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Research Article

Evaluating the Impact of Economic Order Quantity Strategy on Organizational Performance

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Abstract— The primary objective of this research is to assess the Inventory Control Analysis utilizing the Economic Order Quantity (EOQ) Method at Nina Plastic Ltd. The data collection process involved a preliminary survey, literature review, and field survey. Descriptive analysis was employed for data analysis. The study's findings reveal that, based on EOQ calculations, the optimal quantity for purchasing 500ml bottles and kettles is 1,008,425 units. Notably, there is a cost saving of approximately ₦ 217,409 per year for 500ml bottle raw materials (13.84% reduction) and around 5.88% for kettle making raw materials. The determined safety stock comprises 25,494 units of 500ml bottles and 531 units of kettles, necessitating 15 order placements per year. Additionally, the research identifies a maximum inventory of 107,429 bottles and 1,955 kettles, with reorder points set at 49,026 bottles and 1,021 kettles.

Keywords— Inventory Control, Economic Order Quantity Method, descriptive analysis

1. Introduction

In contemporary Nigeria, the business landscape is experiencing rapid growth, marked by the proliferation of diverse businesses ranging from individual-owned small enterprises to large corporations with numerous subsidiaries. Consequently, heightened competition necessitates strategic thinking for companies to thrive, achieve their ultimate goal of maximizing profits, and secure a competitive edge. Vital to this success is the imperative for companies to enhance their performance, particularly in the production process, ensuring the delivery of quality products that meet consumer expectations.

Achieving an optimal production process demands a harmonious balance among various factors of production, including raw materials, capital, machinery, methods, and human resources. Of these factors, raw materials hold particular significance due to their pivotal role in facilitating a smooth production process [1]. Every company, therefore, must engage in effective planning for raw material needs, aligning these plans seamlessly with all elements within the organization. It is acknowledged that different companies adopt varying approaches to manage raw material inventory, encompassing considerations such as the quantity of units, utilization timelines, and total procurement costs.

However, the commonality lies in the importance of proper management of raw material inventory for efficient production activities. Without meticulous inventory management, companies risk inefficiencies and potential losses. Excessive quantities of raw materials can incur storage costs, heightening the risk of damage during storage. Additionally, companies must allocate substantial funds for the procurement of such materials, potentially diverting capital from other investment opportunities [2]. Consequently, an excessively large raw material inventory can impede progress in other areas of the company. The study which is based on the Economic Order Quantity (EOQ) is a fundamental concept in inventory management, aiming to determine the optimal order quantity that minimizes total inventory costs. Understanding the impact of EOQ strategy on organizational performance helps companies optimize their inventory levels, leading to cost savings and improved efficiency.

2. Related Work

Research conducted by Akindele O. reveals significant increases in raw material inventory for each year between 2018 and 2020. Utilizing the Economic Order Quantity (EOQ) method, the study demonstrates cost savings compared to existing company policies. While the EOQ method proves effective, it is essential to note potential

drawbacks, such as inadequate raw material supply resulting in production disruptions [3].

Insufficient raw materials can disrupt production processes, compromising the quality of the final product. Small quantities may necessitate more frequent purchases, increasing ordering costs for the company. To enhance overall efficiency, companies should plan raw material procurement activities meticulously, minimizing costs, and fostering operational efficiency. The Economic Order Quantity (EOQ) method emerges as a particularly efficient approach to raw material inventory control, providing insights into the optimal inventory quantity, associated costs, and the ideal time for reordering (Re-order Point) [4].
Nina Plastics Ltd., a family business engaged in plastic material trading across the North East, has not yet adopted the EOQ method for inventory procurement. Motivated by this, the authors aim to conduct research titled "Evaluating The Impact Of Economic Order Quantity Strategy On Organizational Performance Through Inventory Control." The research seeks to address the following key questions:

a. What is the requirement for economical and optimal raw materials in Nina Plastics Ltd., as determined by the Economic Order Quantity method?
b. b. What is the necessary safety stock for Nina Plastics Ltd., calculated using the Economic Order Quantity method? c. When should Nina Plastics Ltd. initiate a reorder (Reorder Point) for inventory when employing the Economic Order Quantity method?

The research objectives are:

a. To determine the economical and optimal quantity of raw materials needed by Nina Plastics Ltd.
b. To identify the required safety stock for Nina Plastics.

To establish the appropriate time for reordering (Reorder Point) of inventory for Nina Plastics Ltd.

3. Materials and Method

The types of data employed in this study encompass both qualitative and quantitative data. Qualitative data are derived from Nina Plastics Ltd, encompassing both oral and written information. These qualitative aspects include the historical background of Nina Plastics Ltd, the organizational structure, and job descriptions of employees within the company. On the other hand, quantitative data are extracted from inventory reports specific to Nina Plastics Ltd. The sources of data encompass both primary and secondary data.

Primary data used in this study primarily consist of inventory data and inputs from individuals involved in inventory valuation at Nina Plastics Ltd. This includes insights from all parties playing a role in the inventory assessment process within the organization.

Secondary data, on the other hand, are obtained through literature studies, economic magazines, and various documentation accessible through online sources, such as the internet.

The study's population is represented by the inventory data applying the Economic Order Quantity method at Nina Plastics. For the purpose of this study, the sample is drawn from the Economy Order Quantity inventory data specific to Nina Plastics for the year 2023.
To collect the necessary data for the study, the following methods are employed:

3.1. Determine Economics Order Quantity (EOQ)

The Economic Order Quantity (EOQ) is a quantity that minimizes the total cost of inventory, taking into account both order costs and holding (storage) costs. The calculation of the EOQ involves determining the optimal order quantity that balances the expenses associated with placing orders and storing inventory. By using the following formula [9].

$$EOQ = Q^* = \sqrt{\frac{2DS}{C}} \quad (1)$$

Where, Q * = the quantity of goods at each order, D = Number of requests for raw materials in a period, S = Cost every time you order, and C = Storage cost per unit.

3.2. Determine the Total Inventory Cost

The total inventory cost is the combined cost of holding (storage) and ordering costs. The minimum total inventory cost occurs when the holding cost equals the ordering cost. At this point, the order quantity is considered the most economical order quantity, often referred to as the Economic Order Quantity (EOQ). To determine the total inventory cost, the following formula is used [9]:

$$TC = \left(\frac{Q}{2}\right) C + \left(\frac{D}{Q}\right) S \quad (2)$$

Where, TC = Total Inventory Cost, Q = Number of items per order, D = Annual demand for supplies, in units, S = Order fee for each order, and C = Storage cost per unit.

3.3. Determine Safety Stock

To ascertain the expense of the inventory utilized, a statistical analysis was employed. This involved examining the discrepancies between the anticipated consumption of raw materials and the actual usage, thereby establishing the standard deviation. The standard deviation formula is as follows [10]:

$$SD = \sqrt{\sum \frac{x - x^2}{N}} \quad (3)$$

Where, SD = Standard Deviation, X = Real Use, X = Estimated Usage, and N = Amount of Data. Assuming that the company uses 5% deviation and uses one side of the normal curve (the value can be seen in the standard table = 1.65), the Safety Stock calculation is as follows [11]:

$$SS = 1.65 \times SD \quad (4)$$

Where, SS = Safety Stock, and SD = Standard Deviation

3.4. Re-order Point

Re-order Points can be calculated by adding up the need for raw materials during Lead Time plus the amount of safety stock inventory. So Re-order Points can be calculated by the formula [11]:

$$ROP = (d \times L) + SS \quad (5)$$

Where, ROP = Re-order Point, d = level of need, L = Lead Time, and SS = Safety Stock.

4. Results and Discussion

So far, Nina Plastics Ltd. has not implemented the Economic Order Quantity (EOQ) method for inventory control. The current inventory management involves a straightforward approach, where raw materials are ordered based on production requests, occurring every 14 days. Consequently, this method often leads to either surplus or insufficient raw materials. Therefore, precise calculations are essential for determining optimal inventory levels, with one such method being the Economic Order Quantity (EOQ). This study focuses on EOQ calculations, utilizing data from the preceding three years, spanning from 2021 to 2023. The raw material requirements for this period are outlined as follows:

Table 1: Need for 500 ml bottle raw materials and plastic kettle on Nina Plastics Ltd.

Year	Raw Materials	Packaging Needs /Year (Units)	Frequency of Bookings
2021	500ml bottle	1,008,124	21
	Plastic kettles	21,003	21
2022	500ml bottle	1,008,425	21
	Plastic kettles	21,009	21
2023	500ml bottle	1,008,428	21
	Plastic kettles	21,009	21
	Total	**3,087,998**	

Raw material orders are placed 21 times annually, and the lead time is 7 days. These procedures are consistently followed each year without taking into account any alterations in the company's environment or production conditions. The ordering costs for Nina Plastics Ltd vary from year to year. The booking fees are as follows:

Table 2 The expenses associated with the procurement of raw materials at Nina Plastics Ltd.

Year	Product	Cost Per Message (₦)
2021	500ml bottle	1,008,124
	Plastic kettles	21,003
2022	500ml bottle	1,008,425
	Plastic kettles	21,009
2023	500ml bottle	1,008,428
	Plastic kettles	21,009

Costs included in the storage costs on the Nina Plastics is the cost of electricity, the cost of supervision and maintenance. Where from year to year it has increased due to high consumer demand.

Company Policy Calculations that occur in the Nina Plastics fluctuates every year. The Company Policy Calculation is as follows:

Table 3 The computation of corporate regulations on Nina Plastics.

Year	Product	Packaging Needs /Year (Units) (D)	Frequency (f)	Average Order Amount Q=(d/f)
2021	500ml bottle	1,008,124	21	48,005
	Plastic kettles	21,003	21	1,000
2022	500ml bottle	1,008,425	21	48,020
	Plastic kettles	21,009	21	1,000
2023	500ml bottle	1,008,428	21	48,020
	Plastic kettles	21,009	21	1,000

The provided table illustrates the raw material acquisitions carried out by Nina Plastics from 2021 to 2023. Furthermore, the required supplies remain relatively consistent each year, as there is only a marginal difference in the number of requests, and the order frequency remains unchanged annually at 21 times. The data derived from calculations using the Economic Order Quantity (EOQ) method for Nina Plastics is outlined below.

Table 4 EOQ calculations on Nina Plastics.

Year	Product	Frequency ($F = \frac{D}{Q^*}$)	Order Amount $EOQ = Q^* = \sqrt{\frac{2DS}{C}}$
2021	500ml bottle	12	85,047
	Plastic kettles	15	1,434
2022	500ml bottle	12	85,050
	Plastic kettles	15	1,408
2023	500ml bottle	12	81,933
	Plastic kettles	15	1,424

In light of the aforementioned information, the number of orders exceeds the company's policy. Nina Plastics has gradually reduced the order frequency from the initial 21 times per year to only 12 and 15 times in subsequent years. The computation of total inventory costs using the Economic Order Quantity (EOQ) method is intended to determine the efficiency value achievable through optimizing the company's inventory amount. The data obtained from the calculation of inventory cost savings in Nina Plastics is as follows:

Table 5 Savings in inventory cost on Nina Plastics.

Year	Product	Company Policy (₦)	EOQ (₦)	Savings (₦)
2021	500ml bottle	366,416	313,705	52,711
	Plastic kettles	270,655	253,962.	16,692
2022	500ml bottle	406,680	348,224	58,456
	Plastic kettles	292,963	276,666	16,298
2023	500ml bottle	422,725	368,819	53,905
	Plastic kettles	326,963	307,617	19,347

The table provided indicates that implementing the EOQ method for controlling raw material inventory at Nina Plastics Ltd is seen as viable. The company stands to make significant savings on raw material procurement, particularly for 500ml Bottles and Plastic Kettles. As per Samuel A. (2019), calculating total inventory costs through the EOQ method can lead to cost efficiencies. This is because it helps determine an optimal ordering frequency, thereby reducing both ordering

and storage costs. Nina Plastics currently budgets for safety stock of raw material packaging, keeping it relatively conservative due to the perceived ease of obtaining raw materials promptly. The estimated safety stock for 500ml bottles is approximately 150,000 units and for plastic kettles around 6,500 units. Additionally, the company plans to calculate safety stock using deviation analysis, considering acceptable tolerance limits and service ratios. With a tolerance limit of 5% and a service ratio of 95%, the safety factor is set at 1.65. Safety stock calculations according to the EOQ method with deviation analysis for 500ml bottles and plastic kettles were 25,501 bottles and 531 kettles in 2021, 25,494 bottles and 531 kettles in 2022, and 25,496 bottles and 531 kettles in 2023.

Thus far, Nina Plastics determines the maximum inventory for packaging raw materials based on the average amount ordered plus safety stock. This calculation aims to prevent shortages or excess inventory, both of which can disrupt production and distribution processes, leading to potential losses. The maximum inventory using EOQ is detailed in the table below.

Table 6 Maximum Inventory Computations on Nina Plastics Ltd

Year	Product	Safety Stock (SS)	EOQ (₦)	Maximum Inventory (EOQ+SS)
2021	500ml bottle	25,501	85,047	110,548
	Plastic kettles	531	1,434	1,966
2022	500ml bottle	25,494	85,050	110,543
	Plastic kettles	531	1,408	1,939
2023	500ml bottle	25,496	81,933	107,429
	Plastic kettles	531	1,424	1,955

Reorder Points (ROP) are used to monitor inventory items, so that when ordering goods returned ordered items will arrive on time [11]. Nina Plastics Ltd schedules reorder points based only on the time and estimated number of consumer requests, so re-ordering will be done when inventory in the warehouse starts to feel a little amounting to around 550,000 for bottles and 15,000 for Plastic Kettles. Table 4.8 shows the reorder point calculation according to the EOQ method.

Table 7 Reorder Point computations on Nina Plastics Ltd

Year	Product	D	Q	Lead Time	SS	ROP
2021	500ml bottle	1,008,124	3,360.42	7	25,501	49,024
	Plastic kettles	21,003	70.00	7	531	1,021
2022	500ml bottle	1,008,425	3,361.44	7	25,493.50	49,023
	Plastic kettles	21,009	70.05	7	531	1,021
2023	500ml bottle	1,008,428	3,361.44	7	25,496	49,026
	Plastic kettles	21,009	70.05	7	531	1,021

5. Conclusion

The number of purchases of 240 ml bottle materials and kettles according to EOQ calculation is 1,008,425 5000ml bottle and kettles are 21,009 units. Savings on inventory costs of 13.84% are around ₦ 217,409 for 500ml bottle raw materials per year and kettle making raw materials around 5.88%. The safety stock amounted to 25,494, 500ml bottle and kettles around 531 units, with ordering frequency as much as 15 times a year. In addition it was found that a maximum inventory of 107,429 bottles and 1,955 kettles with reorder points of 49,026 bottles and 1,021 kettles.

Data Availability

The data used in this project has been sourced from various repositories, databases, and literature.

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