Inventory Management in Corporate Firms: Reasons for and Techniques

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ABSTRACT

This paper aims at explaining and exposing the importance of inventory management in a corporate firm. In this work, the exposition of inventory as stock of various kinds such as raw materials, work in progress, maintenance, repairs and operating goods, finished goods and safety stocks incited the question of how and ways the inventories could be managed to achieve the optimal quantity and required profitability for engendering sustainable growth of the firm. In a bid to obtaining the optimal quantity, various costs associated with the inventory and the techniques of optimizing the quantity and minimizing the costs for effective management were elucidated. Thus, if the elucidated techniques are appropriately and religiously adopted, efficient inventory management and hence sustainable growth of the firms will be assured.

Keywords: Inventory management, inventory control, inventory costs, stock-outs, economic order quantity.

INTRODUCTION

Inventory can be defined as stock of goods which a company keeps with the view to using them for further production of goods or selling them as finally goods. Inventory can take the form of raw materials that a firm buys and turns into tangible goods or the bulk of products that can be transformed into constituent parts for sale separately and/or consumable finished tangible or intangible goods. Inventories are the less liquid types of current assets. They are the stock of product, a company is manufacturing for sale, the components that make up the products and the stock of work as it progresses. In the light of the importance of these stored assets, it becomes imperative that prudent and effective management be put in place so as to avert a run on the sustainability of firm's growth. Neglect of the efficient management of the inventories will have far reaching repercussions on the progress and thriving of the firm. Storing of the liquid assets is necessary and hence inevitable to firms. In a nut shell, firms' inventory can be described as the totality of stock of various kinds, such as:

- Raw materials
- Work in progress
- Maintenance, Repairs and Operating (MRO) goods
- Finished goods and
- Safety stock.

Raw materials: These are current assets required for the production of finished goods. They can take the form of primary goods, intermediate goods or finished goods. Adequate stock of raw materials assures a company of production materials. Also, the bulk purchase of it attracts quantity discount from the suppliers and permits a lesser per unit cost.

Work-in-progress is an inventory which consist of partly finished goods and materials, sub-assemblies and all items that are being presently processed in the manufacture of goods. The longer a firm's production cycle, the larger the firm's work-in-progress. The completion of work in progress transforms to stock of final goods.

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MRO Goods stands for maintenance, repairs and operating expenses. This is the inventory the firm uses for supporting the manufacturing process which is otherwise called the working process.

Finished goods or goods ready for sale. These are goods that reach the final consumer. They are otherwise goods made available to customers.

Safety stock: This is the additional inventory a firm keeps in store to bridge scarcity that might result owing to supply shortages or surges in demand. However, the kinds of inventories managed by firms will depend on the nature of the business the firm undertakes. A manufacturing firm will involve itself in the management of the enumerated kinds of inventories while a retail or wholesale firm involved in trading of tangible goods will only engaged in inventories of finished goods and precisely safety stock.

Inventory Management

The question of how the products stored could be managed so as to achieve sustainable growth of the firm is the concern of the inventory management.

Inventory management is therefore concerned with the keeping track of the company's stock of goods in a safe and sufficient manner for the purpose of replenishing products at the lowest possible cost to obviate supply shortages. Inventory management insures the supply of required quantity of homogeneous goods at the required time. It is sometimes used interchangeably with inventory control. However, inventory management is much more broader than inventory control. In any business outlay, inventory management system will have to be put in place before they drill down to control why inventory management is concerned with how to manage suppliers' production and sales or how to run the business, serve the customers and grow the sales, inventory control centers on how the stock currently in storage could be managed. Inventory control ensures that the stock be efficiently stored, the cost of inventory keeping be at least as moderate as possible while time spent in counting and controlling inventory should be made minimal.

Cost of Holding Inventories

The major goal of inventory management is to articulate the required inventories that can sustain the firm's operations at the lowest possible cost. In view of this, it becomes necessary to identify all the costs associated with the purchasing and maintenance of the inventory. Inventory holding, is a costly decision. In the event of inventory holding, the firm's working capital is seized up, the interest payment for a levered firm is a burden, storage cost is incurred whether the warehouse belongs to the firm or not, and there is also a risk of obsolescence or deterioration in the stock. Thus, besides the obvious buying costs, other major costs associated with inventory holdings are:

- Ordering (or replenishment) costs;
- Carrying (holding) costs; and
- Stock out costs

Ordering Costs

Ordering costs involve the costs of placing and receiving an order. These include transportation or shipping cost, clerical and administrative costs that are involved in the bought-in goods. If the goods are produced internally, ordering costs include production and set up cost or expense incurred in getting the plants and equipment ready for operation. These types of costs are generally called set-up costs.

Holding or Carrying Costs

Holding (or carrying) costs consists of all costs of holding items in inventory (which is also called tied up cost) for a given period of time. They are expressed in Naira per unit period. These costs include:

(i) Storage and handling costs which comprise the costs of staffing, equipment maintenance and handling;
(ii) Storage overhead, which include the costs of heat, light, rent and so on;
(iii) Insurance, security and pilferage. The stock is insured against losses due to theft, fire outbreak, or natural disaster; also included are property taxes.
(iv) Obsolescence and deterioration costs. Obsolescence represents the costs owing to decline in inventory value due to technological changes and hence of taste; while the cost due to deterioration is associated with the cost of goods owing to wear and tear.

Stock Out Costs

Stock out costs are associated with the cost of running out of stock. The stock are incurred because the business is unable to meet with the demand for its product within the given period of time. Such cost may be in the form of penalty, loss of goodwill, loss of sales, idle manpower and machines, loss of profits, etc. When a stock out occurs, the expense incurred in expediting actions to place a special order is the stock out cost. In work-in-progress, inventory, cost of holding and speeding production are involved.

Reasons for Inventory Management

Management of inventories involves some costs as enumerated, yet inventories are held for the following reasons:

- To ensure that enough goods are available to meet anticipated demand. Then lack of this causes a stock out cost which may lead the business to fall apart. Since all goods produced at any time period are likely not to be demanded at the same time, excess of what is produced and supplied could be stored not without cost which invariably will cut into the producer's margin. Even if all the goods produced is demanded at the same time, it is necessary for the producer to have some reserves which will be kept aside to meet the demand upsurge in case contingency warrants that. The reserve set aside will attract some cost of housing and keeping it safe. Apart from storing the final goods, the raw materials need to be stored because at any point the raw materials runs out suddenly, production will suddenly and entirely cease unless the lead time is cut short, this could be disruptive to the flow of the business.
- It is necessary to count stock for the purpose of tracking what is in the store but where this is manually done, it constitutes a hard nut to crack counting some goods. This of course calls for a well designed management style in place, for the enumeration of the accurate number of goods in stock. By determining the exact number of inventories in the warehouse, inventory is factored into the cash flow management as the number not only determines how much that could be sold, but also suggests how much liquid asset that is on hand.
- Work-in-progress stocks provide a buffer between production processes;
- Raw materials stock affords the advantage of bulk purchasing discounts;
- It enables production process to flow smoothly without delay;
- Stock holding is advantageous when there is expected possible shortage in the future. In case of seasonal fluctuations, stock holdings absorbs the fluctuation shocks. Also stock holding especially the raw materials holding, is a deliberate investment policy in times of rising costs.
- The inventory control has the objective of maintaining a system that will establish the optimal amount of stock to be ordered in order to minimize costs. This is done by establishing two factors; when to order and how many to order. The firm should be able to determine the quantity needed and be able to place order for them at the appropriate time to avoid stock out. The decision to hold inventory will have to be taken after matching the stock holding cost against the benefits derivable from holding it. The quantity, reasonable enough to offset these costs should be considered.

Inventory Management Techniques

A variety of techniques exists in the discussion of inventory management, however we shall have a look at some of the techniques that are commonly utilized by firms for stock-guide decisions. Such techniques are

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economic order quantity (EOQ), ABC system, Just-in-Time Inventory Management, Safety Stock Inventory, First-in-First out, Last-in Last out, Reorder Point, Set par levels, Contingency Planning, Managing Relationship, Batch tracking, Dropshipping, Perpetual inventory management, Periodic Inventory System, Consignment Inventory and Cross-Ducking. Others which we may not discuss in the scope of this write up include lean manufacturing, lean six sigma, demand forecasting, bulk shipments and so on.

1. Economic Order Quantity.

Inventory must be required to minimize stock outs and abate its consequential effects. However, too much or too little of the inventory is inimical to the profitability and growth of the firm. This situation poses a challenge on what inventory level will be optimal for freeing up stock outs. One commonly used quantitative approach for determining the optimal level is the Economic Order Quantity (EOQ). Economic order quantity, or EOQ, is a formula for optimizing the ideal order quantity a firm needs to purchase for its inventory. The overall goal of EOQ is to minimize related costs that arise in the purchasing more or less of the required inventory. The formula is used to identify the greatest number of product units to order at possible minimum costs and by so doing helps to free up tied cash in inventory for most firms. Economic quantity is one of the most commonly used tools for determining the optimal order quantity of inventory for replenishment. The economic order quantity bothers on how much of the inventories should be ordered and when exactly should they be ordered. The question of what constitutes the optimum inventory to be added for replenishment of the inventory (economic lot size) is the task facing the firm. These problems are referred to as order quantity problems. Determination of the optimum inventory level is cost involving. The involved costs are namely: ordering costs, carrying cost and total costs.

- Ordering costs include the entire cost of acquiring raw material such as costs involved in requisition, transportation, inspection, storing purchase order and so on. Ordering cost is a positive function of the number of orders placed, the higher the ordering costs, the higher the number of orders placed and vice versa. It however decreases or declines with increase in inventory size.
- Carrying costs on the other hands is associated with all costs incurred in maintaining the level of inventories ordered. They include expenses on warehousing, handling, insurance, clerical staff, deterioration and obscelence. Unlike ordering costs, carrying costs vary with inventory size.
- Total cost is the sum of the order costs and carrying costs. Thus, Economic order quantity is concerned with the minimization of the totality of the two costs

Mathematical modeling of the Economic order Quantity (EOQ).

Suppose the ordering cost per order denoted by O is fixed and inventory usage for a period of time say one year is A, where Q represents the order quantity in units and C denotes the carrying cost per unit per period.

Given the above, we can calculate the number of orders placed as inventory usage per period divided by the order quantity. Thus,

$$\text{No. of orders} = \frac{A}{Q} \qquad (1)$$

Total ordering cost is the product of the cost per order O and the number of orders. That is

$$\text{Total ordering cost} = O \times \frac{A}{Q} = \frac{OA}{Q} \qquad (2)$$

The total carrying cost is the product of the cost of carrying a unit per period C and the firm's average inventory units. $\frac{Q}{2}$

$$\text{Average inventory} = \frac{\text{Order size}}{2} = \frac{Q}{2} \qquad (3)$$

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$$\text{Total carrying cost} = C \times \frac{Q}{2} = \frac{QC}{2} \quad (4)$$

Combining the total ordering cost and the total carrying cost gives us the total inventory costs. Thus

Total inventory cost = Total carrying cost + Total ordering costs

$$TC = \frac{QC}{2} + \frac{AO}{Q} \quad (5)$$

Equation 5 reveals that with a large order quantity Q, the ordering cost will decreases while the carrying cost will increase. On the other hand the ordering cost will be higher and the carrying cost lower when the order quantity is lower. This behaviour depicts a tradeoff between the carrying costs and ordering costs while determining the EOQ.

If we differentiate equation 5 with respect to Q, we obtain the economic order quantity (EOQ). This is obtained at the point where the total inventory costs is minimized and this point is termed the optimal average inventory level.

$$\frac{dTC}{dQ} = \frac{C}{2} - 1Q^{-2}AO = 0 \quad (6)$$

$$\rightarrow \quad \frac{C}{2} = \frac{1AO}{Q^2} \quad (7)$$

$$Q^2C = 2A0$$

$$Q^2 = \frac{2AO}{C} \quad (8)$$

$$Q = \sqrt{\frac{2AO}{C}} \quad (9)$$

$$EOQ = \sqrt{\frac{2AO}{C}} \quad (10)$$

By differentiating the total cost in equation (5), we get the marginal cost which is obtained by making Q, the order size a subject,:

$$Q = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2\ x\ quantity\ required\ x\ ordering\ cost}{Annual\ carrying\ cost}}$$

which is the economic order quantity. Thus,

$$EOQ = \sqrt{\frac{2AO}{C}} \quad (11)$$

Graphical method for determination of Economic order quantity

Graphical method can also be used to determine the optimal level or economic order quantity of a firm. To sketch the graph, a numerical example will make this simpler.

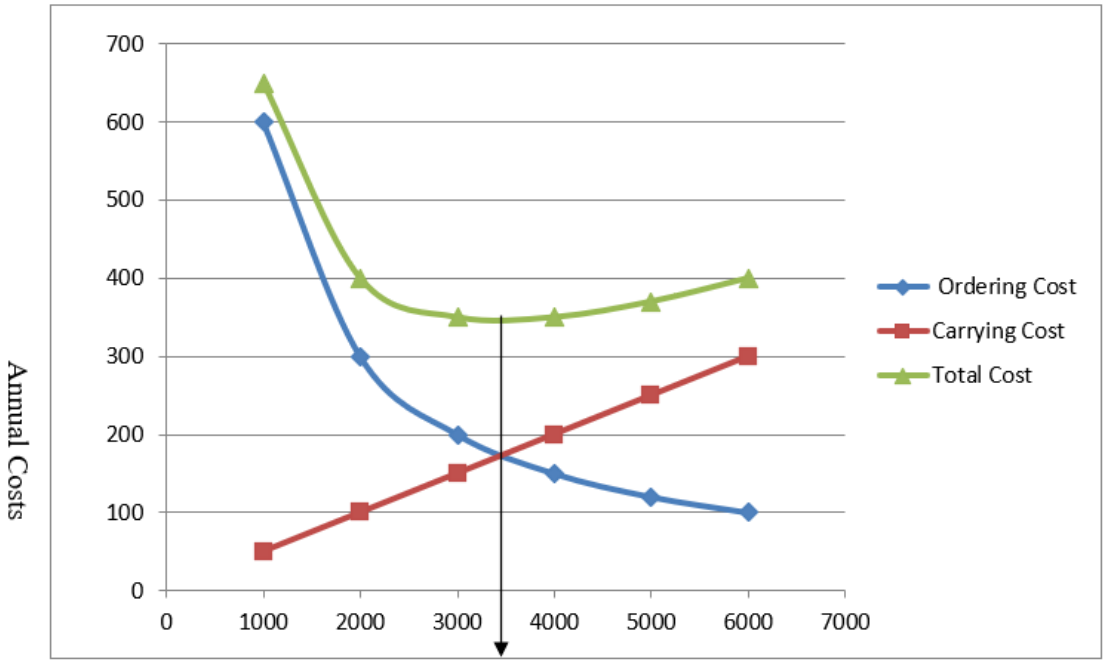
Suppose a firm uses 50,000 drums of oil per annum with ordering and handling cost of ₦12 per order and a carrying cost per unit(C) of 10kobo. If the order quantity (or size), ordering cost and carrying cost per annum as well as the total annual costs are supplied in table 1, graphically determine the economic order quantity of the firm.

Table 1 Annual cost of ordering and carrying inventory (N)

Ordering Quantity (Q)	Ordering Cost $(\frac{OA}{Q})$	Carrying Cost $(\frac{QC}{2})$	Total Cost
1000	600	50	650
2000	300	100	400
3000	200	150	350
4000	150	200	350
5000	120	250	370
6000	100	300	400

Graphical Method

Using graphical method, cost of ordering and carrying inventory and the totality of the costs are plotted on vertical axis while the order quantity (size) is plotted on horizontal axis. Remember that we noted earlier that carrying costs increase with the increase in the order size. Increase in the order size is synonymous with larger average inventory which has the effect of increasing warehousing costs, insurance and obsolesce costs as well as interest on funds tied up in inventory. Noted also is that ordering costs decrease with increase in order size (that is order quantity). In the light of this, it becomes obvious that an optimal order size which minimizes the total cost of the inventory be sought. The point where the total inventory costs is minimized represents the optimal inventory level which signifies the economic order quantity (EOQ). In the above figure, EOQ is about 3464 drums of oil.



The EOQ value for the graphical method is therefore 3464 drums of oil.

Employing the EOQ formula method to ascertain the authenticity of the graphical result, we proceed as follows:

$$\text{EOQ} = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2(50000)12}{0.1}} = \sqrt{\frac{2(50000)120}{1}} = 3464.10 \text{ drums of oil.}$$

The value of EOQ using the formula is 3464.10 drums of oil.

The value of the EOQ with the graphical and mathematical methods are approximately the same. Thus, graphical method can also be used to determine EOQ provided ordering size, ordering and carrying costs are calculated.

2. ABC analysis.

This inventory categorization technique splits the subject into three categories prioritized with ABC to identify items that make heavy revenue impact on the overall inventory.

- Category A represents the valuable products that contribute most to overall profit. It represents the stock that controls about 80% of the firms revenue.
- Category B is the products that have less profit impact lying between the most and the least and/or representing about 15 % of the firm's revenue.
- Category C is for the small transactions bearing about 15% of the firm's revenue.

Products A being the most profitable products must always be on hand to avoid missing out future sales and the associated profits while product C is the slow moving so called dead stock which could readily be disposed at a discount in order to evacuate the warehouse and free up seized cash from the inventory. Dead stock is inventory that was never sold or used by customers before being removed from sale status owing to its staleness.

3. Just-in-Time Inventory Management.

In Just-in-Time (JIT) Inventory Management, raw material orders are arranged in direct connection with production schedules from suppliers. In other words, JIT demands that the lowest inventory levels possible be kept to meet demand with a careful watch to replenishing before the product goes out of stock.

JIT helps to reduce inventory costs as companies receive inventory on as-needed basis instead of ordering too much and risking chances of dead stock.

4. Safety Stock Inventory

Safety stock inventory management has to do with ordering extra inventory beyond expected demand. This extra stock is set aside to prevent stock outs that might be warranted by unforeseen contingences. Safety Stock can be deduced mathematically as:

Safety Stock = (Maximum Daily Usage x Maximum Lead Time) - (Average Daily Usage x Average Lead Time).

Advantage of safety inventory is that it acts as a shock observer obviating unanticipated disruptions to maintain the flow of stocks thereby giving a breathing space for the firm to regain its composure.

5. First-in-First out (FIFO)

FIFO implies first-in, first-out meaning that the stock that came first (old stock) must be sold first (first out). The use of FIFO is suitable not only to the perishable goods but also to the non perishable goods. To manage FIFO system very well, arrangements of the products in an organized way becomes necessary in such a manner that the old products are displayed first from time to time in the front view while displaying the new product at the back.

6. Last in, First out (LIFO)

Last in First out (LIFO) inventory management suggests that the stocks which are recently acquired should be sold first. In other words, the inventories that are purchased last should be the first to be sold. This proposition

is an exact opposite of FIFO. However, this is very useful in inventory management as the application is superior during the steadily rising prices. At the rising prices, the most recently purchased inventories should be sold at higher costs which they were purchased to avoid unexpected fall in prices that might lead to sustenance of losses to the firm. Most often, higher cost reduces higher demand (especially if the goods in question are elastic) with a repercussion effect of drastic fall in total revenue and hence total profit.

7. Reorder Point.

The reorder point is concerned with the level of inventory at which the firm will deem it necessary to replenish her stock. In other words, reorder point connotes that level of inventory which serves as an indicator or a pointer that the stock has fallen to a minimum level which must be replenished. Once the safety stock level is known, the firm considers her lead time with the supply chain to determine the probable time period where by new order could be placed. Lead time is the period between an order being placed to replenish inventory and when the order is received. A reorder point is usually higher than a safety stock number to factor in lead time. Thus, the reorder point is calculated as follows:

Reorder Point = Lead Time Demand + Safety Stock.

8. Set Par Levels

Inventory management could be made easier by setting par levels for each of the products. When a minimum amount of each product is set on hand at all times, par levels are established. The inventories must not dip below these predetermined levels. Peradventure, a fall below this threshold level depicts an indication that more inventories should be ordered to maintain the par levels. To set par levels, upfront research and decision making are necessary to systemize the ordering process. The progress of par levels must be evaluated from time to time in relation to the predetermined standard. In case deviations from the predetermined standard occur, adjustment of the par value levels up and down should not be unfounded.

9. Contingency Planning.

Unanticipated problems can pop up and cripple unprepared businesses. On the basis of this, contingency planning becomes a desideratum to keeping the safeties of the inventories to avert a sudden close down of the business. The planning should have the ability to shut out some of if not all of the unexpected contingencies. Such contingences that may likely occur are:

1. Spiking of sales that triggers off reduction in inventory through overselling of stock
2. The warehouse may lack space to accommodate demand geared by unforeseen spike in sales
3. Miscalculated inventory level under sales spikes may have some inherent consequences.
4. A slow moving product takes up the firms storage space.
5. Short fall of cash flows can cause unnecessary indebtedness to the firm

Firms should therefore identify such risk sources and prepare a contingency plan before hand to abate any of the problems that may arise.

10. Managing Relationship

In this method, company's restocking rate depends on the relationship between the firm and the suppliers. Thus, a cordial relationship is maintained between the firm and the suppliers. The suppliers who regard the good will of the firm's business tries to have full knowledge of the progress of the business in terms of when to restock as this enables the suppliers to make necessary supplies and adjustment at the appropriate time.

11. Batch Tracking,.

Batch tracking management techniques group and monitor the inventory with similar traits. In order words, the inventory is grouped according to similarities they share in common. The common similarity could be

earmarked in terms of manufactured date or expiry date. Batch tracking enables the firm to trace or figure out the position of the inventory in the store room. It helps to track expiration of the items or the probable defective items for the purpose of quickening their sales perhaps on discount, auction or for disposal as a waste.

12. Dropshipping

Dropshipping is an inventory management technique in which products for sale are not actually kept in stock. In this technique, a sale made is directly picked from the whole sellers own inventory and directly shipped to the consumer. Under this arrangement the seller does not keep goods in stock but instead transfers its customer's order details to the manufacturer or wholesaler who now ships the goods directly to the customer. The basic thing here is that the seller keeps no product in stock, he only receives the sales order and passes it to a third party supplier who directly ships the goods to the buyer. The seller may not see or touch the product for it to reach the buyer. This arrangement helps to untie huge amount of capital which could have been otherwise confined to keeping the inventory in the store.

13. Perpetual Inventory Management

Perpetual Inventory management technique has to do with the counting and recording of inventory on pen, paper or spreadsheet as soon as the inventory arrives. Each time any transaction is made, the perpetual management system updates all relevant information to the firm's accounting system.

14. Periodic Inventory System

Another inventory management system used by firms that may share some common features with perpetual inventory system is the periodic inventory system. In periodic inventory system, the firm uses the staff to undertake audit of its stock by physically counting the inventory in the store and comparing the outcome with the sales data to fish out the discrepancies. This however poses a herculean task to businesses that involve large volume of stock but not to businesses involving heavy goods such as that made by carpenters, the builders products like houses, and that of manufacturers with products like vehicles and other machines.

15. Consignment Inventory

In consignment inventory management, the supplier supplies goods to the consignee without receiving payment until after the goods are sold. In other words, the business deal is contracted when the consignor who could be a wholesaler agrees to give the consignee the goods without upfront payment for the inventory. Under this arrangement, the consignor offering the inventory still remains the owner of the goods until the consignee pays for them after he has sold the goods.

16. Cross-Docking.

Cross- docking is an inventory management arrangement that functions without storage sequence. In other words, it is an inventory management technique in which an incoming truck from the manufacturing plant unloads materials directly into an outbound trucks that will make them available to the place where they are needed for instant production rather than being stored on-site.

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