International Journal of Engineering Innovation & Research
Volume 3, Issue 5, ISSN: 2277 – 5668

Evaluation of Distribution Mechanism in Some Vegetable Oil Companies in Nigeria

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***Abstract* – This research work evaluated the distribution mechanism in some vegetable oil companies in Nigeria: namely, RIVOC Port-Harcourt, CAMELA vegetable oil Company Owerri and KEN oil Owerri. The distribution performance measures evaluated are: capacity utilization, backorder probability, product flexibility and minimum cost of product distribution to the various customers. The products under investigation in RIVOC are: vegetable oil, toilet soap, washing soap and detergent. The results obtained for the period under investigation indicate considerable capacity utilization of (51.57%, 81.65%, 56.19% and 54.94%) respectively of the warehouse for the various products. The backorder probability of (0.2052, 0.1609, 0.1647, 0.2089) shows that the company will run out of stock throughout the period under investigation. Also, the product flexibility of (28.84% 30.99%, 80.96%, and 11.76%) obtained is a clear indication that the distribution mechanism cannot respond to demand fluctuations.**

***Keywords* – Evaluation, Mechanism, Distribution, Vegetable Oil, Comparism.**

I. INTRODUCTION

Today's business environment has become increasingly competitive as many companies engage in the production of similar products. In such an environment, companies need to continuously manufacture and distribute these products in an efficient fashion to ensure that their products are made available to the customers at the right time, required quantity, at the designated place and in a usable form at a reduced cost (Boyson et al, 2009). After years of focusing on reduction in production and operation costs, it is pertinent for companies to look at distribution, as it is the last frontier for cost reduction. Distribution therefore is an important aspect of every manufacturing company.

However, supply chain can be defined as a network of autonomous or semiautonomous business entities collectively responsible for procurement, manufacturing and distribution activities associated with one or more families of related products. Different entities in a supply chain operate subject to different sets of constraints and objectives. However, these entities are highly interdependent when it comes to improving performance of the supply chain in terms of objectives such as on-time delivery, quality assurance, and cost minimization. As a result, performance of any entity in a supply chain depends on the performance of others, and their willingness and ability to coordinate activities within the supply chain (Burns, 2005). A global economy and increase in customer expectations regarding cost and service have influenced manufacturers to strive to improve processes within their supply chains, often referred to as supply chain reengineering).

Supply chain efforts have the potential to impact performance in a big way. Often they are undertaken with only a probabilistic view of the future, and it is essential to perform a detailed risk analysis before adopting a new process .In addition, many times these reengineering efforts are made under politically and emotionally charged circumstances. As a result, decision support tools that can analyze various alternatives can be very useful in impartially quantifying gains and helping the organization make the right decision. In most organizations, decisions are generally based on either qualitative analysis (such as benchmarking) or customized simulation analysis. This is because complex interactions between different entities and the structure of supply chains make it difficult to utilize closed form analytical solutions. Benchmarking solutions provide insights into current trends but are not prescriptive. This leaves simulation as the only viable platform for detailed analysis for alternative solutions.

II. STATEMENT OF PROBLEM

Most manufacturing companies are faced with the challenges of effective distribution mechanism. Small and medium scale companies consider only cost minimization as their primary performance measure. These companies under survey have not been outstanding in the efficient evaluation of distribution mechanism to boost its productivity and supply chain performance to achieve cost reduction, profit maximization and customer satisfaction. It is equally observed that the evaluation of supply chain performance and proper production planning and control is ignored (Boyson, 2009).

III. RESEARCH METHODOLOGY

(i) The method used in this work involved preparation and administration of structured questionnaire to the staff of the companies to obtain the relevant data. Oral interviews were also conducted.
(ii) Formulation of a model that will minimize the total cost of the various products distribution cost. Evaluation of the various warehouse capacity utilization, back order quantity and the back order probability of the various products.
(iii) Data analysis and model validation.

A monthly record of the total output and monthly demand of the products was taken for a period of three years. The products under survey are:

International Journal of Engineering Innovation & Research
Volume 3, Issue 5, ISSN: 2277 – 5668

(i) Vegetable oil (RIVOC vegetable oil)
(ii) Toile soap (RIVOC toilet soap)
(iii) Washing soap (JUMBO)
(iv) Detergent washing powder (JUMBO)
(v) CAMELA Vegetable oil
(vi) CAMELA palm kernel cake (PKC)
(vii) KEN Vegetable oil
(viii) KEN palm karnel cake (PKC)

IV. Results and Discussion

Evaluation of capacity utilization of the various product warehouses.

Capacity utilization is a measure of the efficient use of each plant warehouse.

$$\text{Capacity utilization} = \frac{\text{utilized capacity}}{\text{available capacity}} \times \frac{100}{1} \quad (1)$$

Vegetable oil plant capacity utilization.

Available capacity =30000 Metric Ton/year (2)

Table 1: Capacity Utilization of veg. oil

Product	Year	Total Production (Metric Ton)	Capacity Utilization
VEGETABLE OIL	2010	14,976.51	$\frac{14976.51}{30000} X \frac{100}{1} = 50\%$
	2011	15,517.34	$\frac{15,517.34}{30,000} X \frac{100}{1} = 51.7\%$
	2012	15815.83	$\frac{15815.83}{30,000} X \frac{100}{1} = 53\%$

Table 2: Capacity Utilization of Toilet soap warehouse in RIVOC

Product	Year	Total Production (Cartons)	Total Production (Metric Tons)	Capacity Utilization
TOILET SOAP	2010	1,500,283	7,201.36	$\frac{7201.36}{9000} = 80.02\%$
	2011	1,529,802	7343.05	$\frac{7343.05}{9000} = 81.6\%$
	2012	1,565,280	7513.34	$\frac{7513.34}{9000} = 83.34\%$

Toilet soap plant capacity utilization.

I carton contains 60 pieces of soap weight of 1 piece = 80g (3)

I carton = 4800g = 4.8kg = 0.0048 Metric Ton (4)

Available Capacity = 48000 Metric Ton/Year (5)

Washing soap plant capacity utilization.

I carton contains 30 bars of soap weight of each bar = 550g (6)

I carton contains 6500g = 16.5kg = 0.0165 Metric Ton (7)

Table 3: Capacity Utilization of washing soap warehouse in RIVOC

Product	Year	Total Production (Cartons)	Total Production (Metric Tons)	Capacity Utilization
WASHING SOAP	2010	1,611,053	26582.37	$\frac{26582.37}{48,000} X \frac{100}{1} = 55.38\%$
	2011	1,632,368	26934.07	$\frac{26934.07}{48,000} X \frac{100}{1} = 56.11\%$
	2012	1,661,547	27415.53	$\frac{27415.53}{48,000} X \frac{100}{1} = 57.1\%$

Detergent plant capacity utilization.

1 Bags = 5kg = 0.005 Metric Ton (8)

Available Capacity = 15,000 Metric Ton (9)

Table 4: Capacity Utilization of detergent warehouse in RIVOC

Product	Year	Total Production (Cartons)	Total Production (Metric Tons)	Capacity Utilization
DETERGENT	2010	1,625,640	8128.20	$\frac{8128.20}{15,000} X \frac{100}{1} = 54.17\%$
	2011	1,652,297	8261.48	$\frac{8261.48}{15,000} X \frac{100}{1} = 55.07\%$
	2012	1,667,823	8339.12	$\frac{8339.12}{15,000} X \frac{100}{1} = 55.59\%$

Capacity Utilization In CAMELA

(From equation 4.1)

$$\text{V.OIL Warehouse Capacity Utilization} = \frac{2250.2}{5000} \times \frac{100}{1}$$

$= 45\%$ (10)

$$\text{PKC Warehouse Capacity Utilization} = \frac{2349.07}{5000} \times \frac{100}{1}$$

$= 47\%$ (11)

Capacity Utilization In KEN Vegetable Oil Company

(From equation 4.1)

$$\text{Veg. Oil warehouse capacity utilization} = \frac{2709.86}{4500} \times \frac{100}{1}$$

$= 60.22\%$ (12)

$$\text{PKC warehouse capacity utilization} = \frac{2666.81}{5000} \times \frac{100}{1}$$

$= 53.34\%$ (13)

Back order parameters

The back order (stock out) is the demand of a product that cannot be met by the manufacturer. It is the difference between the demand quantity and the available quantity of a product at a given period of time.

However, the back order probability is the probability that the distribution mechanism can meet customer satisfaction.

(i) $\text{Average Output} = \frac{\sum_{t=1}^{T} ot}{T}$ (14)

(ii) $\text{Average Demand} = \frac{\sum_{t=1}^{T} Dt}{T}$ (15)

(iii) $\text{Average Back order} = \frac{\sum_{t=1}^{T} BOt}{T}$ (16)

Where,

Ot = Output at a given period t.
T = Total period under consideration.
Dt = Demand at a given period t.

Therefore, back order probability

$$= \frac{\text{Back order during period T}}{\text{Total order during the period}} \quad (17)$$

International Journal of Engineering Innovation & Research
Volume 3, Issue 5, ISSN: 2277 – 5668

Table 5: Summary of results

Prodct	Year	Capacity Utilization (%)	Backorder Probability	Volume Flexibility (%)
Vegetable Oil	2010	50	0.2214	13
	2011	51.7	0.1877	46.54
	2012	53	0.2066	27
Toilet Soap	2010	80.02	0.2307	30.97
	2011	81.60	0.2094	17
	2012	83.34	0.0426	45
Washing Soap	2010	55.38	0.1086	88.23
	2011	56.11	0.1553	70
	2012	57.1	0.2301	84.65
Detergent	2010	54.17	0.1977	0.85
	2011	55.07	0.1942	1.83
	2012	55.59	0.2347	32.6

From the results obtained, the capacity utilization for vegetable oil plant, washing soap and detergent are considerable, but that of toilet soap plant is high. The acceptable warehouse capacity utilization for any manufacturing company ranges from (40% - 50%) as recommended by the international standard organization. (ISO). This justifies the utilization of the various warehouses for each product

The back order probability for each product is low considering the ISO recommendation for the back order of a product. The normal back order ranges from (0.5- 0.99). The result obtained below falls below the recommended standard. This is associated with the inability of the supply chain mechanism to meet customer demand. It leads to loss of customers and integrity.

It is clear that vegetable oil, toilet soap and detergent have low flexibility. But washing soap and CAMELA vegetable oil are high. The low flexibility is a clear indication that supply chain mechanism cannot meet up with demand fluctuations.

V. Conclusion

Today's competitive business environment has resulted in increasing pressure for many companies in almost every industry. In such an environment, companies must fill customer orders, accurately, quickly and efficiently. At the same time, they must reduce inventory, and consider other important logistical factors. A company's distribution mechanism constitutes of several interactive processes, which are important to the integrated logistics system. In order to reduce costs for every single component of a supply chain, companies may have to redesign their supply chain network and consider every operation as part of a whole. After years of focusing on reduction in production and operation costs, companies are beginning to look into distribution activities as the last frontier for cost reduction. It is imperative for manufacturing companies to evaluate their supply chain mechanism periodically. This will save unnecessary waste of resources and guarantee customer satisfaction.

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International Journal of Engineering Innovation & Research
Volume 3, Issue 5, ISSN: 2277 – 5668

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His engineering practice took him to National Productivity Centre as a Productivity Research Officer. He was one of the pioneer staff of Benin zonal office in charge of research operations within Edo, Delta, Ondo and Ekiti States. He rose to Ag. Director of Technological Services at the Abuja Corporate headquarters from where he transferred his services to Federal University of Technology, Owerri (FUTO) as a lecturer in Mechanical Engineering. He is a Senior Lecturer and has over 49 Technical publications (Local and International). He holds his Ph. D. in Industrial Engineering from Federal University of Technology, Owerri, Nigeria. He is married with four children.