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Invitation to Inventory Control Application and Analysis

Nwankwo Steve C

***Abstract*— Inventories are idle goods or materials that are waiting to be used or displaced, It seeks to determine when it is necessary to stock goods and the quantity to stock. This article therefore examines the fundamental application of inventory in a Small business as it affects decision making. Economic order quantity (EOQ) model For a production process was derived and the optimal quantity to produce to minimize cost was determined with the optimal production level. Raw data collected From ANAMCO ENUGU in their batteries production unit was analyzed and it Was determine that the optimum quantity of batteries it should produce to Minimize cost was 309 batteries, and the optimal production cycle should be every 4 years.**

***Index Terms*— EOQ, Control Application,**

I. INTRODUCTION

Inventories are "idle goods or materials" that are waiting to be used or displaced. Inventory problem seeks to determine when it is necessary to stock physical goods or commodities for the purpose of satisfying demand over a specified time period.

Mukesh (2013) reported that an inventory (stock of goods) for future sale or use is common in business, he stated that inventory overstock requires higher invested capital per unit time, but less frequent occurrences of shortages and replacement of orders, whereas inventory under stock decreases the invested capital per unit time but increases the frequency of ordering as well as the risk of running out of stock. In order to meet demand time, companies must keep on hand "goods that are waiting for sale". The purpose of inventory theory is to determine rules that management can use "to minimize the cost" associated with maintaining inventory and meeting customers demand. Inventory is studied in order to help companies save large amounts money.

Satoybroto (2011) opined that inventory models are meant to provide answers to questions like :-

When should an order be placed for a product?

What quantity can we order?

He concluded that the answers to these questions are collectively called an "inventory policy."

Companies save money by formulating "mathematical models" describing the inventory system and then proceeding to derive an "optimal inventory policy" .In this course we are going to consider "deterministic continuous review models".

II. RELATED LITERATURE

According to Sharma (2010) most industries and business organizations are no longer in business due to the fact that there are less or no customers to patronize their products, he maintained that customers are therefore seen as one of the resources that "boost push up" production in industries and help business firms to move on.

Industries and business firms are concerned with what they should do "to achieve and maintain high level of production" so as to be in business, they therefore pay attention to how their customers demand could be met at any point in time.

As a result of these facts Mukesh(2013) reported that inventory control is of great important to industries and business firms as its overall objective is to maintain stock levels so that the costs associated with the maintenance of the stock are kept at the barest minimum.

Inventory control is a vast topic. It covers among other things, "deterministic and probabilistic models".

There are many ways of classifying inventories depending on the type of business being considered.

There are basically goods from" extractive industry", these are product of the farms, mines, forest and fishers, which enter into production process basically in their natural state. Examples include; cotton, iron ore, raw petroleum (crude oil) and other farm product such as fruits, fishes etc used in the manufacture of products, these goods are classified as "raw materials".

Andrew (2013) observed that there are partly finished goods and materials held between the manufacturing stages, he described them as end products of one industry and the basic manufacturing material of another company. Examples include; steel, lumber etc. These goods he classified as "work in progress (WIP)".

Orders are completed products ready for sales or distribution such as cars etc. These goods are classified as "finished goods".

The items of goods in each classification depend on the type of business or firm. What is listed as finished goods for a firm may be listed as raw materials for another.

Poyu(2013) highlighted some of the reasons why many companies or individuals keep inventories,

Some of the reasons he gave include among others to:-

Ensure protection against "uncertainties" and to make sure that sufficient goods are available to meet anticipated demand for production or distribution and or retailing.

To provide a "buffer production stages" especially in "work-in-progress stock", which may effectively disrupt operations?

To meet up with what he called "emergency shortages" that may occur due to unforeseen circumstances like strikes, breakdown of plants etc.

To "maximize the advantages of bulk purchases", which may offer some discounts.

Nita and Poonum (2010) observed that the type of inventory model depends on the nature of the demand of the commodity and that the demand may be deterministic that is known "with certainty" or probabilistic that is described by a "probability density".

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A deterministic demand may be :-
"Static", that is when the consumption rate remains constant with time.
"Dynamic" that is when the demand is known with certainty. But it varies from one time period to the other.
A probabilistic demand on the other hand may be:-
"Stationary", that is when the demand probability density function remains unchanged overtime.
"Non-stationary", that is when the demand probability density function varies with time.
The economic order quantity are often used under two systems the "Reorder level system and the Periodic review system".
Boos etal (2013) described the periodic review system or the two-bin system as a type of inventory control which has a predetermined reorder level set for each item and in this case, when the stock level falls to the reorder level, a "replenishment order" is issued. He maintained that the replenishment order quantity is invariably the "economic order quantity (EOQ)".
In organizations operating the reorder system, stock record is maintained with calculated reorder levels which "signal the required replenishment order".
Boos etal (2013) maintained that in this type of inventory control system, there are well defined levels of inventory which must be calculated and entered on a stock record card so that comparison can be made between the actual stock level and the control levels each time an entry is made on the stock record card.
The reorder level is a defined "action level", the minimum and the maximum points are levels at which management would be warned that action should be taken about the stock.
Satoybroto (2011) reported that the minimum reorder level is calculated so that the management is warned when demand is above average, and accordingly "buffer stock" is used, and that the maximum level is calculated in order to warn the management when demand is the minimum expected and consequently the stock level is likely to rise above the maximum intended.
Prem and Hira (2011) stated that a critical factor in establishing reorder levels and for calculating the economic order quantity (EOQ) is for the forecast of expected demand.
Now let us examine how these three levels (re-order, minimum and maximum) can be obtained.

III. METHODOLOGY

For example a company has the following information relating to one of their items in stock
Normal usage: 220 units per day
Minimum usage: 108 units per day
Maximum usage: 260 units per day
Lead time: 20-25 days
If the company has (already calculated EOQ): 5010
Then Reorder level = maximum usage x maximum lead time
= 260 x 2 5 = 6500 units
Minimum level = reorder level + usage for average lead time

= 6500-(220x22.5)= 1550units
Maximum level = reorder level + EOQ + minimum expected usage in lead time
= 6500 + 5010 – (108 x 20) = 9350 units

These three levels obtained above are then entered into the "stock record card" of the company for comparison to be made between the actual stock level and the control levels each time an entry is made on the card.
Charles and Corrine (2012) observed that the effect of periodic review system is to order variable quantities at fixed intervals instead of the fixed quantities ordered at variable intervals in the reorder level system.
"Periodic review system" is based on the assumption that the "lead time" is less than the periodic review period. Also in this system, a recommended "safety stock" is usually determined. This safety stock in this system is based on the probabilistic demand during the review period plus the lead time period.
Poyu (2013) observed that this longer period for the safety stock means that the periodic review system tends to require larger stock than do the continuous review systems.

Paolo (2011) sighted the basic assumptions of EOQ to include:-
i.)The demand rate is constant, recurring and known.
ii.)The lead time is constant and known.
iii.)No stock outs are allowed.
iv.)Materials are ordered or produced in a lot or batch and placed into inventory all at one time.
v.)The costs structure provides that the unit item cost is constant and no discounts are given for large purchases.
The main objective of EOQ of is to determine "the quantity Q that minimizes total cost
and the cost of operating the inventory itself" .
Sharma (2010) opined that the most important aspect of inventory is to hold finished goods to meet up with customers' unexpected demand, since demand are not known with certainty.

He advised that additional amount of inventory called "safety stock" should often be kept on hand to meet up with the unexpected demand.
George and Isidoros (2008) in there paper "Do stock outs undermine immediate and future sales?" outlined three major inventory costs to include;
Cost of holding items in storage, this cost is called "holding cost".
Cost for clerical works, this cost is called "administrative cost".
Cost incurred when customers demand cannot be satisfied, this cost is called "stock out cost".
The EOQ formula is a "symbolic model", which uses the variables in the real life system to represent in a symbol in the form of a mathematical relationship.
The symbolic model (EOQ FORMULA) is applied into a production company's operating system to establish the actual EOQ value for the operation.
We now examine the real life application in a production company of a continuous review model with uniform demand.
Here Poyu (2013) assumed that withdrawals (demands) are continuously at a known constant rate D.
We now derive a model to determine when to replenish inventory and how much quantity we should produce to minimize the cost of inventory.
Driving the EOQ model in a production process:
Let us use the following notations to formulate the model:
D = demand for a product
Q = units of a batch inventory

Q/D = Cycle length of time between production runs
K = The setup cost for producing or ordering one batch
C = The unit cost for producing or purchasing each unit
h = The holding cost per unit of time held in inventory
Q^* = The quantity that minimizes the total cost per unit time
t^* = The time it takes to withdraw this optimal of Q^*

With a fixed demand rate, shortages can be avoided by replenishing inventory each time the inventory drops to zero through constant production, and this will also "minimize the holding cost".

If we start at a zero point (0) by producing or ordering a batch of Q units in order to increase the initial inventory level from 0 to Q then the total cost per cycle will be equal to the total production cost per cycle plus the cost holding the current inventory (setup cost).

Thus the total production cost per cycle will be

PC = K + cQ……(1)

We can then obtain the average inventory level during a cycle to be (Q+0)/2 = Q/2 units per unit time, and the corresponding cost will be (h.Q/2) per unit time.

Because the cycle length is Q/D, the holding cost per cycle will be obtained as follows:

$\frac{hQQ}{2D} = \frac{hQ^2}{2D}$……..……(2)

Therefore, the total production cost will be equation (1) plus equation (2)

That is

$(K + cQ) + (\frac{hQ^2}{2D})$……..……(3)

Now to obtain the total cost per unit time, we divide the total production cost per cycle by $\frac{Q}{D}$ to obtain our total cost per unit time equation as:

$\frac{DK}{Q} + Dc + \frac{hQ}{2}$……..……(4)

The value of Q* that minimizes the total cost is found by taking the derivative of equation (4), the total cost, and setting it equal to zero, and solving for Q, we arrive at the following two equations which describe our model, Sharma (2010).

$Q* = \sqrt{\frac{2Dk}{h}}$……..……...(5)

$t* = \frac{Q*}{D}$……..……...…(6)

The equation (5) is called the economic order quantity (EOQ) or the Wilson's Economic lot size which is the optimal value which minimizes the total cost of production.

While the equation (6) is the optimal time it takes to produce the optimal value Q.

IV. NUMERICAL APLLICATION

ANAMCO Motors limited assembles an produces E320 Mercedes cars in Nigeria.

The information gathered shows that ANAMCO also produces its own batteries which
are used in the production of its new Mercedes cars E320.The car is assembled on its production line at the rate of 800 per annum. Each time a batch of battery is produced a
Set-up cost of N120,000 is incurred, it is also estimated that the cost the company uses to keep a produced battery in stock is N20 per annum .The production cost of a single Battery (excluding the set-up cost) is N100.The Company wants to determine the quantity
to produce to enable them minimize cost and when such quantity will be produced.

Solution

Here we assume shortages are not allowed since there is continuous demand and continuous replenishment from the production line.

We know Demand (D) = 800
Holding cost (h) = N20
Set-up cost (K) = N120,000
Now, we use equation 1 to get:

$$Q^* = \sqrt{\frac{2(800)(120000)}{20}} = 3098\ units$$

We, use equation 2 to get

$$t^* = \frac{Q^*}{D} = \frac{3098}{800} = 3.9\ years$$

Interpretation: With this result ANAMCO is advised that the optimum quantity of batteries it should produce to minimize cost is 3098 batteries, and the optimal production cycle should be every 3.9 years or approximately 4 years.

V. SUMMARY

George and Isidoros (2008) opined that inventory control is of great important in customer retention as it goes as far as helping industries, firms and business organization to know when to order, the optimal order size, and maintain stock level so that the cost associated with the maintenance of the stock are kept at a minimum.

In summary, inventory control is a helping tool for retaining customers since it makes industries, firms and business organization to:

1. Provide adequate customer services so as to retain them and maintain the image of their industry.
2. Achieve "production efficiency"
3. Maintain "minimum cost" in keeping inventory
4. Meeting up with emerging shortage due to unforeseen circumstances

Inventory control is a very useful tool in every business organization as it serves a big need for successful functioning of firms and business organization.

Progressive organizations in the competitive labor market "use inventory as it protects against shortages (shock outs)".

VI. RECOMMENDATION

Due to the much importance found in inventory control the following things are recommended.

1. Every industry and business organization should keep inventory so as to meet up with "unanticipated customers demand".

2. To provide independence between operations and avoid "work stoppages or delays" and achieve operational excellence by industries.
3. To meet up with emerging shortages due to unforeseen circumstance like strikes, breakdown of plants etc, inventory has to be kept on hand.
4. Inventory should also be kept on hand to meet up with "seasonal and cyclical demands".
5. In terms of quantity discount, large quantity of commodities should be purchased so as to take advantage of price discounts.
6. Seminars and workshops should be organized to sensitize businessmen and companies on the need for them to maintain a functional inventory system.
7. A basic knowledge in mathematics and statistics is recommended for this course to enable the readers understand the applications.

VII. CONCLUSION

The application of inventory analysis in management planning is very useful in every organization. Every progressive organization in the competitive world makes use of inventory control as a strategic means toward their achieving progress and success.

Prem and Hira (2011) opined that the application of inventory analysis in management planning is a bed-rock for effective growth since it helps to protect against uncertainties and unanticipated demand. Any production organization that lacks the knowledge of inventory maintenance is liable to fall at any point in time. Thus with the help of inventory management in organizations, cost can be easily reduced and profit can be easily maximized.

A new dimension to propagate inventory control is to encourage stocking of farm products in the agricultural sector, enforce owning a warehouse for industries, standard libraries in the education sector and others among companies and states.

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