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TRANSPORTATION MODEL: A QUALITATIVE SOLUTION TOOL FOR ACHIEVING INSTITUTIONAL AND MANAGERIAL GOALS IN THE 21ST CENTURY

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ABSTRACT: *Managerial activities have become complex and it is necessary to make right decision in avoidance of heavy losses. Whether a manufacturing unit or service organization, the resources have to be utilized maximally in an efficient manner otherwise, the erratic future is clouded with uncertainty thus decision making – a crucial activity – cannot be made on a trial and error basis or by using a thumb rule approach. Today several scientific management techniques are available to solve managerial problems and use of these techniques helps managers become explicit about their objectives, providing additional information to select an optimal decision in the 21st century. The quantitative technique is a scientific approach to managerial decision making. The successful use of quantitative technique for management could help organizations in solving complex problems on time, with greater accuracy and in the most economical way. This work examined transportation model of quantitative techniques for management. The definition of the term management and transportation was reviewed, the role of quantitative analysis and method for solving problems in management identified, the model development and management science techniques itemized, basic feasible solutions for non-degeneracy model and transshipment model where the study saw Organization goals as an action that facilitate planning, motivate and inspire employees' management as a process of getting things done through the efforts of other people and transportation model as the determinant for resource allocation in existing business structures. The work argued that, managers must be aware of the quantity of available supplies, the quantities demanded and location to find the cost of transporting one unit of commodity from place to another. Conclusions were drawn and recommendation made that the optimal solution to a transportation problems must consist of integer values for the decision variables as long as all supply and demand values are integers.*

KEYWORDS: Transportation Model, Quantitative Analysis, Managerial Goals, 21st Century.

INTRODUCTION

Scientific methods have been man's outstanding asset to pursue an ample number of activities it is analyzed that whenever some natural crisis emerges due to the impact of political, social, economic or cultural factors, the talent from all walks of life amalgamate together to overcome the situation and rectify the problem. In this study, an attempt will be made to see how the quantitative techniques could facilitate the organization in solving complex problems on time

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with greater accuracy. Transportation problem is a particular class of linear programming which is associated to day to day activities in our real life and mainly deals with logistics (Nwadighoha, Alamba and Onwuka 2010). It helps in solving problems on distribution of resources from one place to another. The goods are transported from a factory to different destinations to meet the specific requirement. In other words, transportation problems deals with the transportation of a product manufactured at different plants (supply origins) to number of different ware houses (demand destinations).The objectives is to satisfy the demand as destinations from the supply constraints at a minimum transportation cost possible. To achieve these objectives, we must know the quantity of available supplies and the quantitative demanded.
In addition, we must also know the location, to find the cost of transporting one unit of commodity from the place of origin to the destination. The model is useful for making strategic decisions involved in selecting optimum transportation route so as to allocate the production of various plants to several warehouses or distribution centers'. The transportation model can also be used in location decisions. The model helps in locating a new facility, a manufacturing plant or an office when two or more number of locations is under considerations.

Management Review

Management is the process of getting things done through the efforts of other people. The action of an individual working alone is excluded because a person is not a manager unless involved in the process of getting things done through others. The ability to use specific knowledge, method and techniques in performing work. Management is concerned with controlling the business system which consists of inputs, processes, and outputs. According to Nwankwo (2014) a frequent problem will determine what part of the system to monitor, ideally, every resource, processing activity and output should be measured, reported on, and compared to a standard. This can be extremely costly and time-consuming. A manager must determine what activity to measure and how to measure it. Management science as an approach to decision making is based on the scientific method and makes extensive use of qualitative analysis. The management revolution of early 1900s, initiated by Taylor (1947) provided the foundation for the use of qualitative methods in management.

Role of Qualitative Analysis

Qualitative analysis is based primarily on the mangers judgment and experience. It includes the manager's intuitive "feel" for the problem and is more an art than a science. When using the quantitative approach an analyst will concentrate on the qualitative facts or data expressions that describe the objectives, constraints, and other relationships that exist in the problem. Then by using one or more quantitative method the analyst will make a recommendation based on the quantitative aspects of the problem. A manager can increase decision making effectiveness by learning more about quantitative methodology and by better understanding its contribution to the decision making process. A manager who is knowledgeable in quantitative decision – making procedures is in a much better position to compare and evaluate the qualitative and quantitative sources of recommendation and ultimately to combine the two sources available to make the best possible decision. In general, wherever there is any problem simple or complicated the scientific management technique can be applied to find the best solutions. We can see that qualitative analysis begins once the problem has been adequately structured, work can begin on developing a model to represent the problem mathematically, and 'solution' procedures can then be

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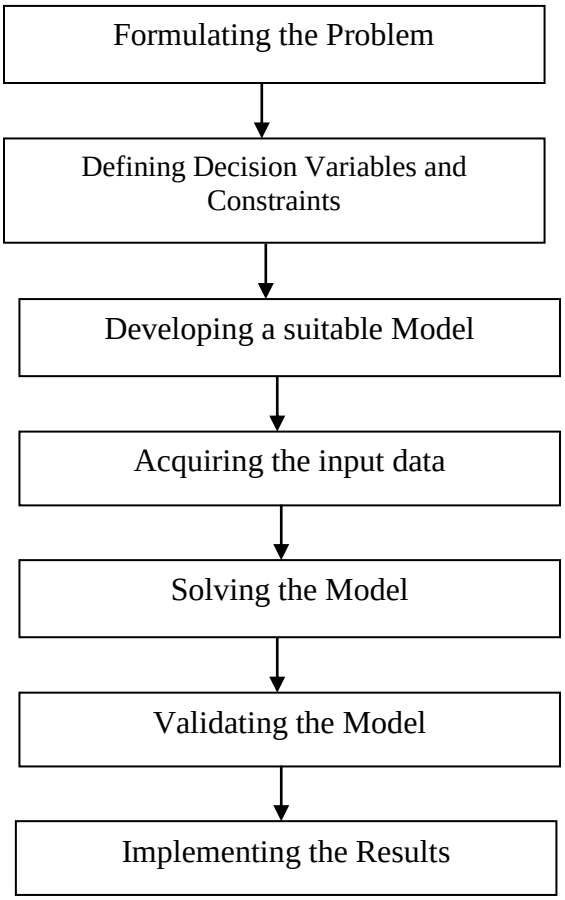
employed to find 'the best solution for the model. The best solution for the model then becomes a recommendation to the decision maker. The process of developing and solving models is the essence of the qualitative analysis process.



Source: The Author

Describing the Problems: A Mathematical expression

Objective is referred to as the goal function. For example the profit equation P=10X would be an objective function for organizations attempting to maximize profit. A production capacity constraint would be necessary if, for instance, 5 hours are required to produce each unit and only 40 hours of production time are available per week. Let X indicate the number of units produced each week. The product time constraint is given by;

$$5X \leq 40$$

The value of 5X is the total time required to produce X units, the symbol ≤ indicates that the production time required must be less than or equal to the 40 hours available. The decision problem or question is as follows: *How many units of the product should be scheduled, or dispatched each week to maximize profit?*

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A complete mathematical model for the marginal goal represents the aims or objectives of an organization and their attainment serve as a measure of organizational effectiveness or performance. Organizational goal are also seen as the diverse function's which organizations as sub-systems perform for the society. Although they appear to take life on their own, they remain inventions of man. Goals and objectives provide organization with a blue print that determines a course of action and guide them in preparing for future changes. According to Barney and Griffiri (1992) organizational goals serve four basic functions: they provide guidance and direction, facilitate planning, motivate and aspire employees and help organizations evaluate and control performance. Organizational goals inform managers where the organization is going and how it plans to get there. According to Imaga (2007) goals affect manager's performance through four mechanizations. Firstly, goals direct action and effort toward goal-related activities and away from unrelated activities. Secondly, goals energize employees, challenging goals lead to higher employees, and challenging goals lead to higher employee's effort than easy goals.
Thirdly, goals affect persistence and fourthly, goals motivate employees to use their existing knowledge to attain or to acquire the knowledge needed to do so. Although management science incorporates quantitative analysis, it would be a mistake to regard management science as merely a collection of techniques. It is as much a philosophy of problem solving as it the use of quantitative methods.

Transportation Model

The Transportation model uses the principle of transplanting something, like taking hole from one place and inserting it on another without change. First it assumes that to disturb or change the idea being transported in any way will damage and reduce it somehow. It also assumes that it is possible to take an idea from one person's mind into another person's so that the two people will then understand it exactly the same way. The transportation model is valuable tool analyzing and modifying existing transporting systems of the implementation of new ones. The model is effective in determining resource allocation in existing business structures. The model requires a few key pieces of information, which includes the following: The Origin of the supply, destination of the supply and unit cost of the ship.

The transportation model can also be used as a comparative tool providing business decision makers with the information they need to properly balance cost and supply. This model will help decide what the optimal shipping plan is by determining a minimum cost for shipping from numerous sources to numerous destinations. This will help for comparison when identifying alternatives in terms of their impact on the final cost for a system.The main applications of the transportation model mention in this paper are location decisions, protection planning, capacity planning and transshipment. Nonetheless, the major assumptions of the transporter model are as follows according to (Handy 1993);

1) Items are homogenous
2) Shipping cost per unit is the same no matter how many units are shipped.
3) Only one route is used from place of shipment to the destination.

The transportations problem involves: Determining cost plan for shipping from multiple sources of multiple destinations. A transporter model used to determine how to distribute supplies to

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various distinctions while minimizing total shipping cost. In this case, a shipping plan is produced and is not changed unless factors such as supply, demand, or unit shipping cost change. The variables in this model have a linear relationship and therefore, can be into a transportation table. The table will have a list of origins and each one's capacity of supply quantity period. It will also, show a list of destinations and their respective demands per period. It will also show the unit cost of shipping goods from each origin to each destination. Transportation costs play an important role in location decision. The transportation model can be used to compare location alternatives in terms of their impact on the total distribution costs for a system. It is subject demand satisfaction at market supply constraints. It also determines how to allocate the supplies available from the various functions to the warehouses that stock or demand those goods, in such a way that total shipping cost is minimized. The total transportation cost, distribution cost of shipping cost and production cost are to be minimized by applying the model.

Procedure to Solving Transportation Problem

The procedure to solving transportation problems as outlined in Nwadighoha et.al (2010) are as follows:

Step 1: Formulate the Problem: Formulating the given problem and settling it up in a matrix form. Check whether the problem is a balanced or unbalanced problem. If unbalanced, add a dummy source (row) or dummy destination (column) as required.

Step 2: Obtain the Initial Feasible Solution.

The initial feasible solution can be obtained by any of the following three methods.

i) Northwest Corner Method (NWC)
ii) Least Cost Method (LCM)
iii) Vogel's Approximation Method (VAM)

Step 3: Check for Degeneracy

The solution that satisfies the above said conditions

N = m+n-1 is a non-degenerate basic feasible solution. Otherwise, it is a degenerate solution. Degeneracy may occur either at the initial stage or at subsequent interactions. If number of allocations, N=m+n-1, then degeneracy does not exist.

If number of allocations, N = m+n-1, the degeneracy does exist.

Step 4: Solving Degeneracy

To resolve degeneracy at the initial solution, allocate a small positive quantity *d e* to one or more unoccupied cell that have lowest transportation costs, so as to make m+n-1 allocations (i.e., to satisfy the condition N=m+n-1).The cell chosen for allocating *e* must be of an independent position. In other words, the allocation of e should avoid a closed loop and should not have a path.

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Table: Showing Independent Allocation

*	*	*
	*	

Table a

	*	*
	*	*

Table b

Table c

	*		*
	*		*

Table d

*	*		
	*		
*	*		

Table e

*	*		
		*	
	*		*

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Step 5: Test for Optimality

The solution is tested for optimality using the Modified Distribution (MODI) Method (also known as U-V method).Once an initial solution is obtained, the next step is to test its optimality. An optimal solution is one in which there are no other transportation routes that would reduce the total transportation cost, for which we have to evaluate each unoccupied cell in the table in terms of opportunity cost. In this process, if there is no negative opportunity cost the solution is an optimal solution.

Step 6: Procedure for Shifting of Allocations.

Selection the cell which has the most negative Cij value and introduce a positive quality called 'q' in that cell and then to balance that row, allocate a 'q' to that row in occupied cell, Again, to balance that column put a positive 'q s' and '-q's, a closed loop is formed. Two cases are represented in the table below. If all the 'q' allocation are joined by horizontal and vertical lines, a closed loop is obtained. The set of cells forming a closed loop is;

CL= {(A, 1), (A, 3), (C, 3), (C, 4), (E, 4), (E, 1), (A, 1)}

This in table appears twice and is not allowed.

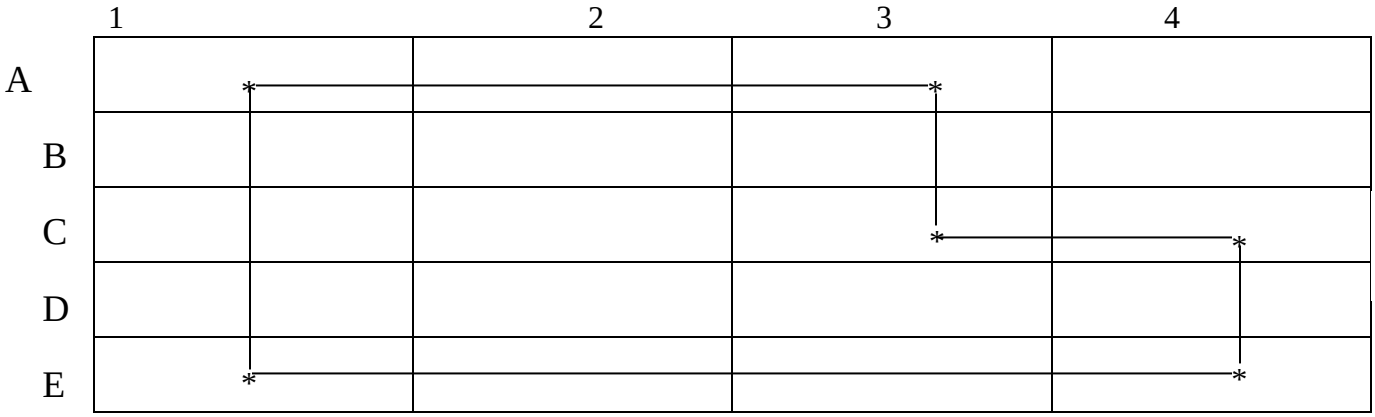

Table (b)

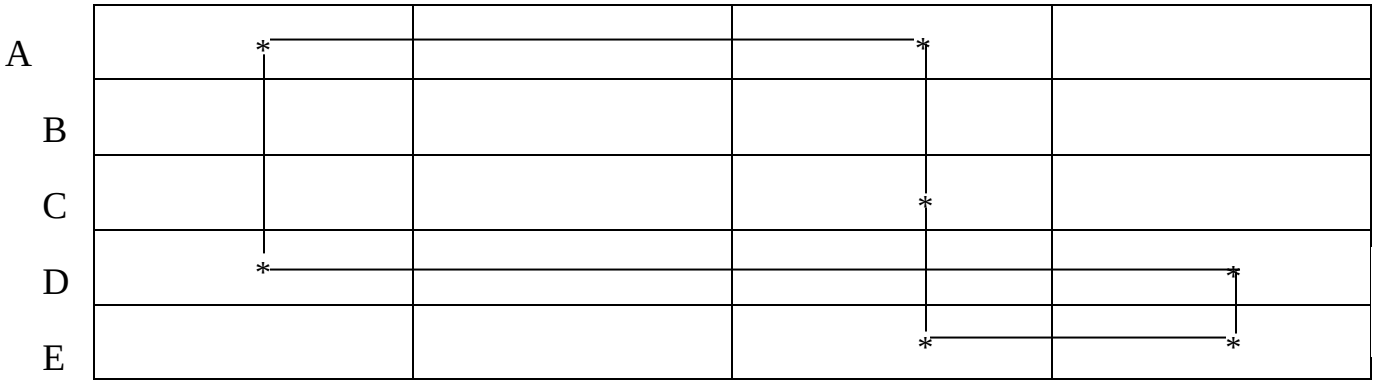

Table (b)

In the formulation of a Loup; as the conditions arise;

i) The start and end points of a Loup must be the same

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ii) The lines connecting the cells must be horizontal and vertical
iii) The turns must be taken at occupied cells only.
iv) Take a shortest path possible for easy calculations

Step 7: Calculate the total Transportation cost.
Since all the G j values are positive, optimality is reached and hence the present allocations are the optimum allocations. Calculate the total transportation cost by summing the product of allocated units and unit costs.
Example: The cost of transportation per unit from the sources and four destinations are given in table 6. 12 obtain the initial basic feasible solutions using the following methods.

1) North-West Corner Method
2) Least Cost Method
3) Vegal's approximation Method

Maximization of Transportation Problem
Some transportation type problems concern profits or revenues rather than costs. In such cases, the objective is to maximize rather than to minimize. Such problems can be handled by adding one additional step as the start: identify the cell with the largest profit and subtract all other cell profits from that value. Then replace the cell profits with the resulting values. These values reflect the opportunity costs that would be incurred by using routes with unit profits that are less than the largest unit profit. Solve in the usual way for the minimum opportunity costs solution this will be identical to maximizing the total profit. For example:
A manufacturing company has four plants situated at different locations, all producing the same product. The manufacturing cost varies at each plant due to internal and external factors. The size of each plant varies, and hence the production capacities also vary. The cost and capacities at different locations are given in the following table.

Cost and Capacity of Different Plants

Particulars		Plant		
	A	B	C	D
Production Cost Unit (RS)	18	17	15	12
Capacity	150	250	100	70

The company has five warehouses. The demands at these warehouses and the transportation costs per unit are given in the table above. The selling price per unit is RC. 30/-
Another use of transportation method by the manager is to compare transportation costs for alternative locations.

RECOMMENDATION AND CONCLUSION

This study has extensively looked at transportation model as a tool for the achievement of organizational goals, for the benefits of the managers.

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The study described several problems that lead themselves to solution using the transportation problem. The transportation type problems involve the distribution of goods. Usually, for each type of problem, a procedure for formulating the problem in a way that lends itself to its solution these are procedures used and are described for setting up each types of problem. Transportation models give the managers the opportunity to maximize the cost of transferring goods it has a number of origins and a number of destination initial basic feasible solution. There can be an optimum solution from these various techniques and furthermore transportation problem can be generalized into transshipment problem to where shipment could be feasible for origin for origin to origin.

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