



Optimizing Material Management in Manufacturing: A Process Inventory Study of 7Up Bottling Company

Chinonso Betran Meremikwu

Department of Mechanical Engineering Technology, Imo State Polytechnic, Omuma, Nigeria.

E-mail for correspondence: chinonsomeremikwu@yahoo.com

Abstract	Article History
<p>This research analyzes the economics of material management in the Seven-Up (7Up) Bottling Company, Enugu, from 2018 to 2022, with the objective of designing an effective process inventory system. The study examines specific objectives related to product improvement and internal material management practices, offering practical recommendations for optimizing material usage. The Economic Order Quantity (EOQ) model was employed to analyze the collected data. The findings indicate that the company incurred a total production cost of ₦118.8 million while generating total sales revenue of ₦395.84 million. This suggests that the adoption of the EOQ model in production planning and material management contributes to operational efficiency and profitability. Based on these findings, the study recommends that optimizing the quality and timing of material orders is essential for maximizing profits in the manufacturing process.</p> <p>Keywords: <i>Economic order Quality (EOQ) model, seven-up, manufacturing firms, material management, process inventory, variance Analysis.</i></p>	<p>Received: 28 Jan 2025 Accepted: 04 Feb 2025 Published: 06 Feb 2025</p> <div data-bbox="1157 853 1409 1081" style="text-align: center;"> </div> <p style="text-align: center;">License: CC BY 4.0*</p> <div data-bbox="1157 1122 1399 1193" style="text-align: center;"> <p>Open Access article</p> </div>
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1. Introduction

Inventories has been described as the life wire of any manufacturing firm, it represent investment designed to assist in manufacturing activities and or serve customers without any doubt, inadequate supply of inventories may grind manufacturing operations into a half (Aashua & Vivek, 2016, Unyimadu, 2014). The importance of material to efficient operation of a manufacturing firm cannot be over emphasised, in that the availability of the material in the right quality and quantity will determine to a reasonable extent, the availability, quality and quantity of the resultant output. Material management is critical to the overall performance of a manufacturing concern. Beside demand and other forces like competitor's actions and general price index, raw material situation in terms of efficient management and effective planning determines the activity level, the turn-over and the ultimate profit in a given company. The determination of economic order quantity (EOQ), re-order level and minimum/maximum stock level is important in material management in any manufacturing outfit. The material function is assumed to be organized and operational on an integrated basis and is also presumed to be responsible for

material forecasting planning, inventory control, serap control and disposal, providing management information regarding purchases and inventories within the framework of the financial policies and norms. A glance at these functions will reveal the intricacies involved in maintaining balanced policies on material management.

Material management being the co-ordination of efforts (Planning, controlling, organizing, directing) towards achieving efficiency in the procurement, transportation, stocking and utilization of inputs of a manufacturing organization is therefore central to production activities and management. Effective and efficient functioning of the material has direct bearing on the total performance of the organization.

The management of raw material in manufacturing organization therefore deserves attention and critical study in order to achieve uninterrupted production runs and enhanced performance in operations (Khalid, 2008). Besides, holding the right stock level could improve the level of available working capital that could be profitably employed in other

areas. These objectives could only be achieved through integrated approach to material management functions by combining planning, procurement and inventory control the process.

The process of control and management of material is a very important factor in the success or failure of any business for example; little stock will result in stock out which will disrupt the production distribution cycle that is crucial to the survival of all manufacturing companies while too much stock will tie down the resources of a company. Poor or inadequate material management can present a serious challenge to the productive capacity of a manufacturing organization. In addition to raw materials and finished goods, many companies also maintain items of assets, property, inventories of work in progress, office supplies, business firms and general operation supplies. Materials often constitute the most significant part of current assets of large companies. In the public limited companies, materials, especially raw materials are approximately 60% of current assets on the average. The US Bureau of census stated that inventory and accounts receivable are the two largest accounts of equal magnitude and together they comprise almost 80% of current assets and over 30% of total assets for all manufacturing companies. Considering the large sum of money that is committed to the stock of raw materials, work in progress and finished goods, it is therefore of paramount necessity that these stocks be managed efficiently and effectively in order to avoid the jeopardizing of the profit position of the firm. In material management, there is an optimum level therefore inadequate inventory causes loss of sale and disrupts the production process while excessive stock level leads to unnecessary carrying cost and obsolescence or spoilage risks. According to Homgren (2007), the optimum inventory level lies between the inadequate inventories and the excessive inventories. Materials management aims at maintaining an optimum inventory level that will be carried at the least cost.

1.1 Concept of materials management.

Materials management is a tool to optimize performance in meeting customer service requirements at the same time adding to profitability by minimizing costs and making the best use of available resources. The basic objective of materials management as explained by Banjoko (2000) and Jacob et al. (2009) is to ensure that the right item is bought and made available to the manufacturing operations at the right time, at the right time place and at the lowest possible cost. According to Wild (1995), materials management is a concept, which brings together the responsibility for determining the manufacturing requirement that is scheduling the manufacturing processes and procuring, storing and dispensing materials (Ondiek, 2009; Wild, 1995).

An integrated approach to material management defines it as the function responsible for the coordination of planning, sourcing, purchasing, moving, storing and controlling materials in an optimum manner so as to provide a predetermined service to the customer at a minimum cost. Ramakrishna (2005) and Gopalakrishna & Sundaresan (2006) gave definitions that provide the scope of materials management, which includes materials requirements planning

(MRP), decision on purchasing, procurement of materials, inventory management, staffing stores and warehouse management, production and distribution of finished goods at minimum cost at due time (Mondy, 2008; Ogbadu, 2009; Osotimehin, 2006).

Chase et al. (2009) explained the concept of materials management brings in the total systems approach to managing the entire flow of information, materials and services from raw materials suppliers through factories and warehouses to the end user/customer. The study further confirmed that a firm's success depends on how they manage their materials effectively. This indicates that it is important to monitor inventory at each state because it ties up resources. Therefore, effective materials management is fundamental to the survival of business, industry and economy.

1.2 Concept of Inventory

Inventories are vital to the successful functioning of manufacturing and retailing organizations. This is because many companies hold inventories as part of their business operation. Inventories made up the most significant part of current assets of most companies especially the manufacturing companies. The need for management to ensure inventory control if properly managed cannot be over emphasized. A firm neglecting inventory management will be jeopardizing its long run profitability and it may end up failing in its business. The definition of inventory has been defined by many professional bodies and scholars in different ways. The Microsoft Encarta premium defined it as the quantity of goods and materials on hand. A manufacturer's inventory represents those items that are ready and available for sale.

According to Jain et al (2010), inventory is the aggregate of these items of intangible property which are held for sale in the ordinary course of the business, held in the process of production for such sales to be currently consumed in the production of goods and services to be made available for sale. However, according Ama (2009), inventory is the stock of goods a firm is producing for sale and the components that make up the goods. A key decision in manufacturing and retail is how much inventory to keep on hand once an inventory level is established, it becomes an important input to the budgeting system.

1.3 Techniques of inventory

The following are techniques that are used for the calculation of inventory so that we can have a control over inventory (Sharma & Arya, 2016):

- (a) Economic Order Quantity (EOQ): This is the ideal order quantity a company should purchase for its inventory given a set cost of production, demand rate and other variables. This is done to minimize variable inventory costs, and the equation for EOQ takes into account storage, ordering costs and shortage cost.
- (b) Safety Stock: This is an additional quantity of an item held in inventory in order to reduce the risk that the item will be out of stock, safety stock acts as a buffer in case the sales of an item are greater than planned and / or the supplier is unable to deliver additional units at the expected time.

This paper studied the economics of material management in the 7Up Bottling Company, Enugu and it determine the level of efficiency and product improvement in material management and investigates whether the material management practice permit high stock turnover validation and to proffer useful suggestions and idea on how to effectively manage materials.

2. Research Methodology

The study was conducted in seven-up bottling company, Enugu, Enugu State. The choice of the branch in Enugu state was guided by the fact that it is one of the active production plants of the company. The staff from the quality control department were specifically chosen to ensure that data collected were accurate, relevant and dependable thereby making this study more effective and its result reliable. The raw materials that serve as input being used by the company for manufacturing of its assorted processes can be classified into core raw materials and packaging materials.

Core raw materials are sugar, acciducant, concentrate and hydrated lime while the packaging materials in carton/crate include 7 Up, Mirinda Orange, Mirinda, Pepsi and Mountain

Dew (all 24 bottles in a crate). The study adopted procedures for this determination of optional order size, optimal number of orders, optimal time between orders and optimal number of unit per production run. The cost of raw materials using economic order quantity and the cost saving effect was examined using EOQ model as follows:

$$EOQ = \sqrt{\frac{2COD}{CC}}$$

Where, Co = The ordering cost; Cc = The carrying cost; D = The annual demand.

3. Results and Discussion

Data Collection

Figure 1 and 2 compared the budgeted and actual sales of seven-up Bottling company. As observed in (figure 1), the company witnessed a surplus for the five years understudy, because there was a positive variation in each of the years. Positive variation indicates efficiency on the part of the company while negative variation indicates inefficiency since the basic objective of any profit-making company is to maximize sales.

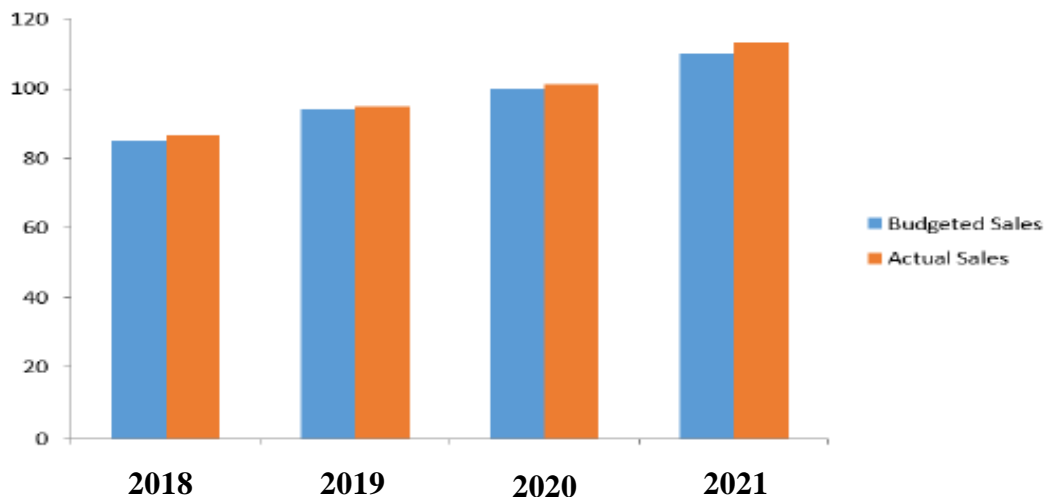


Figure 1: Comparison of budgeted and actual sales (in millions of naira)

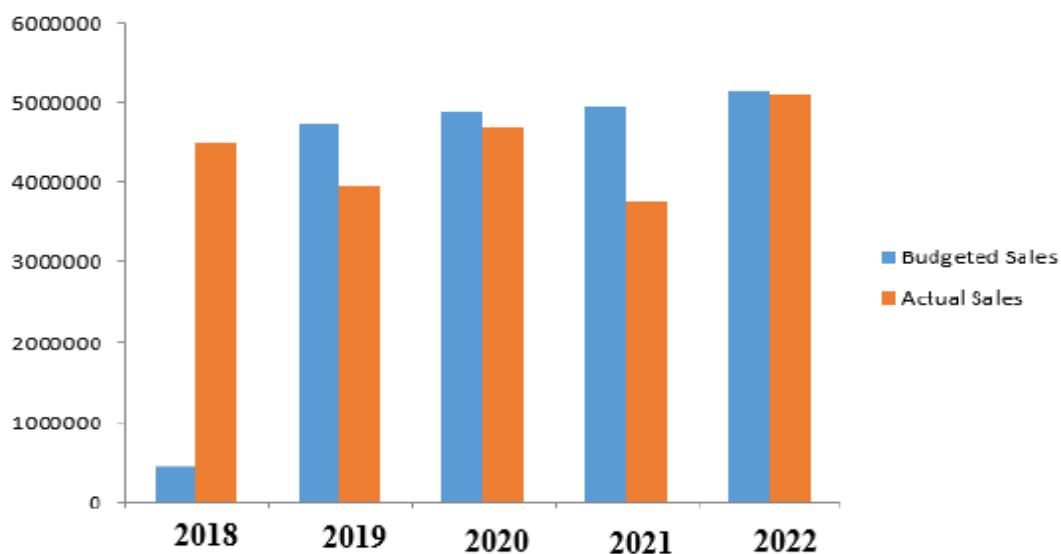


Figure 2: Sales in crates (volume of production)

From Figure 2, the variance reflects, the inability of the company to meet its target for a period of four years understudy. Upon interviews, it was 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 1 shows the annual demand, ordering cost, carrying costs of raw and packaging material of Seven-Up for the duration 2018-2022.

Table 1: Annual demand, Ordering cost, Carrying costs of raw and Packaging material of Seven-Up for the duration 2018-2022.

Years	Annual demand	No. of Orders	Material unit cost	Ordering costs of raw	Carrying cost as a unit
Sugar					
2018	840,000	3	320,000	7,000	4,000
2019	900,000	3	360,000	8,000	4,000
2020	950,000	3	410,000	9,000	5,000
2021	1,010,000	3	480,000	11,000	6,000
2022	1,070,000	3	520,000	12,000	6,000
Concentrate					
2018	450,000	3	210,000	8,000	3,000
2019	600,000	3	220,000	10,000	3,000
2020	700,000	3	230,000	12,000	4,000
2021	720,000	3	240,000	13,000	4,000
2022	800,000	3	250,000	20,000	5,000
Acciducant					
2018	650,000	3	240,000	9000	3,000
2019	840,000	3	300,000	10,000	3,000
2020	900,000	3	330,000	11,000	3,000
2021	950,000	3	350,000	13,000	3,000
2022	1,000,000	3	400,000	14,000	3,000
Hydrated lime					
2018	650,000	3	240,000	9000	3,000
2019	840,000	3	300,000	10,000	3,000
2020	900,000	3	330,000	11,000	3,000
2021	950,000	3	350,000	13,000	3,000
2022	1,000,000	3	400,000	14,000	3,000
Packaging materials					
2018	650,000	3	240,000	9000	3,000
2019	840,000	3	300,000	10,000	3,000
2020	900,000	3	330,000	11,000	3,000
2021	950,000	3	350,000	13,000	3,000
2022	1,000,000	3	400,000	14,000	3,000

Table 1, the inventory purchased for process for the period 2018-2022 indicated that the company had a total sugar demand of 4,770,000 in 15 numbers of orders at a total unit cost of ₦2,090,000, which cost the company ₦25,000 for carrying these materials.

For concentrate, the company made an overall total demand of 3,270,000 on 15 numbers of orders at a total ordering cost of ₦63,000 for ₦1,150,000 unit cost. For acciducant, it costs the company ₦15,000 to carry acciducant material units with a cost of ₦1,620,000 after making a total 4,340,000 in 15 numbers of orders within the specified period of 2018-2022. Hydrated lime, which is another very important inventory for Seven-Up Bottling Company in the processing of their product cost the company ₦15,000 for carrying a total unit of

₦1,570,000 after making a total demand of 4,340,000 in 15 numbers of ordered from 2018-2022. Packaging materials used for the production of bottles and corks were ordered in 15 numbers of ordering within 2018-2022 and it cost the company ₦15,000 to carry a total unit worth of ₦1,720,000 after demanding 4,690,000.

Table 2, showed the ordering time between materials while Table 3 showed the EOQ and Total Cost

Table 2: Ordering Time between Materials (in days)

Materials	Ordering Time in Days						
	2018	2019	2020	2021	2022	Total	Average
Sugar	250	300	317	337	356	1570	314
Concentrate	150	200	233	240	267	1090	2118
Acciducant	217	280	300	317	333	1447	289
Hydrated lime	280	300	317	337	280	1514	303
Packaging Materials	267	280	320	350	367	1584	317

Table 3: EOQ and Total Materials Cost (2018-2022)

Years	Optimum Order of Quality (Q) units	Total Materials Cost
Sugar		
2018	3031.08	2,133,891.72
2019	1000	722,180
2020	9133.16	1,872,298.05
2021	2777.6	4,399,830.39
2022	9072.56	2,830,575.9
Average		2,391,755.212
Concentrate		
2018	33806.6	1,171,395.98
2019	13483.9	889,943.8
2020	13513.2	1,243,221.62
2021	13964.2	7,373,147.60
2022	16000	11,000,000
Average	18153.6	4,335,541.68
Acciducant		
2018	12747.54	917,823.51
2019	13662.60	1,229,634.05
2020	4045.19	2,647,587.95
2021	48500.135	2,800,955.32
2022	4830.45	3,188,107.6
Average	8027.18	2,156,821.69
Hydrated lime		
2018	34156.50	132,597.42
2019	11925.69	590,321.77
2020	46904.15	743,892.48
2021	4994.94	2,734,736.52
2022	1527.52	1,008,169.40
Average	1285943.5	1,041,943.52
Packaging materials		
2018	13601.47	648,459.28
2019	4320.49	2,138,645.96
2020	14605.93	1,445,987.55
2021	16124.51	1,693,074.13
2022	16020.8	1,922,478.37
Average	9730.48	1,569,729.06

From Table 2 above, the company in 2018 at every 250 days, orders were placed for unit quantity of sugar, while in 2019, the company placed orders for sugar at every 300 days interval to replenish stock. In 2020, orders for unit quantity of sugar were made at every 317 days and in 2021 stock were replenished for 337 days interval. In 2022, the company placed orders for unit quantity of sugar for 356 days, meaning only once a year. Generally, the ordering time for sugar averaged 314 days within 2018 – 2022.

For concentrate another important raw material for the processing of their product, it can be clearly seen that in 2018, the company order for 150 days intervals and in 2019 orders, were made at every 200 days intervals. In 2020, orders were made at 233 days interval and in 2021 orders were made at every 240 days intervals. In 2022, the company order unit quantity of concentrate at every 267 days in a year. This implies that the time of ordering average 218 days within 2018-2022.

For acciducant and hydrated lime, the ordering time averaged 289 days and 303 days. Within 2018 – 2022. For packaging materials, the average ordering time is 317 days. The ordering time gives an indication of how inventory is managed to minimized cost and maximized production in Seven-Up Bottling company.

From Table 3 above, it is seen that from 2018 – 2022, the company witnessed increase in the cost of materials for five years under study. This actually exceeded the budgeted cost for materials. Although, this could be attributed to the 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 went a long way to affect company’s profit negatively during these periods of sky rocketing inflation level.

Table 4 shows the optimum ordering quantity, ordering time and overall production cost.

Table 4: Optimum ordering quantity, ordering time and overall production cost.

Raw Materials	Ordering Time in Days					
	Total Ordering Quantity	Average Ordering Quantity	Total Ordering Time (days)	Average Ordering Time (days)	Total cost	Average cost
Sugar	24,941.84	4,988.37	1,570	314	1,195,776.06	239,155.212
Concentrate	90,768.1	18,153.62	1,090	218	21,6777,708.44	4,335,541.6688
Acciducant	40,135.9	8,027.18	1,447	289	10,784,108.48	2,156, 821,694
Hydrated lime	99,508.8	19,901.76	1,514	303	78,658,665.29	1,285,943.585
Packaging Materials	48,652.4	9,730.49	1,584	317	118,772,976. 196	15,737,133. 058

The results (Table 4) shows that the company ordered an average of 4,988.37 units of sugar at an average ordering time of 314 days and at an average minimal cost of ₦239,155 from 2018 – 2022. For concentrate used for the production of the company finished product such as 7-Up, Pepsi, Mirinda etc. the company ordered an average quantity of 11,853.62 units at an average cost of ₦4.3 million for an average number of 218 days within 2018 – 2022.

For acciducant and hydrated lime, the company ordered 802.18 and 19,901.76 units respectively at optimal time of 289 days and 303 days respectively within 2018 – 2022. The average cost of packaging materials, cost the company ₦ 15.7 million for an average quantity of 9739.48 units, which they ordered at an average number of 317 days. A comparison between the overall total cost of production and total sales for the period under review showed that the company spent a total amount of ₦118.8 million within 2018 – 2022. Therefore, the efficient and effective management of materials was responsible for the company’s huge profit of ₦277.04 million.

Conclusion

Finding out the profitability, efficiency and effectiveness in the management of raw material in Seven-Up Bottling Company with the view to optimize quantity so as to minimize the cost production. The following findings and observations were noted. The study and observations were noted. The study showed that the company operates a policy of making orders on a quarterly basis within a period of one year. Analysis of data showed that 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 Seven- Up Bottling Company, Enugu plant has excess investment in inventory. Analysis of data further revealed that there is a positive correlation between sales and inventory usages. However, the total cost of production of 118.8 million naira can be observed to be less than the total N 395.84 million. This implies that with proper material management using the EOQ model, the company could optimize and as well maximize its profit potentials. Again, material usage depends on sales that means, as sales increase, inventory usage should also be on the increase. Therefore, material management is a must for the continuity and survival of any goal focused manufacturing organization.

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