INVENTORY MANAGEMENT IN DELTA ALLIED WIRE INDUSTRIES LIMITED ASABA

By

Ifuwe, P.O.[1] and Agunwamba, J.C.[2]
1. SPDC, Warri
2. Dept. of Civil Engineering
University of Nigeria, Nsukka

ABSTRACT

A good inventory system reduces production cost and consequently increases profit. Optimum management of inventory in the Delta – Allied Wire Industries Limited was studied in this research. The information needed was obtained through questionnaire and interviews of key staff of the company. Data collated were recorded for the operational 5 years period (1997 – 2001) under review and customers' handling processes equally studied for improvement. The data collated were collated were analyzed using the Economic Order Quantity (EOQ) model under constant demand, non-instantaneous receipt as well as other possible scenarios. Results showed that if the order had been reduced from 12 per year to 2 or at most 5 per year savings of ₦602, 876 to ₦2,977,253 could have been made under constant demand. In addition, the company will have even greater saving if it encourages customers to purchase directly from the company than through the warehouses, thereby reducing the carrying cost. Recommendations based on the findings were made to the company for inclusion in future financial management planning and control.

INTRODUCTION

A firm's inventory commonly constitutes from 15 to 25 percent of its invested capital while incurs inventory carry cost ranges from 17 to 24 percent of average inventory value (Lamar and Donald, 1981). Hence, it is obvious that inventory policies affect profitability. There are several analytic models for optimum inventory management. Summer (1974) reviewed several analytical inventory techniques and classified them with a focus on the variables, parameters and set objectives. The classical economic inventory models are usually based on some assumptions which are difficult to satisfy (Wee, 1999). The assumptions include constant rate of inflation, no shortages and constant demand for inventory. In order to make the models applicable to real life problems, the classical models are usually modified. The modifications include ,the assumptions of constant inflation rate but with shortages (Onawunmi and Oluleye, 1998), inflation and inclusion of time value of money (Gurnami, 1981); extension of Gurnami work by considering demand as a variant of time (Hariga and Daya, 1996) and so on.

Several models have been proposed for describing inventory of items which

deteriorate or become damaged during normal storage. These models include those of Williams and Patuwo (1999) who considered perishable inventory with positive lead order times, Balkhi (1999) who considered the production situation with time varying demand and deterioration rates and Hwang (1999) who examined both the deteriorating case as well as the ameliorating case. In addition to the above models, Akanbi and others (2001) described a model for solving the inventory problem with the prevalent twin features of deterioration and inflation.

After testing the model using a case example of medical laboratory chemicals with limited shelf life yielded savings of 2.7%. The inventory system of a selected battery manufacturer was modeled as a dynamic system by Akanbi and others (2001). Optimistic and pessimistic policy runs were obtained by increasing or decreasing facility capacities by 25% among other parametric changes. While the optimistic policyis preferred to satisfy maximization of steady assembly, the pessimistic policy is preferred towards minimizing stock of finished batteries.

Hence, the study is aimed at studying stock inventory management in Delta Allied Wire Industries Limited for improved productivity while meeting the customers demand.

Although there are several applications of models in the study of inventory management of products, none has been applied to Delta Allied Wire Industries Limited. Since management identified the high cost of inventory, the ordering cost and carrying cost were investigated in details for identification of the possible problems and proffering solutions to them.

The main objective of this project is to find out how to improve the inventory management in Delta Allied Wire Industries Limited. The specific objectives are as follows:

1. To study the problems of inventory management of the company as regards product stocking in relation to production.
2. To investigate the level of inventory management on the overall profitability of the company.
3. To see how the inventory fits into an existing model and compare with the improved strategy.

The research covers a five years review of financial activities of Delta Allied Wire Industries Limited and it included a practical review of its inventory management. The inventory covers only the finished products of the company as the existing problem lies within lack of products in the warehouse and increase in inventory cost. Quantitative techniques would be employed in analyzing the data gathered.

Delta Allied Wire Industries Limited was incorporated in November 1994 with Registered office at Igbozor-Asaba Road, Asaba, Delta State. The company commenced production in 1997 and has a staff strength of 75 personnel.

The process of producing BRC welded Wire mesh/chain link fencing and rod straightening (BRC SE65 or SE66) is as detailed below.

Stage I: Reduction Plant
In the first instance, the raw material(s) goes to the reduction plant where the size of the raw material is reduced from 8mm or 6mm to 5.58 as required. Raw materials are obtained in 8mm or 6mm but the plant is installed to process 5.38mm. On reduction, the product are straightened.

Stage II: Basket Process
In the Basket Process the weaving takes place. After the reduction, the item are woven and cross-out into bars.

Stage III: Welding/Fabrication
In this last process of production, the item(s) are welded to size of SE66 as the case may be. As he wire mesh roll out from the machine, they are transferred to the stock-yard and they are ready for sale.

Storage in the premises (stock-yard) and two forklifts are maintained for the movement of inventories at each stockyard in Asaba, Warri, Lagos and Port Harcourt. On receipt, inventories are checked by the engineers and storekeepers to ensure that they conform with the specification ordered. Labourers are equally used to complement the forklift operations.

Each stockyard locations are controlled by its sales Manager who report to te company inventory Manager. Stockyard/Store voucher are not maintained but waybills are prepared for customers afer confirming payment.

METHODOLOGY

Questionnaire with structured questions were used for data generating. In addition, information were obtained directly in the form of personal interview and the interviewees embraced all classes of employee and manager that deal with inventory. Workers at the workshop equally provided information, as they perceived the company production and inventory system. The work reviewed and analyzed previous financial records and other relevant documents.

The storekeepers/stock-keepers were sampled for oral interviews. Data analysis were descriptive and quantitative. On the whole a total of 50 questionnaires were sent out, 40 of them were filled and returned. Categories of personnel mentioned above, ranging from the managers to the workshop floor men including the stock-keepers, filled the questionnaire.

Data Analysis
The data collated from the company were analysed using the EOQ model with constant demand, shortages and back ordering, and non instantaneous receipt of order. The impact of each of the above scenarios on the company profit was discussed in comparison with the existing inventory management.

Models Applied
The following models, aready derived in literature (Taylor, 1982), were used in the analysis.

EOQ Model with Constant Demand
This model assumes that the demand is known with certainty. The total inventory (TIC) cost is expressed as:

$$TIC = \frac{C_c Q}{2} + \frac{C_o D}{Q} \qquad (3.1)$$

Where C_c, Q, C_o and D are respectively the carrying cost per unit per year, the size of the order, cost of an order, and the demand per year.

The optimum order (Q) occurs where the total ordering cost equal total carrying cost and it is obtained as:

$$Q^* = \sqrt{\frac{C_o D}{C_c}}$$

And the time between order (T)

$$T = \frac{365}{D/Q^*}$$

Non-Instantaneous Receipt Model

One oft he assumptions of the last model is that an order is received all at once. In many case, however, an order is received over a period of time.

The total annual inventory cost is

$$TIC = \frac{C_c Q}{2} + \frac{C_o D}{Q} + \left(I - \frac{d}{r}\right) \quad (3.5)$$

Where *d* and *r* are the daily demand rate and daily rate of replenishment of inventory respectively.

$$Q^* = \sqrt{\frac{2C_o D}{C_c(I - d/r)}}$$

where Q^* is the optimum order; d = demand/365 and r = Annual production/365.

EOQ Model with Shortages and Back Ordering

In all the above models, shortages are not allowed. However, it can be economical to allow shortages and backorder demand and been able to meet demand, than keeping an excessive amount of inventory on hand to avoid shortages. The total annual inventory cost is given by

$$TIC = \frac{C_s S^2}{2Q} + C_c\frac{(Q - S)^2}{2Q} + \frac{C_o D}{Q}$$

Where TIC, Q, C_c, D and C_o are as previously defined. The parameter C_s is the shortage cost per unit and S is the maximum shortage level.

$$Q^* = \sqrt{\frac{2C_o D(C_s + C_c)}{C_c C_s}} \quad (3.2)$$

Where $S = Q^* \sqrt{\frac{C_c}{C_c + C_s}}$ (3.3)

The number of orders and the time between orders are as defined previously (D/Q and 365/No. of orders respectively).

All the above models are applied in the Delta Allied Industries Limited as vital analytic tools for solving its inventory problems.

(3.4)

Results and Discussions

The results obtained through interviews, questionnaires, critical study of the companies financial account and the application of the EOQ model under relaxation of most of its assumptions are presented below.

(3.5)

4.1 Inventory as Perceived by the Workers

Most of the workers interviewed, viewed inventory as the lifeblood of the company. Generally, they identified the key for effective inventory management to be as follows setting up an independent department for inventory staff, a good transport department to cater for movement of goods;

computerization of operations; increase in production capacity of the factory; adequate staff training and exposure, and the high amount of money in leasing warehouses for finished product stocking (Holding cost) can be reduced from about ¾ total cost to zero, if the company builds her own warehouses rather than leasing.

4.2 Procurement Procedure

The procurement method are the local purchase order and foreign purchases. Periodically, a hand to mouth buying method is employed. Request for replenishment comes from the production engineer. For local purchases, direct orders are placed with the rolling mills– Katsina, Jos or Oshogbo. The lead-time is three months on average. The mills dictate the types and quantities that can be supplied and deposits made against supplies.

The Delta Allied Wire Industries Limited has very serious problems and it has been escalating over the years. It was gathered that the company missed its quota by 10-155 due to inadequate and effective product stockings in their four (4) warehouses/storeyards. The company has been keeping a one (1) month supply of finished goods at hand in every warehouse, but this has not in any way met the field supply to the customers/warehouse as demands/request were not predicted. The company simply cannot get stocks moved to their warehouses from the factory because sometimes, there are none to move. Again, about 40% of the customer's orders of course are shipped out of the main factory warehouses. The customer's orders by so doing, gets more preference than the out station warehouses while the stock replenishment orders from outstation warehouses (branches) are pushed aside. The company inventory cost has been going up but this is attributed to poor management at the plant. The situation in the factory system has led to salesmen demoralization.

Another factor responsible for the low profit in the company is the inadequate budgetary and control during implementations. It takes policies and due processes to effectively monitor expenses with an audit department as a watchdog. The above is lacking in the operations management of the company.

For any smoothness of company operations, there must be effective operational communication between process department, procurement, inventory and sales unit to determine stocks and lots quantity to keep t he much needed process/product line in optimal operations.

4.3 Presentation of Company Data on Inventory

From Table 4.1 the company inventory cost rose while the profit reduced drastically due to either production cost or ineffective inventory management.

Table 4.1: Company data on Inventory

Year	Opening stock	No. of order/yr	Quantity produced	Inventory cost (₦)000'	Production cost (₦)000'	Sales (₦)000'	Gross profit (₦)000'	Qty demanded (Rolls)	Unit cost (₦)
1997	–	12	10,125	4,500	45,000	50,000	15,000	10,000	10,000
1998	125	12	13,111	4,100	70,250	74,250	14,000	13,000	11,000
1999	236	12	10,900	4,850	67,288	71,500	14,212	11,000	13,000
2000	136	12	14,510	5,160	10,712	113,500	15,980	14,500	14,500
2001	146	12	11,001	5,000	100,100	103,500	13,378	11,500	16,000

The number of orders per year every warehouse number of orders is twelve (12) times, including the customer orders that are handled directly in the base factory warehouse. In 1997, inventory cost ₦4,500,000.00 and the year's gross profit was ₦5,000,000.00 while the annual demand was 10,000 rolls of finished mesh wire. It was also noted that the company leases all its out station's warehoused except that in the factory referred to as "base factory warehouse." By so doing, spending the company's three-quarter (3/4) of its annual total inventory cost on payment of rents of the leased warehouses.

4.4 Inventory with Constant Demand

By applying the simple Economic Order Quantity (EOQ) model to the yearly data the company's Economic Order Quantity were obtained using equations 3.2 to 3.3 and compared with the corresponding actual values for the same year as shown in Table 4.2.

Since the ordering cost and carrying cost are not directly given, these important cost items which are very necessary for the inventory analysis must be determined. It is stated that the total carrying cost is 75% of the total inventory leaving 25% for the to total ordering cost. The calculations are illustrated using the data for the year 1997 (Table 4.1).

The corresponding annual inventory cost obtained by substituting back the value of Q* in the total inventory equation (3.1) is ₦3,897,124.

The number of orders per year $= \frac{D}{Q^*} = \frac{10000}{5846} = 2$ while

in between order $= \frac{365}{2} = 183 \text{ days}$

The calculation was repeated for the other years. The summary of the results is presented in Table 4.2.

Table 4.2: Optimal order quantity total inventory cost, time between orders and savings based on EOQ with constant demand

Year	C_c	N C_o	TIC	Q^*	TIC	Time between orders	No. of orders	Saving
1997	667	1,139,063	4,500	5,846	3,897,124	183	2	602,876
1998	467	122,171	4,100	2,394	1,122,747	79.4	5	2,977,253
1999	667	1,016,635	4,850	6,295	4,198,867	183	2	651,133
2000	533	1,290,890	5,160	8,381	4,466,910	183	2	693,090
2001	682	859,453	5,000	6,350	4,330,901	122	3	669,099

Table 4.2 shows that if the order had been reduced from 12 per year to 2 or at most 5 per year savings of x602,876 to x2,977,253 could have been made. Hence, it is recommended that the company reduce its inventory to at most 5 orders per year and not more than 8381 rolls of wire mesh.

Non-Instantaneous Receipt Model

The assumption in the previous model that an order is received all at once may not be realistic as far as Delta Allied Industries Limited is concerned. This is because it produces steel mesh as well as sells it. In fact, it is generally the practice that over 40% of the customers' orders are shipped out of the main factory warehouse.

The models to apply in this case have already been presented and a sample calculation is presented for the year 1997.

r = daily rate of replenishment of inventory $= \frac{10125}{365}$ for 1997 = 28 rolls/day

d = daily demand rate $\frac{10000}{365} = 27.40$

= 27 rolls/day

with C_o = x667 per order, C_c = x1,139,063 per order

the optimum quantity of order and total cost are 30,802 rolls and = x739,610.45 respective.

Savings = x4,500,000 – x739,610.45 = x3,760,389.55

No. of orders = once in 3 years.

The summary of the values obtained for 1997 to 2001 are given in Table 4.3 and 4.4.

Table 4.3: Values of rates of replenishment and demand

1997	1998	1999	2000	2001
28	36	30	39.75	30
27	30	36	39.7	43.8
0.036	0.17	–0.20	0.0013	–0.46

Table 4.4: Optimal results and coefficients for non instantaneous Receipt Model

Year	C_c x	N C_o x 103	TIC	Q^*	TIC	Time between orders	No. of orders	Savings
1997	667	1,139,063	4,500	30,802	739,610.45	3 years	1 in 3 yrs	3,760,389.55
1998	469	122,171	4,100	12,616	213,026.23	1 year	1 per yr	3,886,973.77
1999	667	1,016,635	4,850	33,175	–	2.5 years	1 in 2.5 yrs	–
2000	533	1,290,890	5,160	44,168	439,090.80	3 years	1 in 3 yrs	4,720,909.17
2001	682	859,453	5,000	33,465	–	2 years	1 in 2 yrs	–

Table 4.4 shows that the company stands to make greater savings if it encourages customers purchasing directly from the company than through the warehouses. This reduces the total carrying cost. The savings are above 1.3 to near 7 times higher. However, this model can only be applicable if the production rate is greater than the demand rate; that is if r > d. Hence, there were no value given for TIC^* in 1999 and 2001.

4.6 The EOQ Model with Shortages and Back Ordering

In this section, the case of inventory with allowance shortages is considered. During the shortages the wire mesh store will be unable to meet demand and will back order wire mesh. Some costs will be incurred due to these shortages and they consist of lost present and future sales due to customer dissatisfaction, late delivery costs for back orders, and special labour cost for handling back orders.

A sample of the calculations is presented as was done in the previous section for the shortage cost, Cs (per roll of wire mesh per year) is assumed to be x2000. Hence, from equation (3.7).

$$Q^* = \sqrt{\frac{2(139063)(667 + 2000)}{667(2000)}}$$

$$= 68 \text{ rolls per order.}$$

From equation (3.6),

$$TIC^* = \frac{2000S^2}{2(68)} + \frac{667(68 - S)^2}{68} + \frac{1,139,063(10000)}{68}$$

But $S = Q^* \sqrt{\frac{C_c}{C_c + C_s}}$

$$= 68\sqrt{\frac{667}{667 + 2000}} = 34$$

$\therefore$ TIC* = 17000 + 11339 + 167,509,264.7

= x167,537,603.7

The too high TIC cost makes this scenario very unattractive. It will be very expensive to embark on inventory policy with shortages allowed. Already the customers are disgruntled. This policy will increase their level dissatisfaction and the company will ultimately lose most of its customers.

From the study carried out, it is obvious that the nature of inventory practiced

by the company has some limitations.

1. The system of accounting does not record inventory cost clearly.
2. The stock keeping records don not appear to be satisfactory.
3. The company inventory are not classified in accordance with ABC classification.
4. Ordering level is done mostly from all warehouses to cater for customers request and sales demand.
5. No much responsibility was given to inventory staff.

Generally, the poor management of inventory has resulted in great losses amounting to millions of naira for some of the years under study. It is obvious that for better management and for achieving greater profitability, management needs to analyse its inventory problems critically. It will be more profitable to emphasize customers purchasing directly from the company production unit since the warehouse could not be adequately stocked. However, the level of production should be increased so as to utilize the warehouse adequately.

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The objective of this work was to find out how Delta Allied Wire Industries Limited manages its business with effective cost control in operation and value for money in other to improve the company's profit.

From the analysis it was gathered that the company from the onset have been losing money from too high frequency of order lots from their policy of monthly stock orders. This was made possible by high cost of logistics and other handling charges in servicing the company's monthly orders. From the comparison made the company obviously lost between x3 to x4 million each of the operating year due to poor inventory cost management. Relatively, these loses have affected the company in one way or the other for five years.

5.2 RECOMMENDATIONS

Managers manage better when functions are defined. The company should formalize its organization structure and line-staff function relationships clearly defined. The company should design a management information system so as to facilitate the flow of information from one department to another and ease assimilation of information passed out.

The lack of budgetary control system is a great weakness in management by objective and exception. The actual cost of inventory broken down into Demand, Holding and Ordering Cost would be compared periodically with the budgeted figure and variances explained.

There should be sound planning and authorization procedure for incurring any expenses and the provision of relevant information to ensure achievement of the objectives of the company. The present financial system should integrate costing system and when operational, management would easily determine the ordering cost and holding cost. Store responsibilities should be divorced from the production Engineer's functions and a cost accountant employed to take charge of the stores. A management information system would be evolved to

ensure a monthly flow of information between the accounting, stores and production department.

A strong and independent Inventory department should be evolved to totally be responsible for inventory management system across operations. They should work with approved company guidelines and quarterly scorecard of achievement made available.

Elements of inventory carrying costs for example, transportation, insurance, interest charges etc, should be well accounted for as much. The company should evolve twice a year stock orders for all its warehouses including that of direct customers, this will reduce inventory cost instead of the existing monthly orders from all locations. By this, the factory operations will treat warehouses order as that of direct customers.

Therefore, it is worth noting that for Delta-Allied Wire Industries Limited to maintain its level of production capacity and to meet its clients demand, drastic action plan towards achieving barest minimum total inventory cost must be adhered to strictly.

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