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Inventory Management: A Tool of Optimizing Resources in a Manufacturing Industry A Case Study of Coca-Cola Bottling Company, Ilorin Plant

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ABSTRACT Inventory constitutes the most significant part of current assets of larger majority of Nigerian manufacturing industries. Because of the relative largeness of inventories maintained by most firms, a considerable sum of an organization's fund is being committed to them. It thus becomes absolutely imperative to manage inventories efficiently so as to avoid the costs of changing production rates, overtime, sub-contracting, unnecessary cost of sales and back order penalties during periods of peak demand. The main objective of this study is to determine whether or not inventories in the Nigeria Bottling Company, Ilorin Plant can be evaluated and understood using the various existing tools of optimization in inventory management. The study methods employed include the variance analysis, Economic Order Quantity (EOQ) Model and the Chi-square method. The answer to the fundamental question of how best an organization which handles inventory can be efficiently run is provided for in the analysis and findings of the study. Consequently, recommendations on the right quantity, quality and timing of material, at the most favourable price conclude the research study.

1. INTRODUCTION

Inventory management is pivotal in effective and efficient organization. It is also vital in the control of materials and goods that have to be held (or stored) for later use in the case of production or later exchange activities in the case of services. The principal goal of inventory management involves having to balance the conflicting economics of not wanting to hold too much stock. Thereby having to tie up capital so as to guide against the incurring of costs such as storage, spoilage, pilferage and obsolescence and, the desire to make items or goods available when and where required (quality and quantity wise) so as to avert the cost of not meeting such requirement.

Inventory problems of too great or too small quantities on hand can cause business failures. If a manufacturer experiences stock-out of a critical inventory item, production halts could result. Moreover, a shopper expects the retailer to carry the item wanted. If an item is not stocked when the customer thinks it should be, the retailer loses a customer not only on that item but also on many other items in the future. The conclusion one might draw is that effective inventory management can make a significant contribution to a company's profit as well as increase its return on total assets. It is thus the management of this economics of stockholding, that is appropriately being refers to as inventory management. The reason for greater attention to inventory management is that this figure, for many firms, is the largest item appearing on the asset side of the balance sheet.

Essentially, inventory management, within the context of the foregoing features involves planning and control. The planning aspect involves looking ahead in terms of the determination in advance:

(i) What quantity of items to order; and (ii) How often (periodicity) do we order for them to maintain the overall source-store sink coordination in an economically efficient way?

(ii) How often (periodicity) do we order for them to maintain the overall stock coordination in an economically efficient way?

The control aspect, which is often described as stock control involves following the procedure, set up at the planning stage to achieve the above objective. This may include monitoring stock levels periodically or continuously and deciding what to do on the basis of information that is gathered and adequately processed.

Effort must be made by the management of

any organization to strike an optimum investment in inventory since it costs much money to tie down capital in excess inventory. In recent time, attention was focused on the development of suitable mathematical tools and approaches designed to aid the decision-maker in setting optimum inventory levels. Economic order quantity model (EOQ) has thus been developed to take care of the weaknesses emanating from the traditional methods of inventory control and valuation, which to some extent has proved useful in optimizing resources and thus, minimizing associated cost.

Financial analysts have sounded enough warning on the danger expose to the long run profitability as well as continuity of business concern when its inventories are left unmanaged. First, a company, which neglects it management of inventory, runs the risk of production bottlenecks and subsequently unable to maintain the minimum investment it requires to maximized profit. Second, inventories that are inefficiently managed may apart from affecting sales create an irreparable loss in market for companies operating in highly competitive industry.

Invariably, a company must neither keep excess inventories to avoid an unnecessary tying down of funds as well as loss in fund due to pilferage, spoilage and obsolescence nor maintain too low inventories so as to meet production and sales demand as at when needed. Therefore, the mere fact that ineffective inventory management affects virtually the organizational objectives necessitates this type of research work.

The researcher has taken Nigeria Bottling Company as a case study so as to clearly see if their resounding success can be attributed to the kind of inventory system the company embarks on. Since their production process requires a lot of raw materials and despite the economic condition of the country at any given time, production has never ceased and their products have never been scarce.

The objectives of this study are as follows:

(i) To describe the inventory management procedures currently in use in Nigeria Bottling Company, llorin Plant
(ii) To determine whether or not inventory management in the Nigeria Bottling Company can be evaluated and understood using the various existing tools of optimization in inventory management and,
(iii) To determine the optimality in the company inventory policies.

2. INVENTORY MANAGEMENT: DEFINITIONS AND CONCEPTS

There is need for installation of a proper inventory control technique in any business organization in developing country like Nigeria. According to Kotler (2000), inventory management refers to all the activities involved in developing and managing the inventory levels of raw materials, semi-finished materials (work-in-progress) and finished good so that adequate supplies are available and the costs of over or under stocks are low. Rosenblatt (1977) says: "The cost of maintaining inventory is included in the final price paid by the consumer. Good in inventory represents a cost to their owner. The manufacturer has the expense of materials and labour. The wholesaler also has funds tied up". Therefore, the basic goal of the researchers is to maintain a level of inventory that will provide optimum stock at lowest cost.

Morris (1995) stressed that inventory management in its broadest perspective is to keep the most economical amount of one kind of asset in order to facilitate an increase in the total value of all assets of the organization – human and material resources.

Keth et al. (1994) in their text also stated that the major objective of inventory management and control is to inform managers how much of a good to re-order, when to re-order the good, how frequently orders should be placed and what the appropriate safety stock is, for minimizing stock-outs. Thus, the overall goal of inventory is to have what is needed, and to minimize the number of times one is out of stock.

Drury (1996) defined inventory as a stock of goods that is maintained by a business in anticipation of some future demand. This definition was also supported by Schroeder (2000) who stressed that inventory management has an impact on all business functions, particularly operations, marketing, accounting, and finance. He established that there are three motives for holding inventories, which are transaction, precautionary and speculative motives. The transaction motive occurs when there is a need to hold stock to meet production and sales requirements. A firm might also decide to hold additional amounts of stock to cover the possibility that it may have under estimated its future production and sales requirements. This represents a precautionary motive, which applies only when future

demand is uncertain. The speculative motive for holding inventory might entice a firm to purchase a larger quantity of materials than normal in anticipation of making abnormal profits. Advance purchase of raw materials in inflationary times is one form of speculative behaviour.

2.1 Inventory Model: The Economic Order Quantity (EOQ) Model

Undoubtedly, the best-known and most fundamental inventory decision model is the Economic Order Quantity Model. Its origin dated back to the early 1900s. The purpose of using the EOQ model in this research is to find out the particular quantity, which minimize total inventory costs that is the total ordering and carrying costs.

2.1.1 EOQ Assumptions

The EOQ has been previously defined by Dervitsiotis (1981), Monks (1996), Lucey (1992), and Schroeder (2000) as the ordering quantity which minimizes the balance of cost between inventory holding cost and re-order costs. Lucey (1992) stressed further that to be able to calculate a basic EOQ, certain assumptions are necessary:

(i) That there is a known, constant, stock holding costs;
(ii) That there is a known, constant ordering costs;
(iii) That the rates of demand are known
(iv) That there is a known constant price per unit
(v) That replenishment is made instantaneously, that is the whole batch is delivered at once.
(vi) No stock-outs are allowed.

It would be apparent that the above assumptions are somewhat sweeping and that they are a good reason for treating an EOQ calculation with caution. Also, the rationale of EOQ ignores buffer stocks, which are maintained to cater for variations in lead-time and demand. The above assumptions are wide ranging and it is unlikely that all could be observed in practice. Nevertheless, the EOQ calculation is a useful starting point in establishing an appropriate reorder quantity.

The EOQ formula is given below; it's derivation and graphical presentation.

$$EOQ = \frac{2CoD}{Cc} \quad \ldots\ldots\ldots (1)$$

Where Co, Cc and D denote the ordering costs, carrying cost and annual demand respectively.

Note also that Annual stock = Q/2, Total annual carrying cost = CcQ/2, Number of orders per annum = D/Q, Annual ordering costs = CoD/Q and Total cost = CcQ/2 + CoD/Q..(2)

In the above formula, Q is defined as the result of the calculated EOQ.

The order quantity, which makes the total cost (TC) at a minimum, is obtained by differentiating with respect to Q and equating the derivative to zero the above total cost equation 2. Thus, $dTc/dQ = Cc/2 - CoD/Q^2$ and when $dTc/dQ = 0$ cost is at minimum.

$DCo/Q^2 = Cc/2$

$Q^2 = 2DCo / Cc$ and Q which represent the EOQ formula would now be

The EOQ formula is given below; it's derivation and graphical presentation.

$$EOQ = \frac{2CoD}{Cc}$$

Graphically, the EOQ can be represent in the Figure 1.

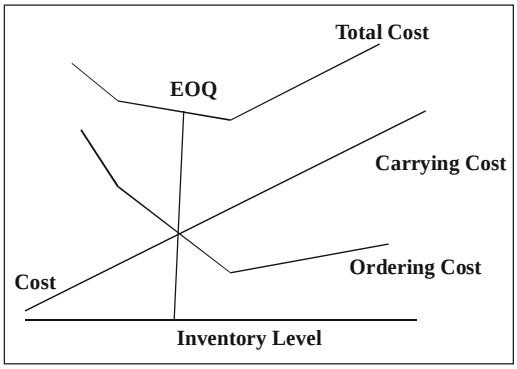

Fig. 1. Presentation of EOQ graphically
Source: Lucey T 1992. Quantitative Techniques. 4th Edition

3. METHODOLOGY

Research methodology represents the strategies involves in collecting and analyzing data collected, in order to have meaningful interpretations of the research findings. This section attempts to give an insight into the way and manner in which this research was carried out. This includes the mode of data collection, how these data were analyzed and the research design.

3.1 Brief History of the Nigeria Bottling Company, Ilorin Plant – The Case Study

Nigeria Bottling Company came into existence

on 8th may 1886. Late A. G. Leventis founded the company and was the first in this country to be offered franchise by an international "soft drink firm". The first plant, which was sited in Lagos, went into operation in March 1953. Coke was the first soft drink to have its own designed shaped bottles, which was different from the common trade bottles. In 1972, the company went public by the issue of 372,580 ordinary shares of 50 kobo each. This was in compliance with the Nigerian Enterprise Promotion Decree of 1972.

Some years after the Ibadan Plant was opened (though later shut down due to non-availability of good water in Ibadan metropolis) that of Port-Harcourt was established and many others followed of which Ilorin Plant came into existence in April 1979 so as to be able to meet the demands of the consumers in the region. Ilorin Plant was mainly established to meet the needs of the people in Bida, Jebba, Ogbomosho, Okene, Oshogbo, Kontagora, Ijagbo, Offa, Lokoja and Ilorin metropolis. The plant has 8 managers.

The range of soft drinks bottled by Nigeria Bottling Company, Ilorin Plant includes Fanta orange, Coke, Sprite, Krest, Bitter Lemon, Ginger Ale and Eva water. In terms of sales, the company enjoys a wide acceptance of its products. Ranging NBC Plc as a whole, its performance is highly appreciated.

3.2 Methods of Data Collection

Essential information for this research work were collected through primary and secondary sources the combinations include:

(i) Interview with some key personnel in the stores, purchasing, production and inventory departments of the company.
(ii) Observation of the production process was done to see the flow of goods in the conversion process. Materials handling and storage were also observed and so was the patrol / inspection procedures.
(iii) Record analysis of relevant data was obtained from the company's annual report and journals.
(iv) Theoretical background information was gathered through review of related literature on inventory management.

3.3 Research Hypothesis

The following hypothesis was tested in this research work:

H0: Coca-Cola Bottling Company does not make use of Economic order quantity [EOQ] optimization model to evaluate their inventory

H1: Coca-Cola Bottling Company makes use of Economic order quantity [EOQ] optimization model to evaluate their inventory

3.4 Method of Data Analysis

The data collected were analyzed using three major quantitative instruments. The simple variance method, the EOQ model and the chi-square distribution method.

The simple variance analysis was used to describe the data presented. The EOQ model was used to determine the optimum inventory level per year, which were considered as the expected value of inventory in the chi-square calculation. The chi-square technique was used to draw inference about the variance of distribution with each distribution determined by the degree of freedom.

4. DATA PRESENTATION, ANALYSIS AND FINDINGS

4.1 Inventory Policy and Stores Function of the Nigeria Bottling PLC, Ilorin Plant

The inventory policy of Nigeria Bottling Company PLC, Ilorin can only be appreciated in the context of its peculiar circumstances as the leading soft drink bottling company and one of the seventeen functional plants of the company within the country. It then implies that whatever policy is adopted at the plant level must take into consideration the overall company's objectives. The main determinant of the company's inventory policy is the national economy itself in which the demand of their product stands as another factor. According to Ilorin Plant managers, the company is constantly reviewing performance as a unit of the economy; thus what happens in the economic environment affects the policies and strategies of the company as a whole and the llorin plants as subsets.

The company's objective is to maintain quality, increase market shares and profitability. This implies that enough inventories should be available to enhance continuos production. This fact also determines the levels of inventory, which the company keeps. Storage space is no barrier to operational activities of the industry as it has a

very large storage space located within the plant premises. Orders for materials are obtained by request or by direct allocation from the head-quarters office in Lagos.

The company operations three sets of stores, the raw material stores the finished goods stores and the spare parts machinery stores. A store manager who operationally works in conjunction with production manager, since most of the products are used by his department alongside with bottling department heads the raw material store. However, the store manager is responsible directly to the plant manager and the bottling manager.

The finished goods store is headed by the sales manager assisted by the bottling manager. The bottling manager helps to confirm the total of bottles produced on regular basis. The sales manager takes responsibility as soon as production is completed.

The spare parts store is headed by the Plant engineer, the raw materials that are stored include the following: -

(a) Sugar: This is obtained locally from Dangote Nigeria Ltd. And sometimes imported from oversea if need be. They are stored in bags, which are stacked in pollets arranged in such a way as to facilitate easy stock taking. A maximum of 10,000 bags of sugar can be stored. Insectucotors are installed in the store keep off bees and other insects.

(b) Concentrates: The concentrates are got from Coca-Cola international while their chemicals are imported from Leventis London. They come in syrup forms stored in bottles and put in worms, which are built within the materials store at temperature of between 40^{c} and 100^{c}.

(c) Crown Corks: They are supplied locally by Crown Product Limited, Ijebu-Ode. The Crown Corks are kept in polythene bags and tore in cases, safe from dust and moisture, which bring about rusting.

4.2 Data Presentation and Interpretation

The preceding section dwells on quantitative information of the plant. Here the data are entirely quantitative as collected from the accounts department, bottling department and the store.

Table 1 show the total sales of the company in Naira value for five years (2000-2004). The company witnessed a surplus for the five years understudy, because there was a positive variation in each of the years. Positive variation indicates good performance on the part of the company while negative variation indicates poor performance, since the basic objective of any profit-making company is to maximize sales.

Table 1: Sales (in Millions of Naira)

Years	*Budgeted Sales in millions (N)*	*Actual Sales in millions (N)*	*Variance (N)*
2000	85.00	86.45	1.45
2001	94	95	1
2002	100	101.25	1.25
2003	110	113.14	3.14

Source: Production Department, NBC Ilorin Plant 2005

Table 2 show the volume of production of the brands of the company's products that is coke, fanta, and sprite. The variance reflects the inability of the company to meet its target for a period of four years (2001-2004) out of the five years understudy. Upon interview, the operations manager explained that this had no negative impact on the overall profit, as it is part of the company's policy to plan in excess of forecast so that even when actual production does not equal budget, it is of no negative consequence.

Table 2: Sales in creates (Volume of Production)

Years	*Budgeted Sales in millions (N)*	*Actual Sales in millions (N)*	*Variance (N)*
2000	4,500,000	4,500,000	0
2001	4,750,000	3,950,000	-800,000
2002	4,900,000	4,700,000	-200,000
2003	4,950,000	3,756,621	-1,193,397
2004	5,150,000	5,100,000	-50,000

Source: Production Department, NBC Ilorin Plant 2005

Table 3 show the overall production cost in naria value. It reveals that the actual cost of production for the five years under study were above the budgeted cost. This was due to increase in the prices of raw materials, incessant increase in fuel price, technology and labour and the resulting effect of inflation in the Nigeria Economy. This has gone a long way to affect

Table 3: Production cost (in Millions of Naira)

Years	*Budgeted Sales in millions (N)*	*Actual Sales in millions (N)*	*Variance (N)*
2000	12	12.50	0.5
2001	20	21.76	1.76
2002	27	28.50	1.50
2003	35	36.14	1.14
2004	41	41.50	0.5

Source: Production Department, NBC Ilorin Plant 2005

company's profit negatively during those periods of sky-rocketing inflation level.

4.3 Data Analysis and Hypothesis Testing

The data in tables 4, 5, 6 show the usage rate of Nigeria Bottling Company's raw materials (that is sugar, concentrates and crown cork / bottles). The data were used to determine the observed frequency value using the economic order quantity (EOQ) formula. The expected frequency was determined by finding the average of all the observed frequency. The chi-square value was then determined at 5% confidence level and 4 degree of freedom, see tables 4, 5 and 6.

***Raw Materials Requirements*:** Using sugar as parameter, table 4 depicts the χ^2 calculated value of 0.3095, which of course is lower when compared with table value of chi-square (χ^2) of 9.488. The null hypothesis was thus accepted this Coca-Cola Bottling Company does not make use of Economic order quantity (EOQ) optimization model to evaluate their inventory specifically using sugar components as a parameter for measurement.

Using concentrates as parameter, table 5 depicts the χ^2 calculated value of 2.5646, which of course is lower when compared with table value of chi-square (χ^2) of 9.488. The null hypothesis was thus accepted Coca-Cola Bottling

Table 4: Sugar

Years	*Annual demand in (000)*	*No. of orders*	*Materials unit cost*	*Ordering cost per order (000)*	*Carrying cost as a % of unit*	*{N} value*	*EOQ (000) O*	*(000) E*	*(000) (O - E)2*	*(000) (O - E)2 / E*
2000	840	3	320	7	4%	12.8	30.31	29.46	0.72	0.0244
2001	900	3	360	8	4%	14.4	31.62	29.46	4.67	0.1585
2002	950	3	410	9	5%	20.5	28.89	29.46	0.32	0.0109
2003	1010	3	480	11	6%	28.8	27.78	29.46	2.82	0.0957
2004	1070	3	520	12	6%	31.2	28.69	29.46	0.59	0.0200

χ^2 = 0.3095
Source: Raw materials stores unit NBC 2005.

Table 5: Concentrates

Years	*Annual demand in (000)*	*No. of orders*	*Materials unit cost*	*Ordering cost per order (000)*	*Carrying cost as a % of unit*	*{N} value*	*EOQ (000) O*	*(000) E*	*(000) (O - E)2*	*(000) (O - E)2 / E*
2000	450	3	210	8	3%	6.3	35.80	43.19	54.61	1.26
2001	600	3	220	10	3%	6.6	42.64	43.19	0.30	0.0069
2002	700	3	230	12	4%	9.2	42.73	43.19	0.21	0.0049
2003	720	3	240	13	4%	9.6	44.16	43.19	0.94	0.0218
2004	800	3	250	20	5%	12.5	50.60	43.19	54.91	1.271

χ^2 = 2.5646
Source: Raw materials stores unit NBC 2005.

Table 6: Crown Cork/Bottles

Years	*Annual demand in (000)*	*No. of orders*	*Materials unit cost*	*Ordering cost per order (000)*	*Carrying cost as a % of unit*	*{N} value*	*EOQ (000) O*	*(000) E*	*(000) (O - E)2*	*(000) (O - E)2 / E*
2000	650	3	240	9	3%	7.2	40.31	45	21.996	0.4888
2001	840	3	300	10	3%	9	43.20	45	3.24	0.072
2002	900	3	330	11	3%	9.9	44.72	45	0.0784	0.0017
2003	950	3	350	13	3%	10.5	48.50	45	12.25	0.272
2004	1000	3	400	14	3%	12	48.30	45	10.89	0.242

χ^2 = 1.0765
Source: Raw materials stores unit NBC 2005.

Company does not make use of Economic order quantity [EOQ] optimization model to evaluate their inventory using concentrates as parameter for measurement.

Using crown cork /bottles as parameter, table 6 depicts the χ^2 calculated value of 1.0765, which of course is lower when compared with table value of chi-square (χ^2) of 9.488. The null hypothesis was thus accepted Coca-Cola Bottling Company does not make use of Economic order quantity [EOQ] optimization model to evaluate their inventory using crown cork / bottles as parameter for measurement.

4.4 Findings

The findings as presented above in all the three cases show that we should reject the alternative hypotheses and accept the null hypotheses. Our analysis also shows that the company operates a policy of making orders on a quarterly basis within a period of one year. Also it can be as well observed that the company does not always adopt the EOQ model in placing orders for its raw materials and this account for the variations between the calculated EOQ and the expected order sizes of the company. For at least three years out of the five years under study, the expected value was greater than the observed value for each product. This implies that the Nigeria Bottling Company, Ilorin Plant has excess investment in inventory. We also observe that there is a positive correlation between sales and inventory usages. We, thus, concluded that inventory usage depends on sales that means as sales increases, inventory usages should also be on the increase.

Therefore, inventory management is a must for the continuity and survival of any goal focused manufacturing organization.

5. CONCLUSION AND RECOMMENDATIONS

Inventory management has become highly developed to meet the rising challenges in most corporate entities and this is in response to the fact that inventory is an asset of distinct feature.

The inventory management situation of the Nigeria Bottling Company, Ilorin Plant has been revealed using the EOQ model. It was also seen that the company through a well-built policy is able to handle its idle stock without incurring unnecessary costs. A basis for inventory planning and control was also provided in this study. Though looking through the inventory policy of the company, it can be said to be dynamic to some extent but the analysis and findings have revealed the need to remedy some situations in the company's management of inventory.

The study thus suggests some recommendations to remedy certain defects in the company inventory policy and if these recommendations are implemented, the company's inventory management situation will attain a greater height.

First, emphasis should be normally placed on the economic order quantity model because it was seen to be in the best interest of manufacturing companies to maintain an optimal level of materials in store, the level that minimizes total cost of investment in inventory. To achieve this successfully, different costs, which are associated with inventory, should be segregated and accumulated in such a way that EOQ can be easily determined.

Secondly, in the analysis we also mentioned that there was a positive relationship between inventory and sales and between inventory and production cost. This does not imply that inventory automatically determines production costs or sales and vice-versa. However, it does show that inventory levels can be a useful indication of what level of sales to expect. It is thus recommended that the sales and marketing department of the company should pay closer attention to the growth pattern of inventory usage and incorporate it in sales forecasting technique.

Lastly, materials management unit should also pay attention to sales growth over the years and thus take into consideration, the apparent relevance of sales and production cost in making decision with regards to inventory.

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