CHAPTER - I

INTRODUCTION AND DESIGN OF THE STUDY

“The efficacy or otherwise of our industries depends on how well the inventories are managed”

- Smt. Indira Gandhi

Public enterprises are chosen vehicles of economic development and social change. Public sector enterprises in India have grown in number as well as in geographical area. The industries covered by the public sector have spread from heavy goods manufacturing to manufacturing and marketing of even consumer goods. One of the main objects of enlargement of public sector undertakings has been to accelerate the rate of economic development through industrial growth. In spite of the expanding role of public enterprises in the economic and social development of the country, there is a growing concern about their poor performance. In India, concern about Central Public Enterprises engaged in manufacturing has often been expressed in terms of financial loss.

In 1975-76, 23 public enterprises incurred cash losses amounted to ` 34 crores. In 1981-82, 73 units incurred cash losses amounting to ` 554 crores. Thus over a period of seven years for an increase of 217% in the number of public sector units incurring cash losses, there was 1529% increase in size of cash losses incurred by them1. In 2008-09, 54 public enterprises incurred cash losses amounting to ` 14,424 crores. Thus over a period of 27 years there was 2504% increase in size of cash losses incurred by public enterprises2.

As finance is readily available from the government, management of public enterprises by and large pay scant regard to the proper and effective utilization of funds. In short, poor financial management is responsible for unsatisfactory return on investment in public enterprises. Inventory management and financial management are directly related to each other. It has been correctly observed “Good inventory management is good financial management”3. Most of the companies are forced out of the business due to poor inventory management. The amount invested in inventories acts as the basis for determination of
many economic trends and making various forecasts. Inventories often constitute a major element of the total working capital. In public sector organizations a large portion of working capital is locked up in inventories. The study conducted by RBI reveals that investment in inventories constitutes 37.2% of total assets, 59% of current assets and 90% of total working capital requirements. Thus a substantial amount of scarce capital gets locked up in inventories resulting in various visible and invisible effects on performance. It is very essential to reduce the amount of capital locked up in inventories. The objective of inventory management is not necessarily to squeeze down inventories but to determine and attempt to hold it at optimum levels. A well planned inventory scheme helps in efficient, smooth and effective service to customers at a lesser cost.

INVENTORY

The term ‘inventory’ refers to the stockpile of the products a firm is offering for sale and various components that make up these products. “Inventory is nothing but a stock of goods that we maintain to facilitate the continuous production of goods and services.” According to Monks, “An inventory is an idle resource that possesses economic value.” In financial parlance, inventory is defined as the sum of the value of raw materials, fuels and lubricants, spare parts, maintenance consumable, semi processed materials and finished goods stock at any point of time. As defined by the Accounting Principle Board, “the term inventory means the aggregate of those items of tangible personal property which are (i) held for sale in the ordinary course of business (ii) in process of production for such sale (iii) to be currently consumed in the production of goods or services to be available for sale.”

Types of Inventories

Generally, inventories can be grouped under four classifications (i) Raw Materials (2) work in Process (3) Finished Goods (4) MRO Goods.

Raw Materials

Raw Materials are inventory items that are used in the manufacturer’s conversion process to produce components, sub-assemblies or finished products.
**Work in Process**

It is made up of all the materials, parts, components, assemblies, and sub-assemblies that are being processed or are waiting to be processed within the system.

**Finished Goods**

A finished good is a completed part that is ready for a customer order/use.

**MRO Goods**

Maintenance, Repair and Operating supplies or MRO goods are items that are used to support and maintain the production process and its infrastructure.

**Functions of Inventories**

Inventories serve as lubrication and spring for production-distribution system. The following are the important functions of inventories.

1. Gear up production
2. Force consumption to adapt itself to the necessities of production.
3. Activise the market.
4. Help in utilising the existing skilled labour and help in making a utilisation plan for future.
5. Strike a balance between the objectives of the stores department and those of the enterprises as a whole.
6. Act as an insurance against errors in demand forecast.

**Need to hold Inventories**

The question of managing inventory arises only when the company holds inventories. Companies hold inventories because of three motives namely transaction motive, precautionary motive and speculative motive.

- Transaction motive emphasizes the need to maintain inventories to facilitate smooth production and sales operations.
- Precautionary motive necessitates holding of inventories to guard against the risk of unpredictable changes in demand and supply forces.
- Speculative motive influences the decision to increase or reduce inventory levels to take advantage of price fluctuations.
**Cost of holding Inventory**

The costs relating to holding inventory are:

(i) **Ordering costs:** These include the variable costs associated with placing an order for goods. The fewer the orders the lower will be the ordering costs for the company.

(ii) **Carrying costs:** These include storage cost, insurance cost, spoilage costs, salaries of stores staff, obsolescence, cost of funds tied up in inventories.

(iii) **Cost of understocking:** It is the cost incurred when an item is out of stock. It includes the cost of lost production during the period of stock out and the extra cost per unit which might have to be paid for an emergency purchase.

(iv) **Cost of overstocking:** It is basically the opportunity cost arising out of the investment in inventory for a longer period than necessary. The holding of surplus and slow moving inventories involves extra cost. Inventory carrying cost alone is estimated to be between 10 and 20% in India, while interest payable on money borrowed from banks for obtaining inventories is around 18%.

**INVENTORY MANAGEMENT**

Inventory management plays a crucial role in the economic operation of an enterprise. Inventory management is the sum total of all activities necessary for the acquisition, storage, sale, disposal or use of materials. Inventory management is the technique of controlling the purchase, use and transformation of materials in an optimal manner. The management of inventory requires careful planning so that both the excess and shortage of inventory in relation to the operational requirements of an undertaking are avoided. Inventory management may be defined as ‘the branch of business management concerned with the development of policies to which the firm’s inventory is meant to conform’. Inventory management is more important because inventory cost is the only area which can afford an easy scope for cost reduction and cost control.

Inventory management in the public enterprises is very important because it sets policies and establishes guidelines to ensure efficient and scientific inventory control and it is said “uncontrolled inventory-the industrial cancer, is as dangerous as if not more than, cancer in the human body”.
SIGNIFICANCE OF INVENTORY MANAGEMENT

Inventory forms an important part of current assets of any organization. The Return on Investment depends on the utilization of inventories.

\[
\text{ROI} = \frac{\text{Profit}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Fixed Assets} + \text{Current Assets}}
\]

Fixed assets constitute capital already sunk and the only scope for improving the Return on Investment therefore, is the efficient management of inventory which constitutes the bulk of current assets.

Inventories are also the subject of reduction efforts because they are a critical variable in the firm’s return on investment. The following hypothetical example illustrates the reason why minimized inventory investment is one of the major goals of top, middle and lower management.

Impact of Inventories

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Firm A (($))</th>
<th>Firm B (($))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>350</td>
<td>300</td>
</tr>
<tr>
<td>Inventories</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td>Other assets</td>
<td>1550</td>
<td>1575</td>
</tr>
<tr>
<td>Total assets</td>
<td>2000</td>
<td>2275</td>
</tr>
<tr>
<td>Revenues</td>
<td>1200</td>
<td>1200</td>
</tr>
<tr>
<td>Cost of goods sold</td>
<td>(500)</td>
<td>(500)</td>
</tr>
<tr>
<td>Operating expenses</td>
<td>(250)</td>
<td>(300)</td>
</tr>
<tr>
<td>Profit</td>
<td>450</td>
<td>400</td>
</tr>
<tr>
<td>Interest</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>Profit after tax and interest</td>
<td>225</td>
<td>175</td>
</tr>
</tbody>
</table>

Firm ‘A’ and ‘B’ have equal sales. Firm ‘A’ keeps its inventory at very low level. Firm ‘B’ has a higher inventory level. The inventory turnover ratio for firm ‘A’ is 5 times (500/100) and firm ‘B’ is 1.2 times (500/400). Firm ‘A’ requires less warehouse space. Firm ‘A’ can finance its assets out of short term cash flow, while firm ‘B’ must often borrow funds in order to cover inventory purchases and holdings. Firm A’s profit is higher due to low interest charges and operating expenses of a smaller ware house. Firm ‘A’ will experience less risk in inventory holding. Firm ‘A’ has higher return on investment
(profit/Assets) 11.25% vs. firm ‘B’ with 7.7%. This occurs from the double impact of higher profits in the numerator and lower assets in the denominator. Thus the importance of inventory management is to strike a balance between the operating efficiency and cost of investment associated with larger inventories with the object of keeping the basic conflicts at minimum level while optimizing the inventory holding.

OBJECTIVES OF INVENTORY MANAGEMENT

There are three main objectives of inventory management:

i) **Provide the desired level of customer service**
   Customer service refers to the company’s ability to satisfy the needs of its customers. The level of customer service is measured through percentage of orders that are shipped on schedule, percentage of line items that are shipped on schedule and the idle time due to material and component shortage.

ii) **Achieve cost-efficient operations**
   Inventories can provide a buffer between operations so that each phase of the transformation process can continue to operate even when output rates differ. By building large production of lots of items, companies are able to spread some fixed costs over a large number of units, thereby decreasing the unit cost of each item. Large purchases of inventory might qualify for quantity discounts which will also reduce the unit cost of each item.

iii) **Minimize inventory investment**
   As a company achieves lower amounts of money tied up in inventory, the company’s overall cost structure will improve, as well as its profitability. When a company aims at minimizing its investment in the form of inventories, it considers the fact that maintaining inventory involves cost. So the objectives of inventory management should always attempt to balance between too much inventory and too little inventory. The objective of inventory management should be to determine and maintain the optimum level of inventory. The optimum level of inventory will be between the two danger points of excessive and inadequate inventories. The phrase optimal signifies that the productivity is not sacrificed in controlling the volume of inventory.
SUCCESSFUL INVENTORY MANAGEMENT

Successful inventory management involves balancing the costs of inventory with the benefits of inventory. The costs associated with inventories not only include direct cost of storage, insurance and taxes but also the cost of money tied up in inventory. Apart from keeping adequate inventory, the success of inventory management depends on

- Maintaining a wide assortment of stock – but not spreading the rapidly moving ones too thin.
- Increasing inventory turnover – but not sacrificing the inventory level.
- Keeping stock low – but not sacrificing service or performance.
- Obtaining lower prices by making volume purchases but not ending up with slow moving inventory.
- Having an adequate inventory on hand but not getting caught with obsolete items.

The inventory management policy of the public sector enterprises has direct influence on profitability and risk. The liquidity can be strengthened by increasing the level of investment in inventory. But increased liquidity through increased levels of inventory decreases its returns because more funds will be tied up in current assets than are absolutely necessary. To raise the rate of return, the liquidity will have to be sacrificed by reducing the level of investment in inventories to the minimum. Thus inventory management of the public sector involves risk-return trade-off. Poor inventory management can present a serious challenge in the validity of an organization and can sometimes have disastrous effect on the solvency.

STATEMENT OF THE PROBLEM

Industrial economy of India consists of both public and private sectors. Public sector undertakings are mainly engaged in production of steel and various types of machines. The performance of public sector undertakings have been subjected to close scrutiny because they contribute more towards social and economic development.

Generally public sector undertakings are interested in supplying quality products at reasonable price and thereby earn profit atleast equal to the nominal rate of return on huge capital invested. There is a sizable gap between the profit rates expected and the rates actually realized. Different financial and other factors would have caused such a situation.
One basic financial factor that should not be ignored in this context is inventory management. Due to cut-throat competition, prices of finished goods are falling down, while prices of raw materials and components to make these goods are alarmingly on the increasing side. So they are forced to invest more in inventories for smooth and uninterrupted production. Apart from raw material inventory, the spare parts for critical equipment are kept in stock to meet emergency situation. These investments involve more holding cost which affects the profitability of public sector undertakings.

Inventory constitutes a major portion of current assets in public sector undertakings. The profitability depends upon the turnover of working capital that in turn depends to a large extent upon the turnover of inventory. If the inventory turnover is lower in public sector undertakings, it would result in lower profit or sometimes even in loss.

The study therefore focuses on the problems of what level of inventories do enterprises really need, when should the inventory be replenished, when to place order, determination of optimum inventory level and the degree of control that is required for the best results and planning for the inventory control in the organizations.

Proper management of inventory not only solves the problem of liquidity but also increases profitability. So the establishment of an efficient and effective inventory management system is not less important than any other aspect of public enterprises.

**REVIEW OF LITERATURE**

Inventory is the lifeblood of the manufacturing industries. Inventories are a major asset and represent sizable investment in business that sells or manufactures products. To achieve higher operational efficiency and profitability of an organization, it is very essential to reduce the amount of capital locked up in inventories. However the importance of inventory management in an organization depends upon the extent of investment in inventory. A number of studies have been conducted to find out the determinants of investment in inventories. Different authors have analysed inventory management in different perspectives. A brief review of various studies in the field is summarized in the following paragraphs:
Review of Articles

Wahi.A stressed the need to re-orient the organization of material management function with due emphasis on linkage between material planning and production planning rather than between material planning in purchase\textsuperscript{11}.

Bunga.Lt.Gen emphasized the importance for material handling and he identifies material handling as a key result area and discussed its potential\textsuperscript{12}.

An article on “Materials Management and Purchasing” by Zenz and Gary. J established that material management centralizes the responsibility for moving materials into and through the organization and usually included several activities like purchasing, production control and inventory control. Purchasing when placed under materials management helped to minimize materials costs and increased the organization’s profit and served as a good training ground for materials management executives\textsuperscript{13}.

Ramalingam.P opined that inventories represent the largest current asset for many organizations, but mismanaged inventory would be a liability for the smooth functioning and growth of a company. Therefore inventory control is vital. Any well-planned inventory control system must (i) enable the company to instal and operate the system at a reasonable cost (ii) facilitate the development and implementation of the system in a short-time frame (iii) provide flexibility and adaptability with respect to changing conditions (iv) facilitate measurement of performance and controlling of operations. The benefits from an effectively managed inventory function include reduction of capital investment in inventories and increased plant efficiency\textsuperscript{14}.

Doll Robert.E’s article emphasized the need for Inventory Evaluation and Review Technique to develop managerial competence in inventory control. In the study, as a first step the existing inventory control system was examined. A functional review on an item-by-item basis was then performed followed by replenishment strategy for each active inventory item along with a disposal strategy for item which was obsolete or in excess of need\textsuperscript{15}.

Varadarajan.A in his article explained the need for and the benefit from forecasting the application of exponential smoothing models in inventory control. He identified the
forecasting systems and the criteria in choosing techniques. The relative advantage of exponential smoothing models as well as the importance of measuring forecast errors and using them in determining inventory levels have been explained by him\textsuperscript{16}.

Ghosh.S.C in his article discussed the need for the management of spare parts inventory. Even though inventory of spare parts was quite small, blockage of funds in non-moving stock and loss due to obsolescence are often found to be quite substantial. He concluded that standardization, cataloguing, codification, disposal of obsolete spares are some of the ways to reduce overstocking of spare parts\textsuperscript{17}.

Toelle-etal identified forecasting errors, inventory record inaccuracies, inadequate planning, variable lead times, obsolescence and master schedule smoothing as the causes of excess inventory. Any item not effectively serving as working stock, safety stock, was excess inventory\textsuperscript{18}.

White R. Douglas in his article explained how to control slow moving items in an organization. Slow moving items called sludge is generated by almost all companies. Sludge can be removed by a combination of 6 generic actions. (1) changing the price (2) intensifying the sale effort (3) selling as a different product (4) selling through different channel (5) selling to different market (6) changing the product\textsuperscript{19}.

Priya Ranjan Chaudhuri has stated that the basic responsibility of the purchasing department is to provide for smooth flow of materials at the lowest ultimate cost from the right sources, so that production schedule can be effectively managed. She also states that the efficiency of purchasing function can be assessed by judging reliability and financial stability of the suppliers\textsuperscript{20}.

Marseata Lockhart and Lawrence Etitkin have emphasized the need for certified supplier. The certified supplier is a business associate whose products arrive on time, in good physical condition, in the right quantity and are offered at a fair price. They have emphasized the need for trust, co-operation, open communication with a goal of long term commitment between buyer and vendor. The partners of vendor certification can realize
the benefits of reduced inventories, less waste, shorter lead time, improved supplier relations, better quality and increased productivity\textsuperscript{21}.

Anthony Inman.R opined that in production planning, uncertainty is a problem for inventory control. Difficulty in planning as a result of uncertainty may lead to higher safety stock levels. Added to this, disassembly, reuse, recycling, repair work and remanufacturing can also create unique problems for those responsible for inventory control\textsuperscript{22}.

Shad Dowlatshai in his article reviewed two approaches to buyer supplier relationships by comparing traditional relationships with co-operative relationships. The two approaches were evaluated and a hybrid approach with the advantages of traditional as well as co-operative systems has been advocated. He opined that the balanced approach would increase business opportunities and distribute bargaining power and risks between the buyer and seller more effectively and equitably\textsuperscript{23}.

**Review of Studies**

1. **Purchase, Storage and Issue of Materials.**

   Bazle Karim and Bahadur have made a study of ‘Spare Parts Management in Public Enterprises’. They have spotlighted the missing links in spare parts management and offered suggestions for improving efficiency in spare parts management\textsuperscript{24}.

   Carter et.al conducted a study on the performance of 300 US purchasing personnel. The study revealed that the purchasing department must develop explicit purchasing/supply management goals and strategies. The study concluded that purchasing performance should be enhanced through a formal performance appraisal system linked to rewards and recognitions, training for purchasing professional to enable them to exercise initiative, encourage them to take risk without any fear of punishment and to develop creative approaches to achieve total quality management goals\textsuperscript{25}.

   Basu.P in his study made an attempt to examine the ways of reducing the cost of purchasing function. He concluded that to produce quality products and maintain delivery schedule, production department must get support from purchase department through
production control department. The purchase officer should have a sound knowledge of
the market and share it with marketing and engineering departments. He should be the
coordinator between vendor and designer with an ultimate goal of reducing cost\textsuperscript{26}.

Renganathan.J in his study discussed the problem of improper management of
stores in a private company in Thailand. He concluded that simple, efficient store
accounting system, online data entry by users, flexible and efficient stores accounting
software and perpetual physical verification are some of the measures to develop efficient
stores management\textsuperscript{27}.

2. Inventory Control and Techniques

Lal examined the inventory problems of Modi Steel. He pointed out that the
current practice in inventory management is that the price variable is not taken into
account in inventory decision making and all the existing inventory models are based on
this practice. He concluded that a well worked out inventory policy must take care of
number of variables both indigenous and exogenous and help management to decide the
largest economic order quantity at the most appropriate time\textsuperscript{28}.

Reid Robert.A et.al conducted a study on inventory cost determination in the
public sector organizations. The study revealed that half of the stores labour costs were
associated with ordering cost component which in turn was dominated by the task of
contract negotiation. Salary expenses were the major factor in the total costs for both the
ordering and operation component\textsuperscript{29}.

Goonatilake.P.C.L carried out a study on inventory problems in developing
nations. The study revealed that due to heavy dependence on imported raw materials and
parts and the endemic bureaucratic delays and related communication problems in
developing nations, order lead times could not be calculated with any degree of accuracy.
The higher buffer stocks thus carried by manufacturers resulted in high inventory cost\textsuperscript{30}.

Silver and Allan conducted a study to increase the inventory turnover. They
illustrated ‘distribution of sales and inventory by value report’- an ABC inventory
management strategy. ‘A’ items were ordered with a relatively low level of safety stock,
‘B’ & ‘C’ items were ordered more. As a result, the cost of acquisition was reduced with a slight increase in carrying cost. Customer service was also improved by maintaining a higher level of safety stock for “B” & “C” items. The results revealed an improved inventory turnover rates, reduced backorder and reduced number of line items issued on stock purchase orders31.

In a study conducted by Flora et.al in controlling work in process inventory for steel maker, a lead time model was presented based on the concept of input-output control. Assuming that the input equals the output, the amount of inventory in process was directly related to the manufacturing lead times. The model called for four calculations to determine the inventory level. They are i) define all possible product flows through a plant ii) determine how long a product takes to go through each step. iii) calculate the yielded production requirements iv) calculate in process inventory. Then the ratio between work in process inventory and the other components of inventory were calculated. The sum of work in process inventory multiplied by each ratio was the target inventory level32.

Swamy’s study on “Materials Management in Public Undertakings” comprises the case studies of five centrally owned public enterprises in Rajasthan. The study revealed that inventory represented more than 61% of total current assets and during the study period inventories stood more than 100% of the networking capital of the undertakings taken together. The rate of growth of inventory was very high. He concluded that existing system of materials management in selected public undertakings was not satisfactory and needed improvements in all directions without delay33.

Clendenen and Garywayne conducted a study on restoration based model for material management in a global manufacturing environment. The objective of this research was to explore the importance of control strategy of material management in global manufacturing networks. The relationship between decision variables and holding cost, labour costs and demand variation were explored using the simulation technique of batch means. The results indicated that a control strategy very similar to base stock was more appropriate for specific network studies34.
Agarwal B.D. in his study on Material Management in Textile Industry analysed material management procedures regarding procurement management, inventory management, stores management, material handling and disposal management. The study revealed that important techniques of operation research such as quality control, linear programming, value analysis, waiting line theory etc must be used so that unit cost of production and distribution could be minimized\textsuperscript{35}.

Buche Reddy P and Krishna Reddy B. examined the inventory techniques adopted in a transport organization. The objective of the study was to identify the trends in using ABC, VED and FNS items. As the time changes, the number of items in either FNS or VED groups is increasing in comparison with ABC. This is because of technological and economic changes and the increased use of fleet vehicle for longer distances and long duration\textsuperscript{36}.

The study by Hirsch and Albert A. analysed the inventory sales ratio which showed a clear evidence of increased long run efficiency for some components. In addition, three other potential avenues of improved inventory management were investigated i) Greater cyclical flexibility ii) Faster adjustment to meet desired levels iii) Diminished buffer stock behaviour. Substantial evidence for improved long run efficiency was largely confirmed to materials and work in process inventories in certain manufacturing industries\textsuperscript{37}.

Kit Faipun and Wong K.H. conducted a study in MAVA, a subsidiary of multinational companies to implement an integrated JIT/MRP approach to improve the existing production system. It was found that MRP push elements (e.g materials, capacity and business planning) could bring the sales forecasts into detailed production schedules and materials requirements, while JIT pull elements (e.g single sourcing, kanban system) could be injected to tackle dynamic inventory problems and improve the efficiency of the system. He concluded that it was advantageous to integrate dynamic features of JIT into the discipline of MRP to close the loop between shop floor and use in medium, and long term planning process\textsuperscript{38}.

Roger C. Vergin in his study “An Examination of Inventory Turnover in the Fortune of 500 Industrial Companies in United States” examined the changes in inventory
turnover ratios and how turnover patterns varied by factors such as industry, size of firm, and the effectiveness of previous inventory management. In addition, the effect of inventory changes on earning was examined. He concluded that inventory turnover ratios had increased by an average of 14.7% during the study period 1986-95. But this study failed to find a direct link of improved inventory turnover to profits\textsuperscript{39}.

Rabiul Alam and Syed Zabin Hussain in their study made an attempt to examine the inventory management scenario with particular reference to impact of working capital in ship building industry in Bangladesh. The results of the study showed that inventory in terms of months’ cost of production showed over investment in inventory. Such overstocking would have adversely affected profitability of Khulna Shipyard Limited (KSL) during the period under review. They suggested gradual reduction of investment in the volume of inventory and improvement in the quality of sales. Sales drive to improve inventory turnover and cash flows, reduction of cost of sales by increasing capacity utilisation, reduction of overhead expenditure were the measures suggested to improve inventory management of KSL\textsuperscript{40}.

Parmar in his study made an attempt to evaluate the performance with respect to inventory management in two selected units - Gujarat State Fertilizer Company Limited (GSFC) and Gujarat Narmada valley Fertiliser Company Limited (GNFC). The study revealed that the overall performance regarding inventory management at GNFC was better in terms of efficient utilization of inventories whereas GSFC was not able to do so during the study period. The results of the study concluded that the overall performance of GNFC was encouraging while that of GSFC was not alarming\textsuperscript{41}.

Sudarshan examined the status of inventory holding in chemicals and pharmaceutical Central Public Enterprises. The analysis revealed the need for reduction in the enterprises inventory holdings in terms of number of days of consumption, cost of production and cost of sales in order to improve their working capital efficiency. The study suggested that the proper control over inventories would improve the operational efficiency and profitability of the enterprise\textsuperscript{42}. 


Sudipta Ghosh in his study evaluated the performance of Stewarks and Lloyds of India Limited. The results of the study showed the overall performance of the company regarding inventory management is satisfactory in terms of efficient utilization of inventories during the period of study. The study suggested that to have an efficient inventory management, a proper balance between excessive and inadequate inventories should be maintained for smooth operation of the business.\textsuperscript{43}

Sukhdev Singh in his study made an attempt to examine inventory control practices in Indian Farmers Fertiliser Co-operative Limited by using various financial ratios. The study revealed that correlation was significant in the case of all the components of inventory except stores and spares. The growth rate of stock of raw material, work-in-process, finished goods and total inventory were more than the ideal situation and provided clues for improvements. According to the researcher the stock of stores and spares required immediate attention of management in order to stop ruthless purchases.\textsuperscript{44}

Pradeep Singh in his study made an attempt to examine the inventory and working capital management of Indian Farmers Fertilizer Co-operative Limited (IFFCO) and National Fertiliser Limited (NFL). He concluded that inventory was not properly maintained by IFFCO whereas the management of NFL had tried to properly utilize and maintain the inventory as per the requirements, so that liquidity would not be interrupted.\textsuperscript{45}

Mukhopadhyay.D in his study examined the benefits of JIT practice in Maruti Udyog and cycle manufacturing factories in Ludhiana. He concluded that they have received benefits to the extent of 25\% to 55\% reduction in cost of quality, 30\% to 65\% reduction in raw material stock, 40\% to 75\% decrease in storage space requirement, 15\% reduction in process lead time. He also added that the success depended on the attitude and policy of top management.\textsuperscript{46}

**SCOPE OF THE STUDY**

Inventory management is of special importance to both public and private sectors. But the share of inventory in total current investment is the highest in public enterprises. The study of inventory management covers two Central Public Enterprises in Salem namely Salem Steel Plant (SSP) and Burn Standard Company Limited (BSCL). Both the
units are significant in the sense that they diversify their product portfolio in new areas. SSP promotes the use of Stainless Steel in new areas namely coinage, railway coaches, furniture, automobiles etc. BSCL promotes the use of bricks to new areas namely cement and glass sector. Salem has one of the largest magnesite deposits in India, which is the major raw material to manufacture bricks.

The study relates to the period from 1999-2000 to 2008-2009. The period is significant in the sense that the Central Public Enterprises in Salem were running at a loss or earning lower profits. The study therefore focuses on how effective management of inventory would help Central Public Enterprises to earn high profits.

**OBJECTIVES**

1. To analyse the existing procedure, methods of purchase and management of stores of Central Public Enterprises in Salem
2. To analyse the impact of i) non-moving items on the stores inventory ii) inventory on output and sales.
3. To examine the trends in inventory – turnover/outputs ratios component wise i.e., raw material, goods in process, finished goods and also changes in the composition of total inventory.
4. To study the behaviour of raw material inventory vis-à-vis consumption over a period of time.
5. To examine the liquidity of public sector undertakings pertaining to inventory.
6. To suggest measures based on the findings of the study for the improvement of existing inventory control techniques practised in Central Public Enterprises in Salem.

**HYPOTHESES**

1. The value of raw material and stores consumed have no direct relationship to the value of sales.
2. Production cycle duration is not significantly related to volume of work in process.
3. Inventory to current assets and total assets do not indicate the liquidity of an enterprise.
4. Inventory turnover has no direct relationship with profit earning capacity of an enterprise.
5. There is no significant growth in the indices during the study period.
OPERATIONAL DEFINITIONS

Integrated Materials Management

It is one wherein the material manager is responsible for exercising control and co-ordinating all interrelated functions namely planning, purchasing, receiving, stores inventory control, scrap and surplus disposal to ensure proper balance of the conflicting objectives of the individual functions.

Inventory Control

The process whereby the investment in materials and parts carried in stock is regulated within predetermined limits set in accordance with inventory policy established by the management.

Material control Vs Inventory Control

Material control covers all activities relating to planning, procuring, receiving, storing and issuing whereas inventory control covers the process of regulating the investment in materials carried in stock within predetermined limit.

Lead Time

It is the time taken for replenishment from the time a requisition is submitted to stores or purchase department to the time the material is received at the stores or using point.

Replenishment of Materials

Materials in a store move in and out automatically and hence the issue stock has to be replaced by fresh arrivals for achieving the desired aim of the organization. This is termed as replenishment of materials.

Buffer Stock or Minimum Level

This is the level at which any further demands will necessitate withdrawals from the buffer or reserve stock. Buffer stock is the insurance stock carried to meet exceptional conditions of demand or delivery.
Maximum Stock Level

It is the level above which the stock should not be permitted to rise. For classification of “B” and “C” materials this level is set by the inventory controller and for ‘A’ materials it should be subject to management policy.

Reorder Level

It is the level at which the order has to be placed. This is the vital stock level at which the requisitions are made out for further supplies.

Insurance Spares

Spares for critical equipment though having very slow movement may have to be kept in stock to meet emergency situation.

Material Requirement Planning (MRP)

MRP takes the output from the master schedule, combines that with information from inventory records and product structure records and determines a schedule of timing and quantities of each item. The basic idea is to get the right materials to the right place at the right time.

Enterprise Resource Planning (ERP)

It is a business management system which integrates multifarious functions of an organization. Organisations today use ERPs to bring various departments on to the same platform. It can reduce cycle times, reduce inventory, improve resource utilization, improve customer response, utilize information effectively and in turn improve profitability.

JIT

Just in time is a philosophy and not a technique. The philosophy aims at preventing all kinds of wastes. Business concerns are giving maximum attention in reducing stock levels by establishing cordial relationship with suppliers to arrange for frequent delivery of quantities. The true spirit of JIT philosophy is “produce when sell and procure when produce”.

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**Activity Based Costing (ABC)**

ABC is a detailed costing technique based on the work flow to assign the soft costs. The ABC approach calls for mapping of a company’s entire work flow and process so that each activity that contributes to costs is identified and traced. Analysis of activity leads to an activity based costing business model from which management can make decisions to improve the effectiveness of the organization.

**METHODOLOGY**

a) **Sources of Data**

The study is mainly based on secondary data. Published annual reports of Central Public Enterprises in Salem for the relevant periods have been used extensively. Apart from the published reports, principles, practices and techniques of inventory management have been collected through interviews with the executives. Moreover a good number of articles published in journals like “The Management Accountant”, “Materials Management”, “Production and Inventory Management” and many financial magazines were also referred for a conceptual background.

b) **Tools of Analysis**

In the course of analysis, network analysis has been applied to find out the time lag involved between time prescribed and the actual time taken for purchase activity. Accounting techniques include ratio analysis, while among statistical techniques, the arithmetic mean ($\bar{x}$), Co-efficient of Variation (CV), Annual Growth rate (AGR), Compounded Annual Growth rate (CAGR), Linear Annual Growth Rate (LAGR), trend indices, simple growth rate, correlation co-efficient (r), ‘t’ test and linear regression models have been applied. In addition multiple correlation and multiple regression have been applied using inventory related ratios as variables to find out impact of inventory on profitability.

**Ratio Analysis**

Ratio analysis is regarded as one of the best tools in analysing and comparing the time series accounting data of Central Public Sector Enterprises in Salem. Various ratios are computed to analyse the efficiency of inventory control techniques practised, determine the inventory holding period, examine liquidity and profitability position of public sector undertakings.
The following formulae have been used in the study.

1. Inventory to current assets Ratio = \( \frac{\text{Inventory}}{\text{Current assets}} \times 100 \)

2. Inventory to total assets Ratio = \( \frac{\text{Inventory}}{\text{Total Assets}} \times 100 \)

3. Inventory to working capital = \( \frac{\text{Inventory}}{\text{Networking capital}} \times 100 \)

4. Cost of production to Average Inventory (in times) = \( \frac{\text{Cost of Production}}{\text{Average Inventory}} \)

5. Inventory turnover Ratio (in times) = \( \frac{\text{Sales}}{\text{Average Inventory}} \)

6. Cost of goods sold to Average Inventory (in times) = \( \frac{\text{Cost of goodssold}}{\text{Average Inventory}} \)

7. Stores and spares consumed as % of Cost of production

\[ \frac{\text{Stores and spares consumed}}{\text{Cost of production}} \times 100 \]

8. Inventory in terms of months’ Cost of production (in months)

\[ = \frac{12 \text{ months}}{\frac{\text{Cost of production}}{\text{Average Inventory}}} \]

(or)

\[ = \frac{\text{Average Inventory}}{\text{Cost of production}} \times 12 \text{ months} \]

9. Raw material inventory in terms of months’ value of raw material consumption (in months)

\[ = \frac{12 \text{ months}}{\frac{\text{Raw materials consumed}}{\text{Raw material inventory}}} \]

(or)

\[ \frac{\text{Raw material inventory}}{\text{Raw material consumed}} \times 12 \text{ months} \]

10. Work in process inventory in terms of months’ value of production

\[ = \frac{12 \text{ months}}{\frac{\text{Value of production}}{\text{Work in process inventory}}} \]

(or)

\[ = \frac{\text{Work in process inventory}}{\text{Value of production}} \times 12 \text{ months} \]
11. Stores and spares inventory in terms of months’ value of stores and spares consumed
\[ \text{inventory} = \frac{12 \text{ months}}{\text{Stores and spares consumed}} \times \text{Stores & spares inventory} \]
(or)
\[ = \frac{\text{Stores and spares Inventory}}{\text{Stores and spares consumed}} \times 12 \text{ months} \]

12. Finished goods inventory in terms of months’ values of sales
\[ = \frac{12 \text{ months}}{\text{Sales}} \times \text{Finished goods inventory} \]
(or)
\[ = \frac{\text{Finished goods Inventory}}{\text{Sales}} \times 12 \text{ months} \]

13. Work in process Index
\[ = \frac{\text{Average work in process}}{\text{Total production value annually}} \]

14. Spare parts turnover Index
\[ = \frac{\text{Spare parts consumed}}{\text{Spare parts inventory}} \]

15. Obsolescence Index
\[ = \frac{\text{Value of non-moving items}}{\text{Total inventory value}} \]

**Statistical Techniques**

i) Descriptive statistics namely \( \bar{x}, CV \) were used to describe the nature and distribution of the data.

\[ \bar{x} = \frac{\sum x}{N} \]
\[ \bar{x} = \text{Arithmetic mean} \]
\[ \sum x = \text{Sum of variables, } N = \text{Number of observation} \]
\[ CV = \frac{\sigma}{\bar{x}} \times 100 \]
\[ CV = \text{Co-efficient of Variation.} \]
\[ \sigma = \text{Standard deviation. } \bar{x} = \text{Mean.} \]

ii) Growth rates namely AGR, CAGR, and LAGR were used to measure the trend as well as rate of growth achieved during the study period.
Annual Growth Rate (AGR) is simply percent growth divided by N, the number of years.

\[
\text{AGR} = \frac{\text{Percent Growth}}{N}
\]

\[
\text{PR (Percent Rate)} = \frac{\text{Present Value} - \text{Past Value}}{\text{Past Value}} \times 100
\]

**Compounded Annual Growth Rate (CAGR)** is often used to describe the growth over a period of time.

\[
\text{CAGR}_{[t_0, t_n]} = \left( \frac{V(t_n)}{V(t_0)} \right)^{\frac{1}{t_n-t_0}} - 1
\]

\[
V(t_0) = \text{Start value} \quad V(t_n) = \text{Finish Value}
\]

\[
t_{n-t_0} = \text{Number of Years}
\]

Linear Annual Growth Rate (LAGR) is helpful in predicting future increase or decrease. Linear growth can be modeled in the algebraic expression \( y = mx + b \), where \( y \) is the final amount, \( m \) is the rate of linear growth, \( x \) is the time period and \( b \) is the original amount.

\[
\text{LAGR} = \frac{\text{Final Value} - \text{Original Value}}{\text{Time Period elapsed}}
\]

iii) Regression analysis was used to find the effect of one or more predictor variables on the dependent variable.

Three Models were developed.

Linear Model \( Y = a + bx \)

Non Linear Models \( Y = a + b \sqrt{x} \); \( Y = a + bx^2 \)

\( Y \) is the dependent variable (such as stores and spares inventory, current assets, total assets, working capital, raw materials consumed, stores and spares consumed, liquidity, profitability and growth indices), while \( X \) is the independent variable (such as non-moving items, inventory, sales, inventory to current assets, inventory to total assets, inventory turnover ratio etc). Correlation co-efficient \((r)\), co-efficient of determinations and ‘t’ test have been computed to ascertain the relationship between dependent and independent variable.
LIMITATIONS OF THE STUDY

There are some limitations of the study, which are generally inherent in all studies.

i) The study is based on secondary data obtained from the published annual reports and as such its finding depends entirely on the accuracy of such data.

ii) The published reports were supplemented by information gathered through discussion with the executives. The executives at the helm of affairs of Public Sector Enterprises in Salem are not able to spare much time due to busy schedule.

iii) The study is largely based on ratio analysis which has its own limitations.

iv) Statistical tests used to interpret the analysed data to generalize the findings of the study have got their own limitations and result in the analysis which is subject to some constraints as are applicable to statistical tools.

v) Since this study covers Central Public Enterprises in Salem, conclusions drawn cannot be generalized.

PLAN OF THE STUDY

The study has been divided into five chapters.

The first chapter “Introduction and Design of the Study” spells out the nature of problem, related research work, scope of the study, objectives, hypotheses, operational definition of concepts, methodology followed and chapter scheme of the study.

The second chapter “Profile of Central Public Enterprises in Salem”, highlights their origin, functional aspects plant, product mix, organization structure, growth and development, and SWOT analysis.

The third chapter ‘Inventory Management Practices in Central Public Enterprises, Salem’ examines the purchase procedure, methods of purchase, purchase analysis, stores management practices and issue procedure.

The fourth chapter ‘Inventory Control Techniques in Central Public Enterprises, Salem’ provides an assessment of composition, size, adequacy and growth of inventory in Central Public Enterprises in Salem. Further inventory control is tested through ratio analysis, inventory holding period, ABC analysis and other inventory control techniques. It also analyses the relationship between variables and impact of inventory ratios on profitability of Central Public Enterprises in Salem.

The fifth chapter ‘Findings, Suggestions and Conclusions’ offers some observations drawn from the study, suggestions and conclusion of the study.
End Notes

8. Accountant Research and Terminology Bulletin, Published by American Institute of Certified Published Accountants, Newyork, 1961, p.28.