer services.
- Minimize the carrying cost and time.
- Control investment in inventories and keep it at an optimum.

## **ADVANTAGES OF INVENTORY CONTROL**

1. Eliminates wastages in use of material.
2. It reduces the risk of loss from fraud and theft.
3. It helps in keeping perpetual inventory and other records to facilitate the preparation of accurate material reports management.
4. To reduce the capital tied up in inventories.
5. It reduces cost of storage.

## **DISADVANTAGES OF INVENTORY CONTROL**

Every firm has to maintain optimal level of inventories. It not the following will be the result in form of losses.

1. Opportunity cost: Every firm has to maintain inventory for that some investment is needed it is known as opportunity cost and the investment in inventory where the funds are blocked up with inventory.
2. Excessive inventories: It will lead to firm losses due to excessive carrying costs the risk of liquidity. It is also referred as danger level.
3. Inadequate Inventory: It is another danger which results in production hold-up and failure to meet delivery commitments. Inadequate raw materials and work-in-process inventories will result in frequent production interruptions. If finished goods are not sufficient customers may shift to competitors.
4. Danger due to physical deterioration: It is one of the reasons with the inventories. Due to maintaining stocks at high levels they will be deteriorated due to passage of time, sometimes due to mishandling or improper storage facilities.

## **COSTS INVOLVED IN INVENTORY**

Every firm maintains inventory depending upon requirement and other features of firm for holding such inventory some cost will be incurred there are as follows.

### **Carrying Cost**

This is the lesser-known aspect of inventory cost.

Inventory carrying costs refers to the amount of interest a business loses out on the unsold stock value lying in the warehouses.

### **Ordering cost**

Ordering costs include payroll taxes, benefits and the wages of the procurement department, labor costs etc. These costs are typically included in an overhead cost pool and allocated to the number of units produced in each period.

- ☐ Transportation costs
- ☐ Cost of finding suppliers and expediting orders
- ☐ Receiving costs
- ☐ Clerical costs of preparing purchase orders
- ☐ Cost of electronic data interchange

### **Holding cost**

This is simply the amount of rent a business pays for the storage area where they hold the inventory. This can be either the direct rent the company pays for all the warehouses put together or a percentage of the total rent of the office area utilized for storing inventory.

- ☐ Inventory services costs
- ☐ Inventory risk costs
- ☐ Opportunity cost - money invested in inventory
- ☐ Storage space costs
- ☐ Inventory financing costs

- Ordering costs
- Shortage costs
- A classification system

### **Inventory Counting Systems**

Physical count of items made at periodic interval

- Perpetual Inventory System  
System that keeps track of removals from inventory continuously, thus monitoring current levels of each item
- Two-Bin System –  
Two containers of inventory; reorder when the first is empty.
- Universal Bar Code –  
Bar code printed on a label that has information about the item to which it is attached
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## **Key Inventory Terms**

- Lead time: time interval between ordering and receiving the order
- Holding (carrying) costs: cost to carry an item in inventory for a length of time.  
usually a year
- Ordering costs: costs of ordering and receiving inventory
- Shortage costs: costs when demand exceeds supply

## **ABC Classification System**

Classifying inventory according to some measure of importance and allocating control efforts accordingly.

A-very important

B-mod. important

C-least important

## **Cycle Counting**

- A physical count of items in inventory
- Cycle counting management
- How much accuracy is needed?
- When should cycle counting be performed?
- Who should do it?

## **Economic Order Quantity Models**

- Economic order quantity (EOQ) model
- The order size that minimizes total annual cost



- Economic production model
- Quantity discount model

### **Assumptions of EOQ Model**

- ☐ Only one product is involved
- ☐ Annual demand requirements known
- ☐ Demand is even throughout the year
- ☐ Lead time does not vary
- ☐ Each order is received in a single delivery
- ☐ There are no quantity discounts

### **Total Cost**

### **Economic Production Quantity (EPQ)**

- Production done in batches or lots
- Capacity to produce a part exceeds the part's usage or demand rate
- Assumptions of EPQ are similar to EOQ except orders are received incrementally during production

### **Economic Production Quantity Assumptions**

- ☐ Only one item is involved
- ☐ Annual demand is known
- ☐ Usage rate is constant

- ☐ Usage occurs continually
- ☐ Production rate is constant
- ☐ Lead time does not vary
- ☐ No quantity discounts

### **Reorder with EOQ Ordering**

**Reorder Point** - When the quantity on hand of an item drops to this amount, the item is reordered

**Safety Stock** - Stock that is held in excess of expected demand due to variable demand rate and/or lead time.

**Service Level** - Probability that demand will not exceed supply during lead time

### **Determinants of the Reorder Point**

The rate of

demand The

lead time

Demand and/or lead time

variability Stockout risk

(safety stock)

### **Fixed-Order-Interval Model**

- ☐ Orders are placed at fixed time intervals
- ☐ Order quantity for next interval?
- ☐ Suppliers might encourage fixed intervals
- ☐ May require only periodic checks of inventory levels

- Risk of stockout
- Fill rate- the percentage of demand filled by the stock on hand

### **Fixed-Interval Benefits**

- ☐ Tight control of inventory items
- ☐ Items from same supplier may yield savings in:
  - Ordering
  - Packing
  - Shipping costs
- ☐ May be practical when inventories cannot be closely monitored

### **Fixed-Interval Disadvantages**

- ☐ Requires a larger safety stock
- ☐ Increases carrying cost
- ☐ Costs of periodic reviews

### **Single Period Model**

- ☐ **Single period model:** model for ordering of perishables and other items with limited useful lives
- ☐ **Shortage cost:** generally the unrealized profits per unit

**Excess cost:** difference between purchase cost and salvage value of items left over at the end.

## **CHAPTER IV**

### **RESEARCH METHODOLOGY**

#### **RESEARCH:**

Research refers to the systematic process of investigating, studying, and analyzing a specific topic, problem, or question in order to generate new knowledge, gain deeper insights, or solve existing problems. It is a structured and methodical inquiry that involves the collection and analysis of data, the formulation and testing of hypotheses, and the evaluation of results.

#### **RESEARCH METHODOLOGY:**

Research methodology refers to the systematic and organized approach or framework used by researchers to conduct a research study. It encompasses the set of principles, processes, techniques, and procedures that guide the entire research process, from the formulation of research questions or hypotheses to the collection and analysis of data and the interpretation of results.

#### **RESEARCH DESIGN:**

Research design refers to the overall plan or structure that guides the entire research process. It is a critical component of research methodology and serves as a blueprint for how a research study will be conducted. The research design outlines the strategies, procedures, and methods that researchers will use to collect and analyze data in order to address their research questions or hypotheses.

#### **Financial Inventory Management Meaning:**

"Recording, maintaining and evaluating of stocks in a value terms is known as Financial Inventory Management." In other words valuation of stocks, and controlling of ordering and holding costs and also maintaining of sufficient valued stocks in Inventory is known as Financial Inventory Management."

Financial Inventory Management is again divided into three different categories.

- 1) Based on Valuation
- 2) Based on Cost Analysis
- 3) Based on Financial Statement

#### **1) Based on Valuation**

There are number of generally accepted methods of determining the cost of inventories at the close of the accounting period. The selection of a suitable

method is important. Therefore, the method should be selected in the light of probable effects on profits over a period of years.

**Note:**

It may not be out of place to mention that once a method is selected, it must be used consistently and cannot be changed from year to year.

The discussion here of the methods to value inventory should, therefore be viewed in this perspective.

**DATA COLLECTION:**

**Secondary Data:**

Secondary data means data that are already available i.e., researcher refer to the data which have already been collected and analyzed by someone else. Secondary data may either be published data or unpublished data. Usually published data may be from books, magazines and newspapers. Unpublished data may be taken from diaries, letters and autobiographies.

The data are collected from the annual reports maintained by the company for the past five years viz., 2018-2022. Data are collected from the company's website, books and journals pertaining to the topic also.

**Inventory Turnover Ratio:**

Inventory turnover ratio showing how many times a company's inventory is sold and replaced over a period. This ratio indicates that how many times the inventories are converted into sales and then to cash. Total inventory turnover ratio shows how many times inventory is replaced during the year.

It shows how effectively inventory is managed by comparing the cost of goods sold with average inventory period.

$$\text{Inventory Turnover Ratio} = \frac{\text{Cost of Goods Sold}}{\text{Average Inventory}}$$

**Inventory Current Asset Ratio:**

It is an indication of excessive inventory over investment in inventory. It will adversely affect the ability of a firm to meet customers' demand. At the same time, a higher ratio reflects efficient business activities. A low ratio may be a result of inferior quality goods, stock and absolute goods.

$$\text{Inventory Current Asset Ratio} = \frac{\text{Inventory}}{\text{Total Current Asset}}$$

**Raw Materials Turnover Ratio:**

Usually a firm has to maintain several types of inventories. It is not desirable to keep the same degree of control over all the items. The firm should pay maximum attention to those items whose value is the highest. The firm should, therefore, classify inventories to identify which items should have the most effect on the firm's control. Thus, the firm should be selective in its approach to controlling investment in various types of inventories. Raw material inventory turnover ratio refers to the number of times the materials have been purchased and replaced over a period. It has been calculated by the following formula:

$$\text{Raw Material Turnover Ratio} = \frac{\text{Annual Consumption of Raw Material}}{\text{Average Raw Material}}$$

**Work in Progress Turnover Ratio:**

The resources and constituents, which have started their conversation to have finished goods. In the other words work in progress is the unfinished inventory, the inventory cannot be sold yet. It is still in an intermediate stage of production. Work-in-progress inventory turnover ratio refers to the number of times of times raw materials have been converted into work in progress. It has been calculated by the following formula:

$$\text{Work in Progress Turnover Ratio} = \frac{\text{Cost of Production}}{\text{Average Work in Progress}}$$

**Finished Goods Inventory Turnover Ratio:**

Finished goods are inventories ready to be delivered to distribution centers, retailers, wholesalers or directly to the customers. Finished good inventory formula:

$$\text{Finished Goods Inventory Turnover Ratio} = \frac{\text{Cost of Goods Sold}}{\text{Average Finished Goods}}$$

#### **INVENTORY CONVERSION PERIOD:**

##### **Raw Material Conversion Period:**

Raw material conversion period is the time period between receiving the raw material and sending them for production. It is the period of stocking the raw materials for usage. So higher the ratio lower will be the profit.

$$\text{Raw Material Conversion Period} = \frac{\text{Raw Material} * 365}{\text{Turnover}}$$

##### **Work in Progress Conversion Period:**

Work-in-progress conversion period are the time period when the raw materials are received for production and the time for their dispatch. The higher the ratio the lower will be profitability.

$$\text{Work in Progress Conversion Period} = \frac{\text{Work in Progress} * 365}{\text{Turnover}}$$

##### **Finished Goods Conversion Period:**

Finished goods conversion period is the time of storage of finished goods in the warehouse until they are sold.

$$\text{Finished Goods Conversion Period} = \frac{\text{Finished Goods} * 365}{\text{Turnover}}$$

##### **Inventory Conversion Period:**

Inventory conversion period is very closely related to the inventory management. Inventory conversion is the part of the net operating cycle. Inventory conversion period indicated in how much days their inventory gets converted. It will consider all type of inventories I.e. raw materials, work in progress and finished goods.

$$\text{Inventory Conversion Period} = \frac{\text{Inventory} * 365}{\text{Turnover}}$$

## **Valuation method for Old and Rejected Stocks:**

### **Old Stock:**

This old stock means excess of materials from specific order. As already viewed in Physical Inventory Process that, always purchase department purchases 20% more than its order. So that remained or excess materials are said to be "Buffer Stock"

These Old stock are in the form of Raw Materials then value it according to purchasing of those materials. If these old stock are after Finishing of production process. Then these are valuing on selling price of same products to the customer.

### **Rejected Stocks:**

Again these are divided into three parts. Rejection of Raw Materials i.e., before sending to Production Process. Rejection of Materials during the Production Process and Rejection of Materials after the Production Process that is, Rejection of Finished Goods.

Rejection of Raw Materials is valuing on Purchase value of those materials. Rejection of WIP Materials then value as Purchase Value Plus its partly incurred Costs like Labour, Overhead Costs etc., And for Rejection of Finished Goods value at Purchase Value and Fully incurred Costs as said now.

### **EOQ**

EOQ applicability due to the nature of Business as above said is not possible.

### **Reorder Point:**

This is the point is also not having much importance because of nature of Business.

### **Lead Time**

Purchases materials from multiple supplier and by on schedule basis to supply materials. So this is also not applicable in this type of business



**First In First Out (FIFO) Method:**

The FIFO method of valuation of inventory is based on the assumption that the inventory is consumed in chronological order, that is, those received first are issued/consumed first and value fixed accordingly. The merit of FIFO method is that the physical flow of materials matches the flow of cost.

**Last in First Out (LIFO) Method:**

Under the LIFO method, the cost of goods sold and the value of closing inventory can be determined only after the final lot of the year has been received. This is because assumption underlying the valuation of inventory, according to this method. As name LIFO suggests, the use of inventory is valued on the basis of the inverse sequence of receipts. Since the LIFO method assumes that the latest item in is the first out, the current cost of materials are matched with the current selling price/current uses. This matching of current costs with current revenues is the essence of the argument for the LIFO method.

**Average Cost Method:**

According to average cost method, each purchase is added to inventory and an average cost determined. Materials are charged into cost of sales at this average until another lot is received, when a new average unit inventory cost is calculated.

Note: There are so many other than these above methods but most wide usefully methods are these three so here we discussed those three methods only.

**2) Based on Cost****Analysis Cost of****Holding****Inventory: -**

One operating objective of inventory management is to minimize cost. Excluding the cost of merchandise, the costs associated with inventory fall into two basic categories: (i) Ordering or

Acquisition or Set-up Costs, and (ii) Carrying Costs. These costs are an important element of the optimum level of inventory decisions.

### **Ordering Cost:**

It is the fixed cost of placing & receiving an inventory order. Like (a) Preparing a purchase order or requisition form & (b) receiving, inspecting & reordering goods received to ensure both quantity & quality. It is also called as setup cost.

### **Carrying Cost:**

The second broad category of costs associated with inventory is the carrying costs. They are involved in maintaining or carrying inventory. The cost of holding inventory may be divided into two categories,

**Those that Arise Due to the Storing of Inventory:** The main components of this category of carrying costs are (i) storage cost, that is, depreciation, insurance, maintenance of the building and utilities; (ii) insurance of inventory against fire and theft; (iii) deterioration in inventory because of pilferage, fire, technical obsolescence, style obsolescence and price decline; (iv) serving costs, such as labour for handling inventory, clerical and accounting costs.

**The Opportunity Cost of Funds:** This consists of expenses in raising funds (interest on capital) to finance the acquisition of inventory. If funds were not locked up in inventory, they would have earned a return. This is the opportunity cost of funds or the financial cost component of the cost.

### **Linking of Costs based and Physical Based Inventory Management:**

The carrying costs and the inventory size are positively related and move in the same direction. If the level of inventory increases, the carrying costs also increase and vice-versa.

**Total Cost:**

The sum of inventory increases, the carrying costs represent the total cost of inventory. This is compared with the benefits arising out of inventory to determine the optimum level of inventory.

**Economic Order Quantity (EOQ):**

How much inventory should be bought in a lot? Should the quantity to be large or small? Should the requirements of material during a given period Order quantity problems. (say 6 months or 1 year) be acquired in one lot or should it be acquired in installments of purchased several small lots? Such inventory problems are called

Therefore EOQ is that level of inventory at which total cost of inventory comprising ordering cost & carrying costs is the minimum

**Formulae for calculating Economic Order Quantity:**

$$EOQ = \sqrt{\frac{2AO}{C}}$$

Where,

A= Annual Quantity

O= Ordering Cost

C=Carrying Cost

**Assumptions:**

1. The firm knows with certainty the annual usage (consumption) of a particular item of inventory.
2. The rate at which the firm uses inventory is steady over time.
3. The orders placed to replenish inventory stocks are received at exactly that point in time when inventories reach zero.

**Reorder Point:**

This is the point at which to order inventory-expressed equation-ally as: Lead Time in days  $\times$  daily usage.

**Lead Time:**

It is the time normally taken in receiving delivery after placing orders with suppliers.

**Safety Stock:**

It implies extra inventories that can be drawn down when actual lead-time and/or usage rates are greater than expected.

**3) Based on Financial Statement**

For having assistance by banks, bankers should first evaluate the followings:

1. Collateral Strength.
2. Inventory Position
3. Some Financial Ratios
4. Payment of all requirements like Income Tax, Wealth Tax, Interests on debt

5. Agreement papers of all authorized persons like Debenture holders, Shareholders etc.,
6. All required documents.
7. Who is the Buyer and his Country's relationship etc.,

### **Single Period Model**

- Continuous stocking levels
  - Identifies optimal stocking levels
  - Optimal stocking level balances unit shortage and excess cost
- Discrete stocking levels
  - Service levels are discrete rather than continuous
  - Desired service level is equaled or exceeded

### **Operations Strategy**

- Too much inventory
  - Tends to hide problems
  - Easier to live with problems than to eliminate them
  - Costly to maintain
- Wise strategy
  - Reduce lot sizes
  - Reduce safety stock

### **Ratio Analysis related to Inventory**

Ratio analysis is a powerful tool of financial analysis. A ratio is defined as "the indicated quotient of two mathematical expressions" and as "the relationship between two or more things." In financial analysis ratio is used as a benchmark for evaluating the financial position and performance of a firm. Ratios help to summarize large quantities of financial data and to make qualitative judgment about to form a qualitative judgment

## CHAPTER V

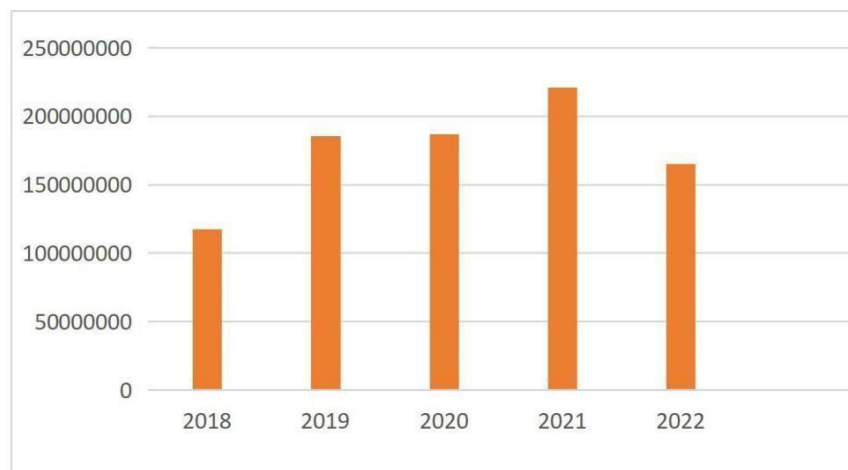
### ANALYSIS OF DATA AND INTERPRETATION

#### 4.1 ANALYSIS OF DATA

##### 4.1.1 INVESTMENT IN INVENTORY:

S.NO	PARTICULARS	2018	2019	2020	2021	2022
1	Raw Materials	75824400	130077946	106263064	9589850	99124639
2	Materials	9321	10611	8820	8558	8618
3	Scrap	1964385	555833	690486	675376	1042138
4	Stores in Transit	5501949	6524322	11503808	10408174	6990694
5	Work in Progress	17013210	18469204	34639334	49852459	35239306
6	Finished Goods	17223084	30025249	33698384	64476523	22742088
	Total	117536349	185663165	186803896	221110940	165147483

**CHART NO.4.1.1 INVESTMENT IN INVENTORY**



#### INVESTMENT IN INVENTORY

##### INTERPRETTION:

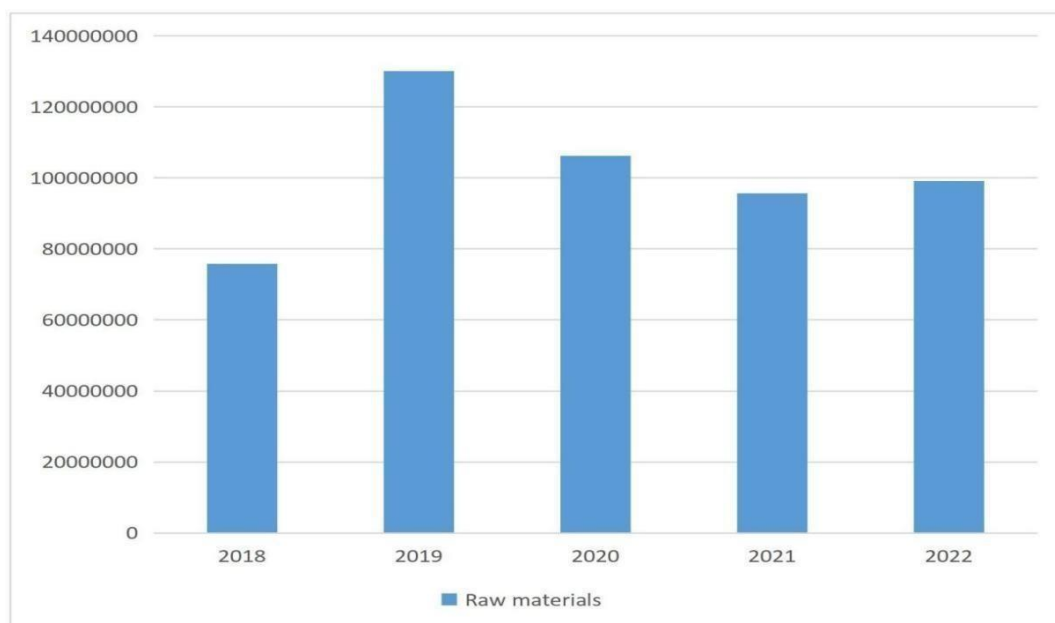
From table no.4.1.1, it can be interpreted that the investment in inventory for the company is alternatively increasing and decreasing. It describes the 2022 inventory investment has decreased by 25% because of a decrease in order.

## 4.2 RAW MATERIALS

**TABLE NO: 4.2.1 RAW MATERIALS**

YEARS	2018	2019	2020	2021	2022
RAW MATERIALS	75824400	130077946	106263064	95689859	99124639

**CHART NO: 4.2.1 RAW MATERIALS**



### INTERPRETATION:

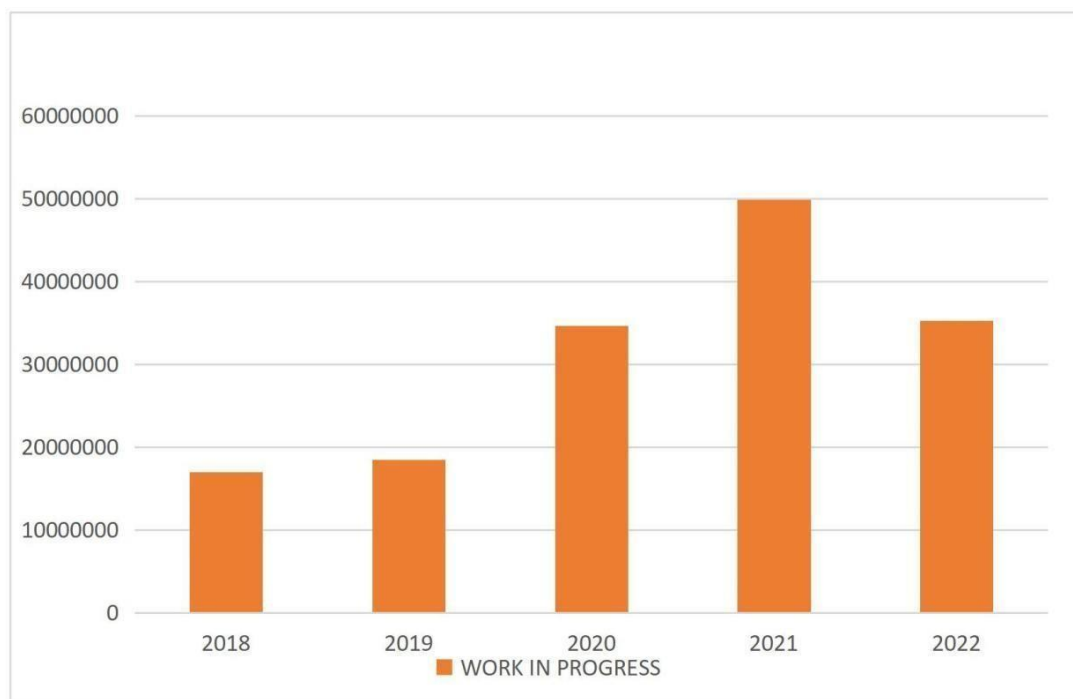
The raw materials used by the company have increased compared with the previous year, 2021-2022. It means the company deals with the inventory more, than the year of 2021 as 3.5%

### 4.3 WORK IN PROGRESS:

**TABLE NO: 4.3.1 WORK IN PROGRESS**

YEARS	2018	2019	2020	2021	2022
WORK IN PROGRESS	17013210	18469204	34639334	49852459	3529306

**CHART NO: 4.3.1 WORK IN PROGRESS**



### INTERPRETATION:

The table shows the work in progress has decreased compared with the previous year of 2021-2022. It means the emergence of the product delivery is decreased. The Works in progress decreased 29%

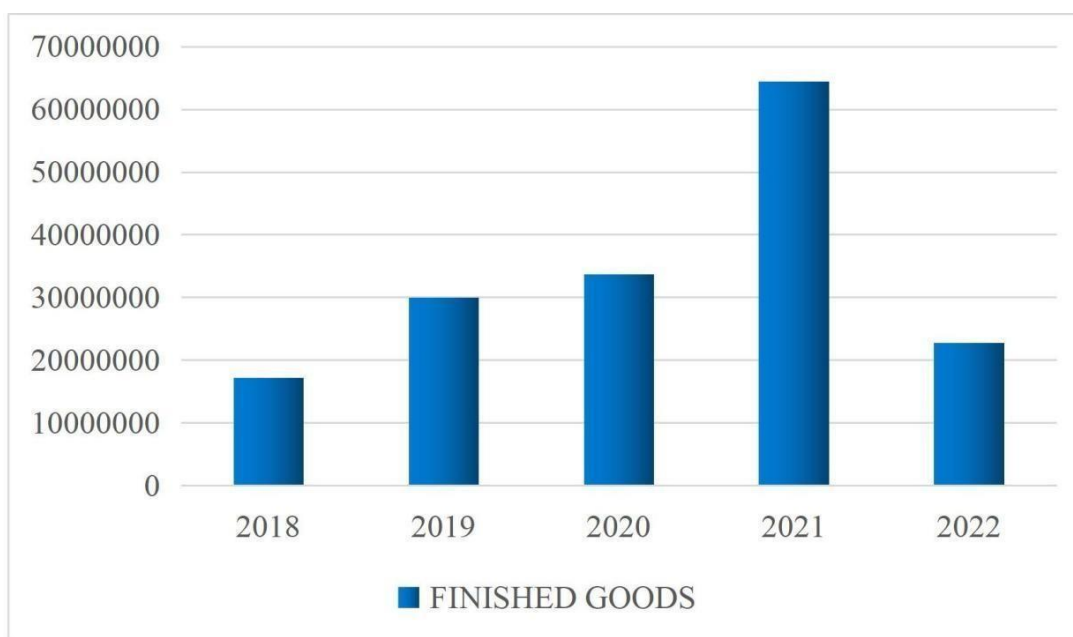


#### 4.4 FINISHED GOODS

**TABLE NO:4.4.1 FINISHED GOODS**

YEARS	2018	2019	2020	2021	2022
FINISHED GOODS	17223084	30025249	33698384	64476523	22742088

**CHART NO:4.4.1 FINISHED GOODS**



#### **INTERPRETATION:**

The above table displays that the finished goods investment has decreased in the year 2021-2022. Compared to the year 2020-2021, the decrease in the production level was 64%.

#### 4.5 INVENTORY TURNOVER RATIO:

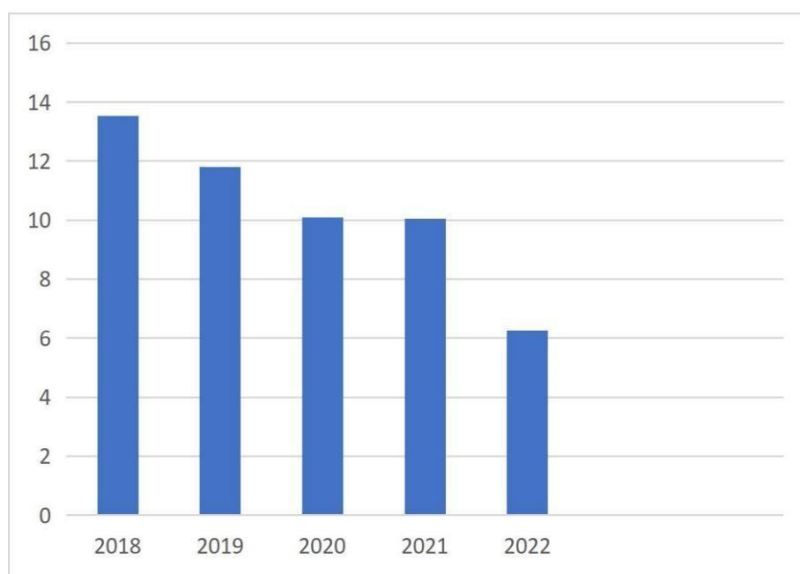
**Inventory Turnover Ratio= Cost of Goods Sold**

**Average Inventory**

**TABLE NO: 4.5.1 INVENTORY TURNOVER RATIO**

<b>YEARS</b>	<b>COST OF GOODS SOLD</b>	<b>AVERAGE INVENTORY</b>	<b>INVENTORY TURNOVER RATIO</b>
2018	246846.05	21958.51	13.52
2019	340382.84	28845.97	11.8
2020	396543.61	39288.84	10.09
2021	425761.74	42356.11	10.05
2022	297579.36	47565.16	6.26

**CHART NO: 4.5.1 INVENTORY TURNOVER RATIO**



#### INTERPRETATION:

The above table shows the Inventory Turnover Ratio is decreased in 2021-2022. It means the effective inventory and cost of goods are reduced by 37%. Because of a decrease in sales.

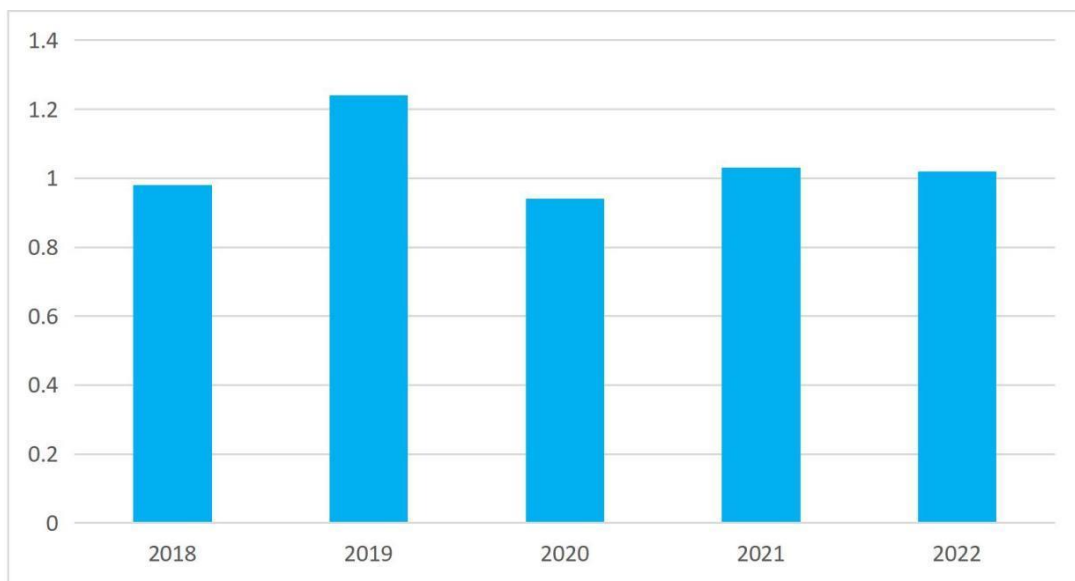
#### 4.6 RAW MATERIAL TURNOVER RATIO:

$$\text{Raw Material Turnover Ratio} = \frac{\text{Annual Consumption of Raw Material}}{\text{Average Raw Material}}$$

**TABLE NO:4.6.1 RAW MATERIAL TURNOVER RATIO**

YEARS	ANNUAL CONSUMPTION OF RAW MATERIAL	AVERAGE RAW MATERIAL	RAW MATERIAL TURNOVER RATIO
2018	12168.09	12447	0.98
2019	19978.38	16073	1.24
2020	17720.66	18850	0.94
2021	18981.93	18351	1.03
2022	19923.77	19453	1.02

**CHART NO: 4.6.1 RAW MATERIAL TURNOVER RATIO**



#### INTERPRETAION:

The table clearly shows that the Raw Material Turnover Ratio has decreased in the year 2022 to 1.02, compared to the year 2021 as 1.03, because of decreases in production.

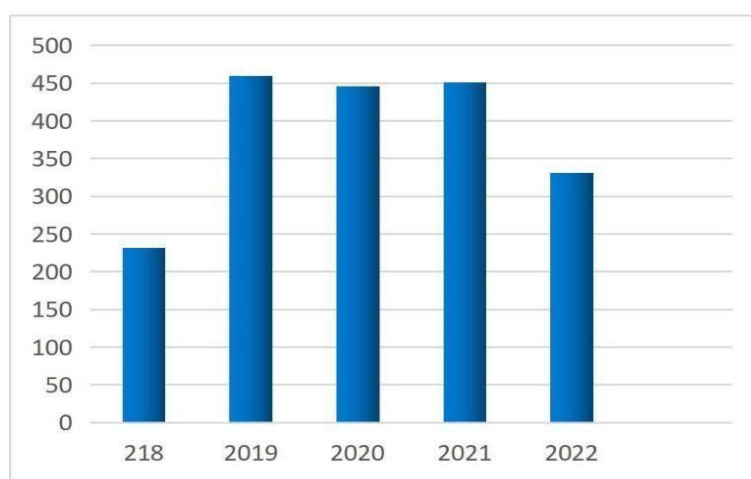
#### 4.7 WORK IN PROGRESS TURNOVER RATIO:

$$\text{Work in Progress Turnover Ratio} = \frac{\text{Cost of Production}}{\text{Average Work in Progress}}$$

**TABLE NO:4.7.1 WORK IN PROGRESS TURNOVER RATIO**

YEARS	COST OF PRODUCTION	AVERAGE WORK IN PROGRESS	WORK IN PROGRESS TURNOVER RATIO
2018	184486.49	4588	226.84
2019	224105.56	489	457.92
2020	264421.87	598	442.48
2021	273459.06	614	445.69
2022	196863.64	595	330.91

**CHART NO:4.7.1 WORK IN PROGRESS TURNOVER RATIO**



#### INTERPRETATION:

The table clearly shows that the Work in Progress Turnover Ratio has decreased in the year 2021-2022, compared to the year 2020-2021. Because of reasons, raw material turnover ratio decreases.

## 4.8 CONVERSION PERIOD

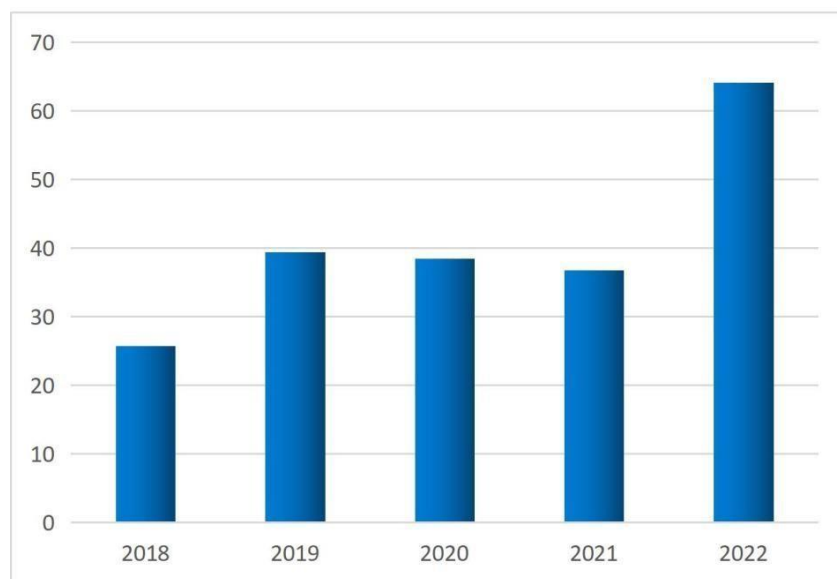
### 4.8 INVENTORY CONVERSION PERIOD:

$$\text{Inventory Conversion Period} = \frac{\text{Inventory} \times 365}{\text{Turnover}}$$

**TABLE NO:4.8.1 INVENTORY CONVERSION PERIOD**

YEARS	INVENTORY	TURNOVER	CONVERSION PERIOD
2018	20946	296846.05	25.76
2019	36746	340382.84	39.4
2020	41832	396543.61	38.5
2021	42880	425761.74	36.76
2022	52250	297579.36	64.09

**CHART NO:4.7.1 INVENTORY CONVERSION PERIOD**



### INTERPRETATION:

The above table shows that the inventory conversion period was high in the year 2021 compared to 2022, due to an increase in sales of 74%. It indicates in how many days the inventory gets converted.

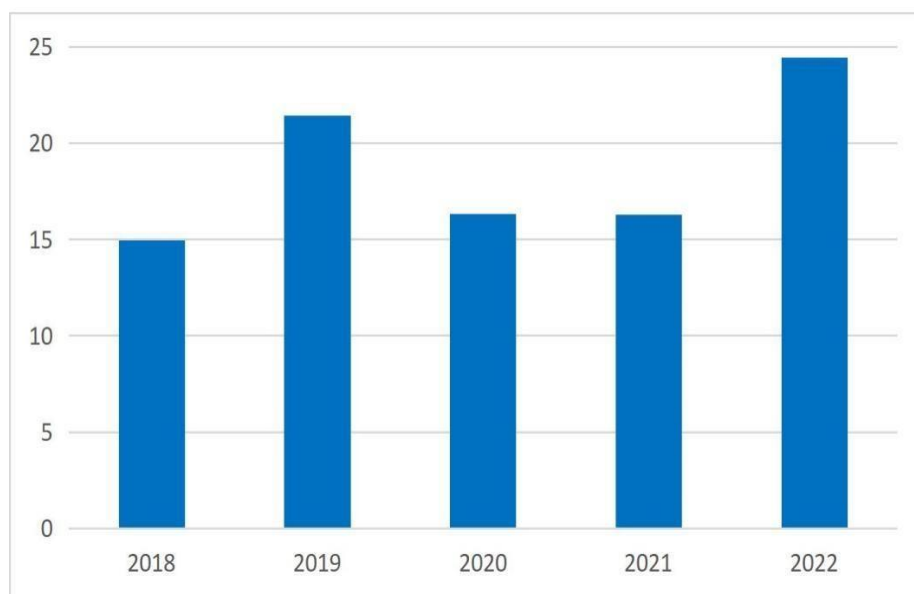
#### 4.9 RAW MATERIAL CONVERSION PERIOD:

$$\text{Raw Material Conversion Period} = \frac{\text{Raw Material} * 365}{\text{Turnover}}$$

**TABLE NO:4.9.1 RAW MATERIAL CONVERSION PERIOD**

YEARS	RAW MATERIAL	TURNOVER	CONVERSION PERIOD
2018	12168.09	296846.05	14.96
2019	19978.38	340382.84	21.42
2020	17720.66	396543.61	16.31
2021	18981.93	425761.74	16.27
2022	19923.77	297579.36	24.44

**CHART NO:4.9.1 RAW MATERIAL CONVERSION PERIOD**



#### INTERPRETATION:

The above table shows that the raw material conversion period was high in the year 2021 compared to 2022, due to an increase of sales by 50%. It indicates how many days the materials gets converted.

#### 4.10 WORK IN PROGRESS CONVESION PERIOD:

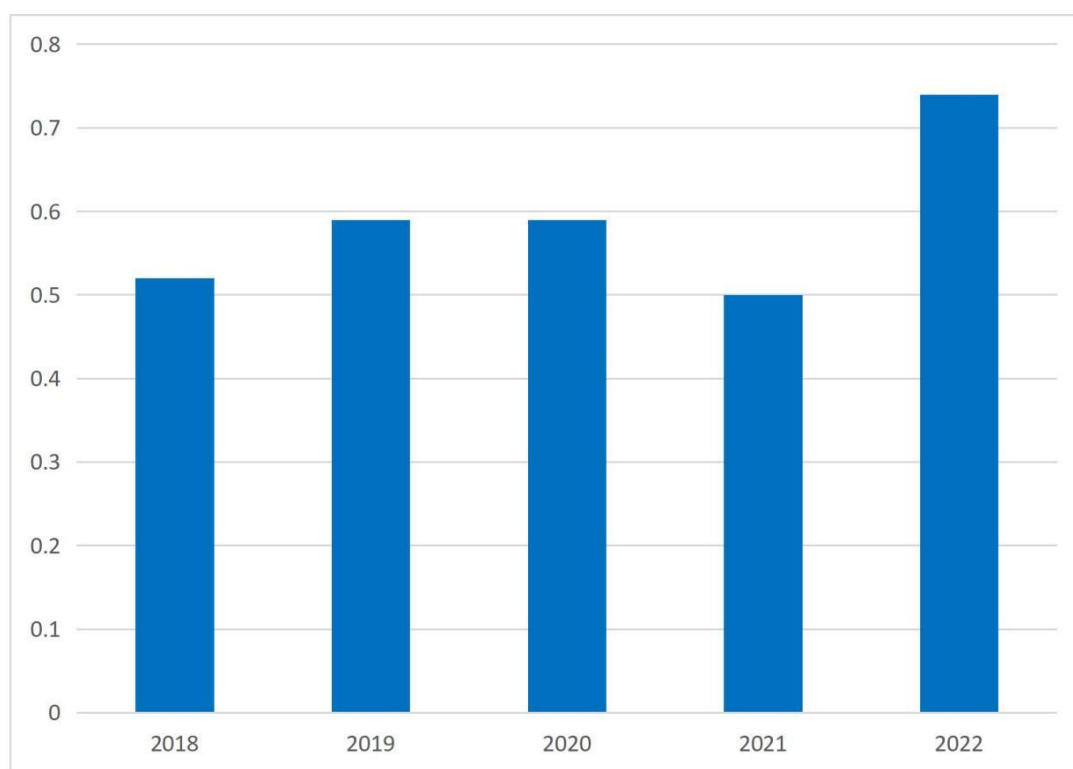
**Work in Progress Conversion Period=  $\frac{\text{Work in Progress} * 365}{\text{Turnover}}$**

**Turnover**

**TABLE NO:4.10.1 WORK IN PROGRESS CONVESION PERIOD**

YEARS	WORK IN PROGRESS	TURNOVER	CONVERSION PERIOD
2018	426.48	296846.05	0.52
2019	552.31	340382.84	0.59
2020	624.86	396543.61	0.59
2021	584.28	425761.74	0.50
2022	605.55	297579.36	0.74

**CHART NO:4.9.1 WORK IN PROGRESS CONVESION PERIOD**



#### **INTERPRETATION:**

The above table shows that the work in progress conversion period was high in the year 2021 compared to 2022, at 48%, because of the raw material conversion.

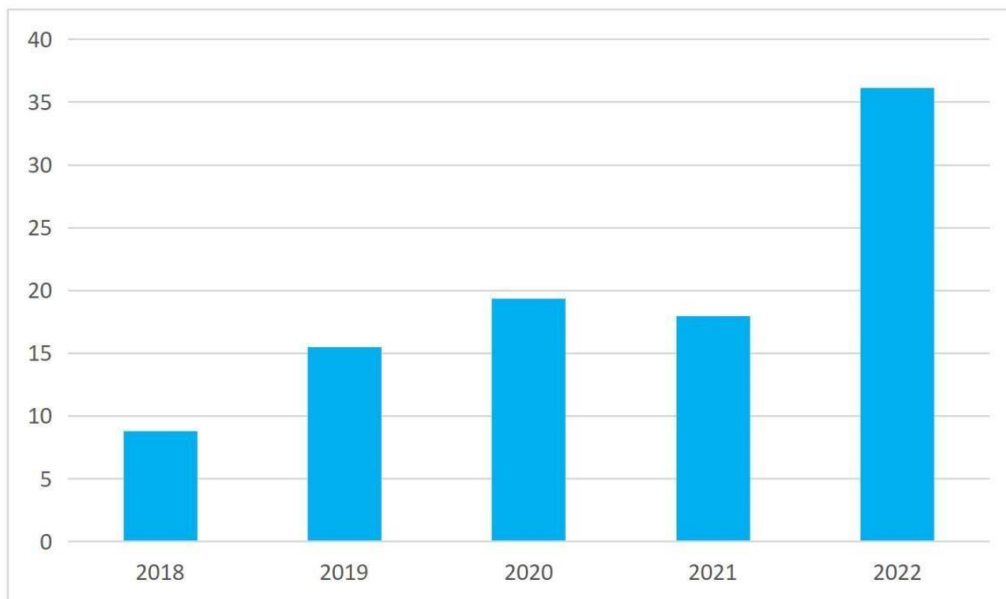
#### 4.11 FINISHED GOODS CONVERSION PERIOD:

$$\text{Finished Goods Conversion Period} = \frac{\text{Finished Goods} * 365}{\text{Turnover}}$$

**TABLE NO: 4.11.1 FINISHED GOODS CONVERSION PERIOD**

YEARS	FINISHED GOODS	TURNOVER	CONVERSION PERIOD
2018	7143.52	296846.05	8.78
2019	14466.52	340382.84	15.51
2020	20997.17	396543.61	19.33
2021	20960.34	425761.74	17.97
2022	29440.75	297579.36	36.11

**CHART NO: 4.11.1 FINISHED GOODS CONVERSION PERIOD**



#### INTERPRETATION:

The above table shows that the finished goods conversion period was high in the year 2021 to 2022, because the orders increased by 84%, because of the production period increases.



#### 4.12 ABC ANALYSIS:

The ABC system is a widely used classification technique to identify various items of inventory for the purpose of inventory control. On the basis of unit cost involved, the various items are classified into 3 categories.

1. A, consisting of items with a large investment.
2. C, with relatively small investments but a fairly large number of items and
3. B, which stands mid-way between category A & C.

Category A needs the most rigorous control, C requires minimum attention and B deserves less attention than A but more than C.

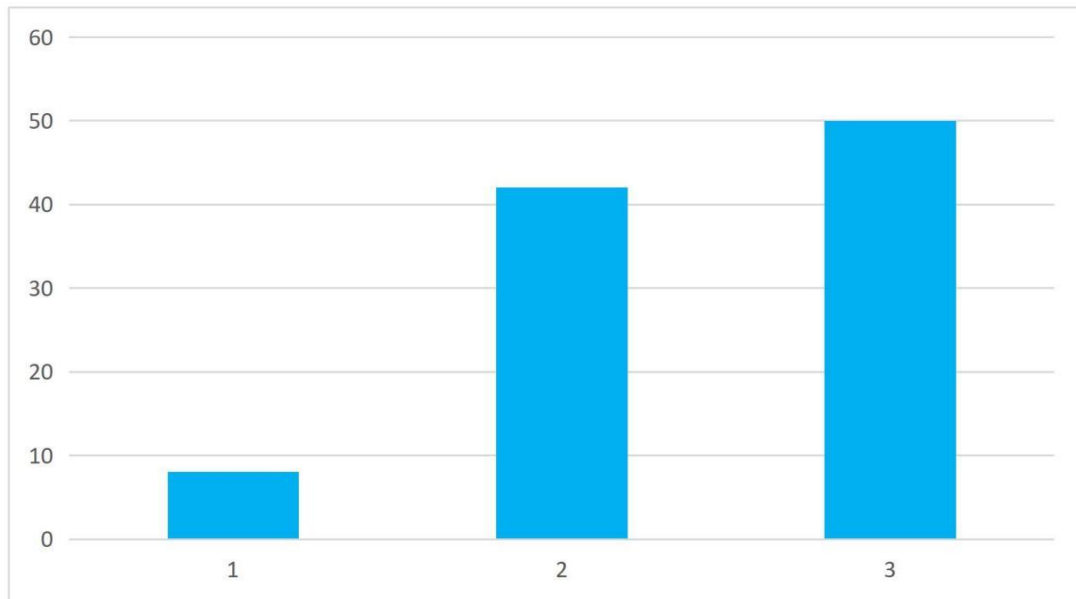
**TABLE NO: 4.12.1 ANALYSIS**

ITEMS	2022	%
A	49	8
B	270	42
C	319	50
TOTAL	638	100

#### ANALYSIS:

The above table shows the classification of various components as A, B & C classes using ABC analysis technique based on unit value. From the classification A classes are those whose unit value is more than Rs.2,00,000 and constitutes 20% of total components. B classes are those whose unit value is between Rs.2,00,00-1,00,000 constitutes 30% of the total components and the C classes are those whose unit values are less than Rs.1,00,000 constitutes 50% of the total components. It is good that the company maintains its inventories based on its value using controlling techniques.

**CHART NO: 4.12.1 ANALYSIS**



**INTERPRETATION:**

The above table shows the classification of various components as A,B & C classes using ABC analysis technique based on the units consumed per annul. From theclassification, A classes are those that constitute 20% of total consumption of the materials, B classes are those that constitute 30% of total consumption of the materials and C classes are those that constitute the remaining 50% of the total consumption of the materials. It is good for the company to maintain small inventories but a fairly large number of items

#### **4.13 TREND ANALYSIS:**

A trend signifies a tendency and, as such, the review and appraisal of tendency is accounting variables in nothing but trend analysis. Trend analysis is carried out by calculating trend ratios (percentage) and or by plotting the accounting data on graph paper or chart. It is important for forecasting and budgeting. Trend analysis discloses the changes in financial and operating data between specific periods. Here the inventories have been analyzed by the method of least square and predicated for the future year 2027. The trend values have been estimated by using a linear equation as given below:

#### **TREND ANALYSIS IN INVENTORY:**

Here the inventory had been analyzed by the method of least square and predicated on the future year 2027. The trend values have been estimated by using a linear equation as given below.

$$Y=a+bx$$

Y = inventory

X = time variable

‘a’ & ‘b’ are parameters to be estimated.

Y= computed trend equation has been estimated by the method of least squares. The value ‘a’ & ‘b’ are determined by solving the following two normal equations.

$$\Sigma y = Na + b \Sigma x$$

N = number of years that in 5 years.

$$\Sigma xy = a \Sigma x + b \Sigma x^2$$

$$a = \Sigma y / n$$

$$b = \Sigma xy / n$$

**TABLE NO: 4.13.1 TREND ANALYSIS IN INVENTORY**

<b>YEARS</b> <b>(x)</b>	<b>Inventories</b> <b>(Rs.)</b> <b>Y</b>	<b>X</b> <b>X=x-2020</b>	<b>X<sup>2</sup></b>	<b>XY</b> <b>(Rs)</b>
2018	20946	1	1	20946
2019	36746	2	4	73492
2020	41832	3	9	125496
2021	42880	4	16	171520
2022	52250	5	25	261250
<b>TOTAL(Σ)</b>	<b>194654</b>	<b>15</b>	<b>55</b>	<b>652704</b>

$$a = \Sigma y / n$$

$$b = \Sigma xy / n$$

$$a = 194654 / 5$$

$$b = 652704 / 5$$

$$= 38931$$

$$= 1305408$$

$$Y = a + bx$$

$$Y = 38931 + 1305408X$$

Estimated Inventory for 2023 to

$$2027X = (x - 2020)$$

**FOR 2023**

$$\begin{aligned} Y &= 38931 + 1305408(2023-2020) \\ &= 38931 + 1305408(3) \\ &= 38931 + 3916224 \\ &= 3955155 \end{aligned}$$

**FOR 2024**

$$\begin{aligned} Y &= 38931 + 1305408(2024-2020) \\ &= 38931 + 1305408(4) \\ &= 38931 + 5221632 \\ &= 5260563 \end{aligned}$$

**FOR 2025**

$$\begin{aligned} Y &= 38931 + 1305408(2025-2020) \\ &= 38931 + 1305408(5) \\ &= 38931 + 6527040 \\ &= 6565971 \end{aligned}$$

**FOR 2026**

$$\begin{aligned} Y &= 38931 + 1305408(2026-2020) \\ &= 38931 + 1305408(6) \\ &= 38931 + 7832448 \\ &= 7871379 \end{aligned}$$

**FOR 2027:**

$$\begin{aligned} Y &= 38931 + 1305408(2027-2020) \\ &= 38931 + 1305408(7) \\ &= 38931 + 9137821 \\ &= 9176752 \end{aligned}$$

#### **4.14 ECONOMIC ORDER QUANTITY(EOQ):**

How much inventory should be bought in a lot? Should the quantity to be large or small? Should the requirements of material during a given period Order quantity problems. (say 6 months or 1 year) be acquired in one lot or should it be acquired in installments of purchased several small lots? Such inventory problems are called EOQ.

Therefore EOQ is that level of inventory at which total cost of inventory comprising ordering cost & carrying costs is the minimum.

#### **Formulae for calculating Economic Order Quantity:**

$$EOQ = \frac{2AO}{C}$$

Where,

A= Annual Quantity

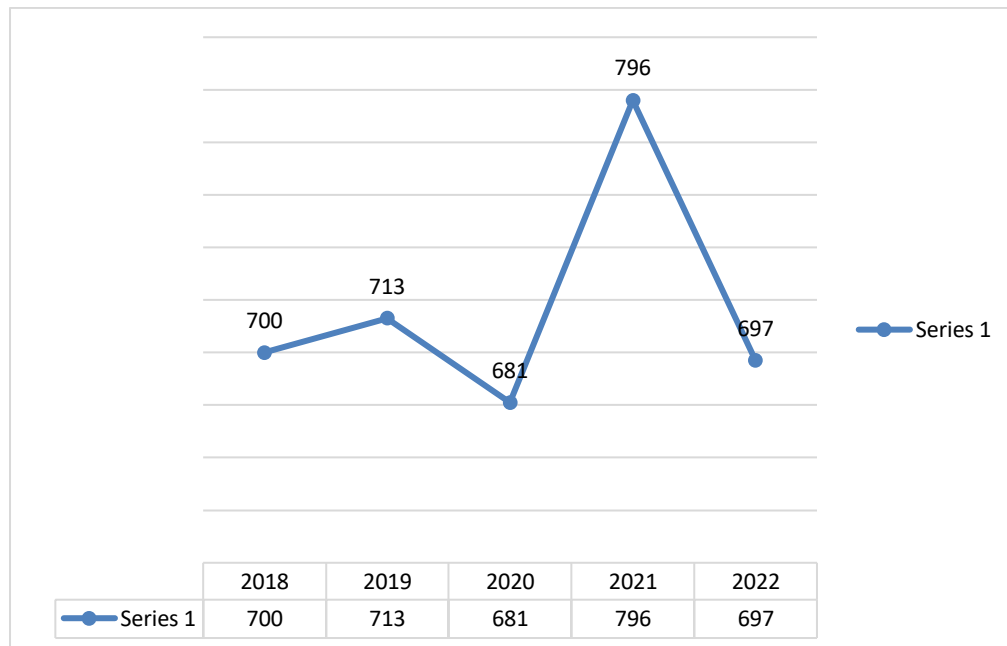
O= Ordering Cost

C=Carrying Cost

**TABLE NO: 4.14.1 ECONOMIC ORDER QUANTITY**

<b>YEAR</b>	<b>ANNUAL QUANTITY</b>	<b>ORDERING COST</b>	<b>2*ANNUAL QUANTITY &amp; ORDERING COST</b>	<b>CARRYING COST</b>	<b>EOQ</b>
<b>2018</b>	34300	10	<b>686000</b>	<b>1.40</b>	<b>700</b>
<b>2019</b>	35600	10	<b>712000</b>	<b>1.40</b>	<b>713</b>
<b>2020</b>	29000	12	<b>696000</b>	<b>1.50</b>	<b>681</b>
<b>2021</b>	39700	12	<b>952800</b>	<b>1.50</b>	<b>796</b>
<b>2022</b>	40500	12	<b>972000</b>	<b>2.00</b>	<b>697</b>
<b>TOTAL</b>	<b>179100</b>	<b>56</b>	<b>4018800</b>	<b>7.8</b>	<b>3587</b>

**CHART NO:4.14.1 ECONOMIC ORDER QUANTITY**



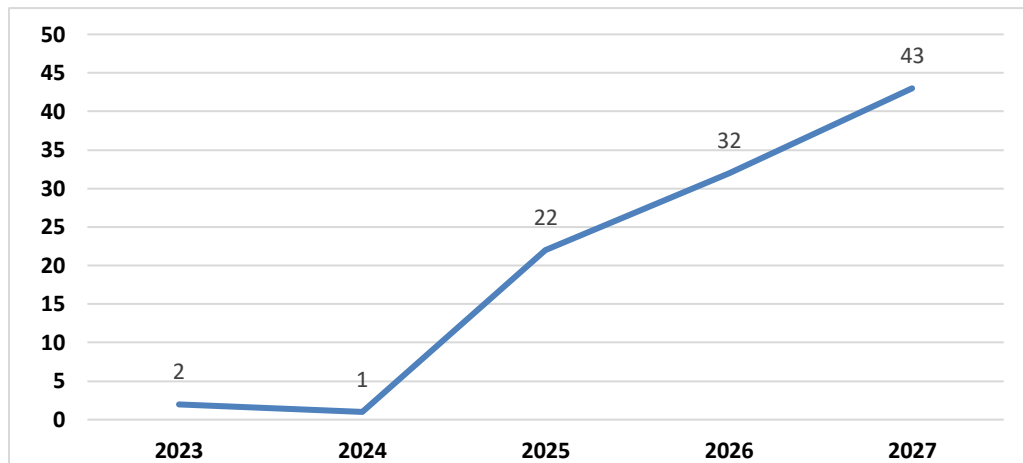
**INFERENCE:**

From the above Economic Order Quantity Chart and Table, it is found that the EOQ of the company in the year 2018 was 700, and in the year 2019, the EOQ was 713, but gradually it met changes in the year 2020, during the pandemic, the EOQ was 681.

**TABLE NO:4.14.1 ESTIMATED INVENTORY**

Years	Estimated inventory	Percentage
2023	3955155	2
2024	5260563	1
2025	6565971	22
2026	7871379	32
2027	9176752	43
TOTAL	32829820	100

**CHART NO: 4.14.1 ESTIMATED INVENTORY**



**INTERPRETATION:**

From the above chart of the Trend analysis, it denotes the forecasting for the next five years of the company. From this analysis, it is known that the middle year 2020, was taken as the year to calculate the trend of the company.



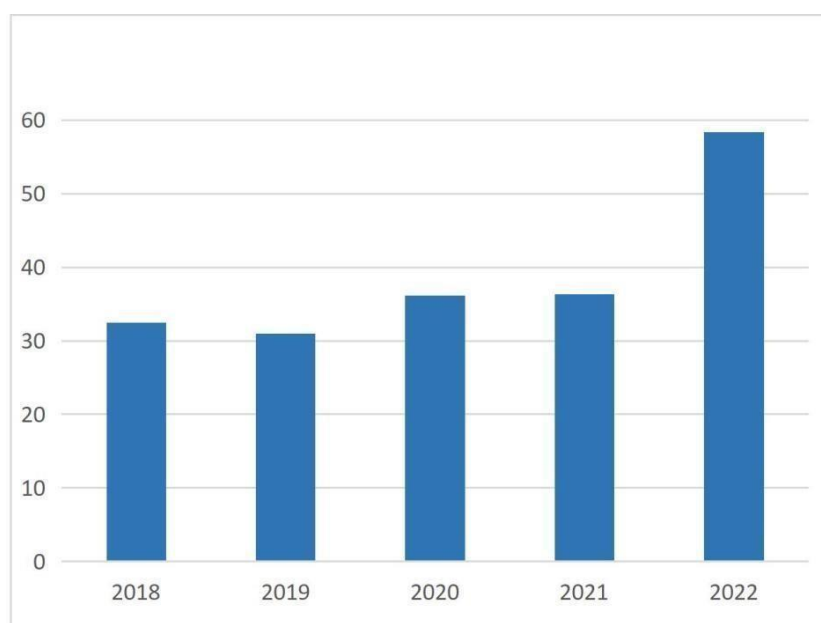
#### 4.15 DAY SALES OF INVENTORY:

$$\text{Day Sales of Inventory} = \frac{\text{Average Inventory} * 365}{\text{Cost of Goods Sold}}$$

**TABLE NO: 4.15.1 DAY SALES OF INVENTORY**

YEARS	AVERAGE INVENTORY	COST OF GOODS SOLD	DAY SALES OF INVENTORY
2018	21958.51	246846.05	32.46
2019	28845.97	340382.84	30.93
2020	39288.84	396543.61	36.16
2021	42356.11	425761.74	36.31
2022	47565.16	297579.36	58.34

**CHART NO: 4.15.1 DAY SALES OF INVENTORY**



#### INTERPRETATION:

The above table shows the day sales of inventory decreased in 2018-2019. It means the effective inventory and cost of goods are reduced by 37%. Because of a decrease in sales.

## **CHAPTER VI**

### **FINDINGS OF THE STUDY**

1. It is found that the organization is following EOQ technique. The company is working as per the defined EOQ level. Overall the working of EOQ is reasonable.
2. From the safety stock calculation, it can be determined how much inventory the company can keep in its reserve stock. Through this analysis, it is known the company is having enough stock at all the times.
3. In material analysis, various types of materials like Raw material, WIP and closing stock are studied. Through this analysis one got to know about the company's inventory value for past three years. The inventory of the company has increased in every year.
4. The overall performance of the organisation is satisfactory because of its prominent increase in sales. The sales have increased every year.
5. In 2022, the company would spend 25% less on inventory because they received fewer orders.
6. In 2022, the company used 3.5% more raw materials compared to 2021, indicating increased activity in managing their inventory.
7. In 2022, the company's work in progress dropped by 29% compared to 2021, indicating a slowdown in product development or delivery.
8. The finished goods investment has decreased in the year 2021-2022, compared to the year 2020-2021, decrease in the production level was 64%.
9. The rate at which inventory is sold decreased by 37% in 2021-2022, meaning the company managed inventory less efficiently due to the drop in sales.
10. The raw material turnover ratio increased from 0.9 in 2021 to 1.02 in 2022, signaling improved efficiency in using raw materials despite a decrease in production.
11. The work in progress turnover ratio decreased by 25% from 2020-2021 to 2021-2022, primarily due to a decrease in the raw material turnover ratio.
12. The inventory conversion period was longer in 2021 compared to 2022, mainly because sales increased by 74%. This means it took more time to convert inventory into sales during that period.

## SUGGESTIONS OF THE STUDY

- Spend less on inventory when orders are low by improving order handling and predicting demand accurately.
- To save money, watch your raw material levels closely, negotiate better prices with suppliers, and adjust your inventory strategies based on production needs and market trends.
- To speed up product delivery, improve how work is done-make processes more efficient, streamline workflows, and enhance team communication. Adjust project timelines as needed and keep a close eye on progress for optimal production.
- Check customer demand, improve production efficiency, and adjust to meet current needs. Keep a close eye on the inventory.
- Sell more, use discounts wisely, and keep an eye on what customers want to improve inventory turnover.
- Improve efficiency, cut waste, negotiate better prices, and adjust production to demand.
- To get work done faster, streamline how things are done, use materials wisely, and communicate well within the team.
- Improve sales, manage inventory better, use promotions, and stay updated on market trends to sell faster.
- Make products faster by improving production, working closely with suppliers, using technology, and adjusting schedules based on sales predictions.
- Speed up production by improving efficiency, using raw materials wisely, and adjusting schedules based on customer demand.
- Improve efficiency, handle orders well, and use technology to speed up production.
- For the most used items(class A), manage them carefully to avoid running out. For the next tier (class B), keep a balanced approach. For the rest (class C), use cost-effective strategies. Adjust your inventory plan based on changes in demand.

- Purchase raw materials at the time when the stock reaches the minimum level
- The purchases should not cross the maximum limit otherwise the stock will be kept in stores as idle.
- Quantity should be ordered as per the demand. We can assume the demand for the goods from past experience.

## CONCLUSION

In conclusion, the company has experienced fluctuations in various inventory metrics, including inventory turnover, raw material usage, and finished goods production. The decrease in inventory turnover and increase in raw material usage suggest a need for more efficient inventory management. To address these challenges, the company should focus on optimizing production processes, negotiating favorable terms with suppliers, and adjusting inventory levels based on demand.

- After the study, it is concluded that, effectiveness of inventory management should improve in all aspects. Hence the industry can still strengthen its position by looking into the following:
  1. The inventory should be fast moving so that the warehouse cost can be reduced. The finished goods has to be dispatched in feasible time as soon as manufacturing is completed.
  2. The observed increase in inventory for the upcoming years requires proactive measures. To tackle this, the company should optimize order quantities, negotiate better deals with suppliers, and explore just-in-time inventory practices. Additionally, cost-cutting measures such as reducing excess stock and streamlining operations can contribute to effective inventory management.
  3. In summary, a comprehensive approach involving efficient inventory management, strategic negotiations, and continuous adjustments based on market dynamics is essential for the company to navigate the complexities of inventory control and enhance overall operational efficiency.

## **BIBLIOGRAPHY**

### **REFERENCES:**

- Ozgun Caliskan Demirag, Sanjay Kumar, K.S. Mallikarjuna Rao (2017) “A note on inventory policies for products with residual-life-dependent demand” *Applied Mathematical Modelling*, Volume 43, Pages 647-658
- M.G. Matsebatlela, K. Mpofu (2015) “Inventory management framework to minimize supply and demand mismatch on a manufacturing organization” *IFAC PapersOnline*, Volume 48, Issue 3, Pages 260-265
- Taofeng Ye (2014) “Inventory management with simultaneously horizontal and vertical substitution” *International Journal of production economics*, Volume 156, Pages 316-324
- Canan Uckun, Fikri Karaesmen, Selcuk Savas (2008) "Investment in improved inventory accuracy in a decentralized supply chain" *International Journal of Production Economics*, Volume 113, Issue 2, Pages 546-566
- Denise Emerson, Wei Zhou, Selwyn Piramuthu (2009) "Goodwill, inventory penalty, and adaptive supply chain management" *European Journal of Operational Research*, Volume 199, Issue 1, 16, Pages 130-138
- Qiu Hong Zhao, Shuang Chen, Stephen C.H. Leung, K.K. Lai (2010) “Integration of inventory and transportation decision in logistics system” *Transportation Research Part E: Logistics and Transportation Review*, Volume 46, Issue 6, Pages 913-925.
- Mahdi Tajbakhsh, Chi-Guhn Lee, Saeed Zolfaghari (2011) “An inventory model with random discount offerings” *Omega*, Volume 39, Issue 6, Pages 710-718.
- Barry R. Cobb, Rafael Rumi, Antonio Salmeron (2013) , "Inventory management with log-normal demand per unit time" *Computers & Operations Research*, Volume 40, Issue 7.

- Euthemia Stavroulaki (2011) "Inventory decision for substitutable products with stock-dependent demand" *International Journal of Production Economics*, Volume 129, Issue 1, Pages 65-78.
  
- Anas M. Atieh, Hazem Kaylani, yourself Al-abdallat, Abeer Qaderi, Luma Ghoul, Lina Jaradat, Iman Hdairis (2016) "performance improvement of inventory management system processes by an Automated warehouse management system" *procedia CIRP*, volume 41, pages 568-572.
  
- Choong Heon Yang, Amelia C. Regan, In Su Kim (2014) "Estimating road management equipment inventory needs and associated purchase costs" *Transport Policy*, Volume 36, Pages 546-566
- Christopher S. Jones, Selale Tuze (2013) "inventory investment and the cost of capital" *Journal of Finance Economics*, Volume 107, Issue 3, Pages 557-579.
  
- David J. Robb, Fei Liu, Richard Lai, Z. Justin Ren (2012) "Inventory in mainland chain: Historical, Industry, and Geographic perspectives" *International Journal of Production Economics*, Volume 135, Issue 1, Pages 440-450
  
- De Felice, D. Falcone, A. Silvestri (2014) "Inventory management using both quantitative and qualitative criteria in manufacturing system" *IFAC Proceedings Volumes*, Volume 47, Issue 3, Pages 8048-8053
  
- Gozdem Dural-Selcuk, Mustafa Cimen (2013) "Optimal Lot Sizing with Approach for Investment System with Constant Demand" *IFAC Proceedings Volumes*, Volume 46, Issue 9, Pages 1997-2002
  
- Mitchell A. Millstein, Liu Yang, Haitao Li (2014) "Optimizing ABC inventory grouping decisions" *International Journal of Production Economics*, Volume 148, Pages 71-80
  
- Yacine Rakik (2011) "Inventory inaccuracies in the wholesale supply chain" *International Journal of Production Economics*, Volume 133, Issue 1, Pages 172-181.

**WEBSITE:**

<http://www.investopedia.com>

<http://www.myaccountingcourse.com>

<http://www.accountingcoach.com>

[en.wikipedia.org](http://en.wikipedia.org)

<http://www.heromotocorp.com>