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Transportation Model Application and Performance of Seven up Bottling Company plc, Nigeria.

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Abstract
The broad objective of this paper is to determine the association between transportation model application and performance of seven up bottling company plc, Nigeria. The study leaned on Theory of Constraint by Eliyahu Goldratt 1984. Survey design was used for the study, interview method was the data collection tool employed, analysis of data was ensured by tora soft-ware version 1.00. Analysis of data revealed that there is a relationship between distribution route and distribution cost of seven up bottling company plc, Nigeria. The optimum solution from the analysis revealed an optimum total distribution cost of #6,800,000. Findings also revealed an allocation from plants to depots along the line of minimum possible cost. Base on the findings, the researcher concluded that there is an association between transportation model application and performance of the focused company. Sequel to the findings and conclusion of the study, the researcher recommended an application of transportation model analysis by management before mapping out distribution route and production of products of all sizes in all plants so that depots won't have to go to distant plants to acquire certain products.

Keywords: *Transportation model, distribution route, performance, distribution cost.*

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I. Introduction

Seven up bottling company plc, Nigeria is a beverage undertaking that harvest soft drinks which includes 7up, mirinda, pepsi-cola and so on. In other for their products to get to the final consumers, these products are moved from various trade plants to their depots in different parts of the country. This has necessitated an analysis of the movement of products from plants to the various depots of seven up bottling company plc, Nigeria using the transportation model by the researcher.

At different times, the transportation model was developed by different scholars. The transportation problem was formalized by the French mathematician Monge in1781. Hitchcock in 1941 made a promotion in the transportation configuration from his study titled; "The Distribution of a Product from Several sources to numerous Localities". Major advances were made in the domain during World War II by the Soviet/Russian mathematician and economist Leonid Kantorovich in 1942. Consequently, the problem as it is now stated is sometimes Known as the Monge-Kantorovich transportation problem. Koopmans in 1947 in a study titled "optimum imposition of the transportation system" contributed to the existing wisdom on the conveyance model. It was improved upon in 1949 by Kantorovich and Gavurin. In 1951, George B. Dantizig applied the thought linear programming in solving the transportation model for firm association (Asase, 2011). It is from this point that several commander of industries all over the world embraced the transportation model.

The transportation model is a special type of linear programming problem where the intention is to minimize the cost of distributing a product from a number of sources or origins to a mathematics of destinations. In a typical manufacturing firm, the origin of a transportation problem is the location from which merchandise are dispatched. The final point of a transportation problem is the location to which products are transported. The term transportation cost is the prize of transporting one unit of the consignment from an origin to a destination. The transportation problem is a distribution-type problem, the main thing of which is to decide how to transfer commodities from various production position (also known as origins) to various acceptance situation (also known as destinations) with minimal costs or maximum proceeds (Anand & Raghunayagan, 2018). In other words, transportation analysis impacts the performance of an organization in no small measure.

Organizational performance is the ability of an institution to achieve congruence and attain its purpose by effective resources imposition (Wokoma, & Iheriohanma, 2010). Achieving its purpose would mean its capability to convey merchandise from plants to depots using the least charge possible. In other words, the aim

of a responsible production/marketing manager is to ensure the movement of finished goods to their destination (depot) using the least cost possible.

The researcher observed that some managers of the depots of the focused organization experience product crisis i.e failure of some plants to meet up with the demands of these depots. Again, specified sizes of goods produced in some plants are not produced in others. This makes superiors of these depots to purchase goods from plants that are very far from their location.

The foregoing necessitated the determination of the association between transportation model application and performance of seven up bottling company plc, Nigeria.

Specifically, this study seeks to examine the relationship between distribution route and distribution cost of seven up bottling company plc, Nigeria.

II. Review of Related Literature

Conceptual Review

Transportation Model

The objective of the transportation model is to determine the best plan of assigning goods from each origin (source) to specific aim so that the prize minimization objective can be accomplished. In other words, its main meaning is to determine the bulk favourable route that could ensure cost minimization objective. As with several operation research concepts, in a bid to get the optimum solution, there is an initial procedure which is followed by an interactive process. A general conveyance ideal with m sources and n destinations has $m+n$ constraints equations, one for each origin (source) and one for each destination. But because the transportation model is always balanced (sum of the supply equals amounts of the demand), one of these equations is always redundant. Hence the model has $m+n-1$ independent equations. The hint of this is that the starting solution has $m+n-1$ basic variable (Hamburg1998 as cited in Monye & Eruteya, 2018).

Monye and Eruteya (2018) observed that some ways of solving the transportation problem are; north west corner method, least cost method, vogel approximation method and the stepping stone method. However, north west corner method, least cost method, and vogel approximation method was used for this study.

Distribution Route

Distribution includes all activities that enable the transfer of products from one location to another (Wirtschaftsleyikon24.net, 2020). Distribution encompasses a system of all activities that are related to the replacement of economic commodities between manufacturers and consumers. It includes such a coordinated preparation of manufactured commodities according to their type and volume, disparity and time, so that supply deadlines can be met (order fulfilment) or estimated demand can be efficiently satisfied (Domschke & Schield, 1994). Distribution route is a particular way or direction designed by an organization for the transfer of its manufacture from its output plant to a determined destination. Manufacturing firms takes the distribution cost into consideration when designing its distribution route.

Organizational Performance

When corporation come into existence, it sets out an objective it intends to achieve. How effective the organization is with regards the actualization of this aim is its achievement (Stoner, Freeman & Gilbert & 2006). The authors are of the lookout that organizational merit is the degree of how well an organization does its job. Organizational performance is the capability of an organization to achieve congruence and attain its aim by effective facility utilization (Wokoma, & Iheriohanma, 2010). The thought of achievement cuts across spheres of life. In business, the actualization of a set goal whether financial, production, marketing, managerial, or in general activities, is very necessary because it is paramount to an organization's future (Oparanma, 2010).

Allen, Dawson, Wheatley and White (2007) noted that when defining organizational performance, it is important to consider a wide phases or blend of organizational characteristic measures which include quality, cost minimization, productivity, market share, profitability, return on equity, customer benefit and the liveliness of a firm. This study is centered on cost.

The foregoing shows that the performance level of an entity is seen from the aspect of target attainment.

Distribution Cost

Olajide, Bello and Alabi (2016) see Cost as what is expended on a product from the transformation stage till it gets to the final consumers. Parker (2015) suggests that the cost of a product determines the amount the output would be sold in the market. O'Sullivan and Sheffrin (2003) see production cost as the value of money that has been used up to produce something or deliver a product. The focal essence of this study is the charge incurred when delivering a product. Surbhi (2014) on the other hand sees cost as any amount that is spent on a manufacture by a firm. This includes the cost of moving a product from production plants to depots.

Ideas of different scholars shows that distribution cost is the cost emanating from the transfer of products from manufacturing plants to different destinations.

Theoretical Framework

This study is fastened on Theory of Constraints propounded by Eliyahu Goldratt in 1984. It is a plan that preaches an identification of procedures which has the greatest negative effect in the production process which starts from the manufacturing plant and ends with the final consumers. The idea operates with the assumption that every process has at least one swaying constraint, of which must be improved for the process to become more economic. Time spent trying to maximize processes which are not beneficial to a manufacturing boldness could have a shattering effect. Attempting to reduce the negative constraint will in no small measure touch the corporate destination and purpose (Goldratt's Marketing Group, 2020).

This body of knowledge is relevant to this study because an identification of the total distribution cost as a constraint by management of the focused firm could lead to the decision of specifying the depots production plants are to supply products. This could lead to an achievement of the least distribution cost possible.

Empirical Review

Anand and Raghunayagan (2018) examined a simple transportation problem of a manufacturing business in India using LINGO soft-ware. The data used for the study was gathered from the firm of study. Analysis of the data using transportation model identified the total cost of conveying products.

Asase (2011) examined the impression of transportation solution on transportation cost of Guinness Ghana limited. The information gathered from Kaasi and Achimota plants were analyzed using solver soft-ware. Findings revealed that transportation analysis effect the transportation cost of the focused firm.

Nnanna (2012) examined optimization of transportation costs in supply chain management using coca-cola plants in Nigeria for the study. Plants at Aba, Owerri, Port Harcourt, and Enugu, and its depots in Mbaise, Orlu, Umuahia, Calabar and Uyo were used for the study. Extensive surveys were carried out and information obtained were analyzed using a software package- TORA. The problem was also subjected to sensitivity analysis. The consequences revealed the optimum transportation cost required to move products from plants to depots.

Dharmendra and Saurabh (2017) studied optimization of the transportation cost for Raipur steel and thermal power plant India.The information and all the parameters are collected manually through the data sheet of conveyance cost of the plant for 30 days and preparation of transportation model and estimation for minimizing the transportation cost was done using the TORA, LINGO and What's Best Solver. The succession of the research reveals that proper routing, scheming of instrument and crew can save Rs.11589.46 in 30 days and also specified the materials to properly run the plant. The saving amount of the transportation cost is utilized into increasing the output of the action is 1.37% rise from saving transportation cost.

Monye and Eruteya (2018) studied transportation model and performance of MTN Asaba Delta state, Nigeria. Survey design was employed, questionnaire was used to collect data from respondents. Pearson output importance similarity resolution was used to test the hypotheses. It was discovered from respondents that the use of this model has contributed to the growth of the organization. In addition, the study revealed that transportation model can help identify minimum total conveyance cost.

Okpara, Okenwe and Iheagwara (2016) examined comparatively the existing technique of solving linear transportation problems with a new approach proposed by Mollah, Aminur, Sharif and Faruque (2016). The existing way known as North West Corner Method, Least Cost Method, and Vogel's Approximation Method were compared to a new proposed algorithm known as Allocation Table Method. Real life information were collected from Dangote Flour Mills Plc, Calabar Cross River State Nigeria. The Allocation Table Method was solved using the stated algorithm, while the other three existing methods were solved via TORA software. Findings of the study showed that the allocation table method did not produce comparatively a better result.

Gap in Knowledge

None of the empirically reviewed has examined transportation model submissiveness as it relates to the performance of seven up bottling company plc, Nigeria. This is the lacuna in cognizance that this study seeks to fill.

III. Methodology

Research Design

The research design adopted for this study was the survey research design. It was used because of the nature of the study. Survey research design enables the researcher to observe what happens to the sample subjects without manipulating them.

Instrument of Data Collection

The data was collected through an interview of the production and marketing manager of the focused organization.

Model Specification

The transportation model of Anand and Raghunayagan (2018) was adopted for this study.

It is defined thus: Each unit has to be conveyed from m sources to n destinations. The supply in source i is ai and the demand in destination j is bj. The unit cost of moving products from source i to destination j is Cij. The constraint is conveying products from source (plants) to destination (depots) with the least cost possible. Let Xij be the quantity of the product conveyed from source (plant) i to the destination (depot) j.

The objective is to:

$$\text{Minimize} \sum_{.i=1}^{m} \sum_{.j=1}^{n} Cij\ Xij$$

Subject to:

$$\sum_{.j=1}^{n} Xij = ai, \text{ where } i=1\text{----------}m$$

$$\sum_{.i=1}^{m} Xij = bj, \text{ where } j=1\text{----------}n$$

$$Xij \geq 0$$

This is called balanced transportation problem where total supply is equal to total demand.

Assumptions

i. No territorial boundary as regards which depot plants can supply products.
ii. Cost minimization objective.
iii. Objectives and limitations are stated in mathematical equations.

Method of Data Analysis

Quantitative research approach was used for the study. This was ensured by the application of transportation model. This was aided by Tora software.

IV. Data Presentation, Analysis and Interpretation

Data Presentation and Analysis

The daily production and sales of some seven up bottling company plants and depots was used for the study.

List of plants and their manufacturing capacity:

1. Benin plant-29,000.
2. Ibadan plants-25,000.
3. Abuja plants-31,000.
4. Aba plants-45,000.

List of Depots and their carrying capacity:

1. Benin Metropolis (A)-18,000.
2. Benin Out-station (A1)-11,000.
3. Ibadan Metropolis (B)-16,000.
4. Ibadan Out-station (B1)-9,000.
5. Abuja Metropolis (C)-19,000.
6. Abuja Out-station (C1)-12,000.
7. Aba Metropolis (D)-27,000.
8. Aba Out-station (D1)-18,000.

Per unit cost for the movement of products from plants to depot:

1. Benin-A#35, Benin-A1#80, Benin-B#130, Benin-B1#120, Benin-C#160, Benin-C1#130, Benin-D#145, Benin-D1#130.
2. Ibadan-A#130, Ibadan-A1#120, Ibadan-B#35, Ibadan-B1#80, Ibadan-C#260, Ibadan-C1#220, Ibadan-D#270, Ibadan-D1#250.
3. Abuja-A#160, Abuja-A1#130, Abuja-B#260, Abuja-B1#220, Abuja-C#35, Abuja-C1#80, Abuja-D#180, Abuja-D1#150.
4. Aba-A#145, Aba-A1#130, Aba-B#270, Aba-B1#250, Aba-C#180, Aba-C1#150, Aba-D#35, Aba-D1#80.

Table 1: Data Summary

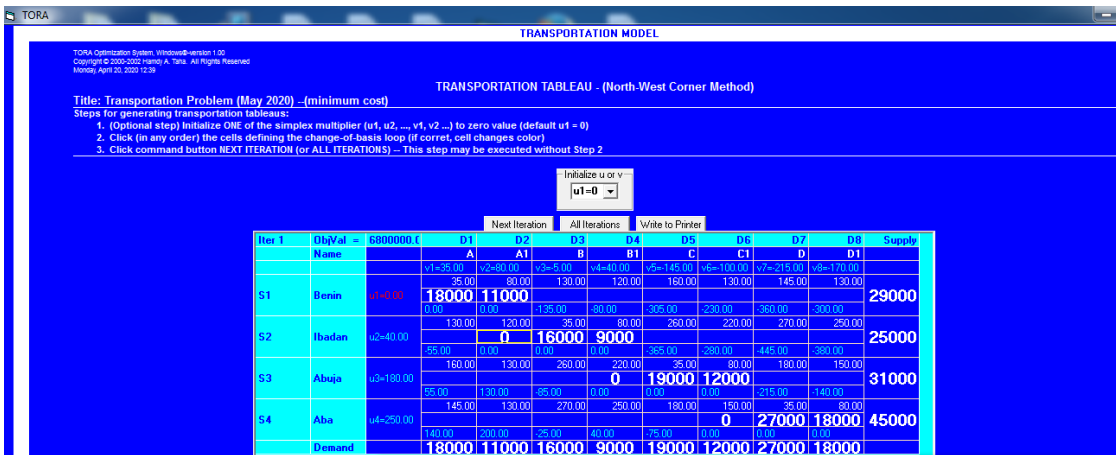
Plants	A	A1	B	B1	C	C1	D	D1	SS
Benin	#35	#80	#130	#120	#160	#130	#145	#130	29,000
Ibadan	#130	#120	#35	#80	#260	#220	#270	#250	25,000
Abuja	#160	#130	#260	#220	#35	#80	#180	#150	31,000
Aba	#145	#130	#270	#250	#180	#150	#35	#80	45,000
dd	**18,000**	**11,000**	**16,000**	**9,000**	**19,000**	**12,000**	**27,000**	**18,000**	**130,000**

Source: Production/Sales Department of the Organization of Study (2020)

Test of Hypothesis

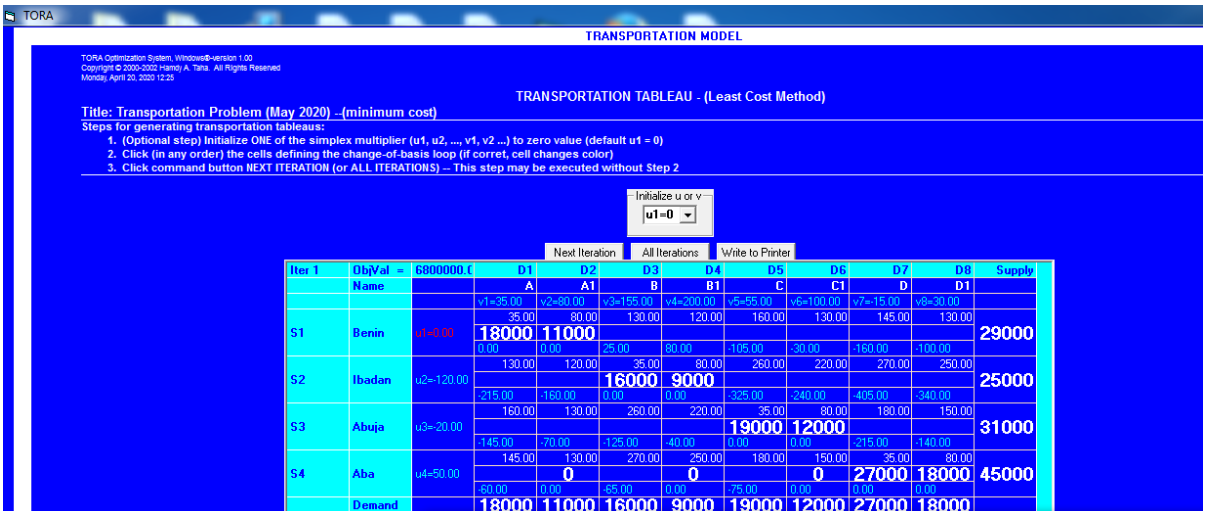
Ho: There is no relationship between distribution route and distribution cost

North West Corner Method:



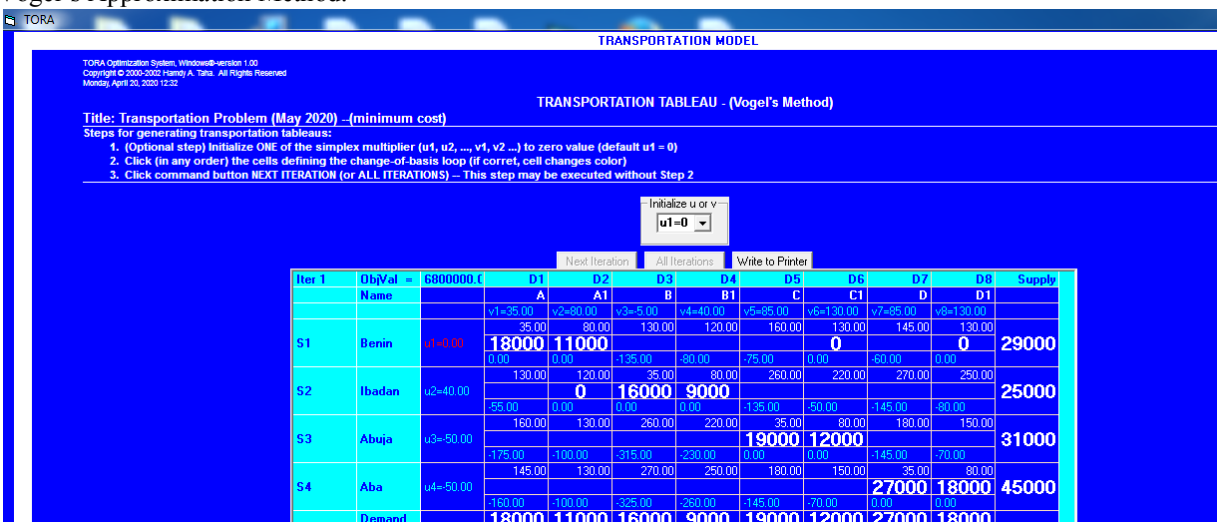
Source: Tora soft-ware version 1.00.

Least Cost Method:



Source: Tora soft-ware version 1.00.

Vogel's Approximation Method:



Source: Tora soft-ware version 1.00.

The analysis of data from an application of the transportation model using north west corner method, least cost method and vogel's approximation method yielded the same result. The result revealed the conveying of products from plants to depots thus;

Benin-A=35*18,000=#630,000
Benin-A1=80*11,000=#880,000
Ibadan-B=35*16,000=#560,000
Ibadan-B1=80*9,000=#720,000
Abuja-C=35*19,000=#665,000
Abuja-C1=80*12,000=#960,000
Aba-D=35*27,000=#945,000
Aba-D1=80*18,000=#1,440,000
Optimum total distribution cost=#6,800,000

The results revealed an allocation along the line of minimum cost possible.

V. Discussion of Findings

Findings revealed that there is an association between distribution route and distribution cost of seven up bottling business plc, Nigeria. This corroborates the study of Anand and Raghunayagan (2018). They examined a simple transportation problem of a manufacturing boldness in India using LINGO soft-ware. Analysis of the data using transportation model identified the total cost of conveying products from manufacturing plant to depot. The study of Asase (2011) on the stamping of transportation analysis on conveyance cost of Guinness Ghana limited is also in accordance with findings of the study. Findings revealed that transportation solution impacts the transportation cost of the focused firm. The work of Nnanna (2012) who examined optimization of transportation costs in supply chain management using coca-cola plants in Nigeria for the study aligns with findings of the study. The results revealed the optimum transportation charge required to move merchandise from plants to depots.

VI. Summary, Conclusion and Recommendations

Summary

Findings revealed that there is a relationship between distribution routes and distribution cost of seven up bottling company plc, Nigeria since optimum total distribution cost=#6,800,000.

Conclusion

Findings revealed that there is a relationship between transportation model application and performance of seven up bottling company plc, Nigeria. The specification of the distribution routes from plants to depots using north west corner method, least cost method and vogel's approximation method revealed an allocation using the least cost possible. It clearly shows the optimum distribution cost possible for the focused company.

Recommendations

The following recommendations were suggested by the researcher:

1. Application of transportation analysis by management before mapping out distribution routes.

2. Production of products of all sizes in all plants so that depots won't have to go to distant plants to acquire certain products.

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