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THE ADAPTABILITY OF MATIX THEORY IN COST ALLOCATION AND COST APPOINMENT

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ABSTRACT:

At times, costs cannot be traced to specific units without considerable difficulty or a clerical labour not justified by the result manufacturing overhead represents all costs incurred in the factory over and above direct material cost, and direct labour cost. In other words, it is the aggregate of factory indirect material cost, factory indirect labour cost factory indirect services. The items of overhead, which cannot be identified with specified departments, are prorated or distributed among the related departments and this proration of distribution is technically referred to as apportionment. All items of overhead, which cannot be allocated are apportioned among the production or service departments on some acceptable basis, which is decided after a lot of

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analysis and careful consideration of factors involved. It should be noted that item of overhead cannot be identified with specific units of production, but it can be identified with specific department for the purpose of allocation. The apportionment of such overhead item can be equitably distributed to production departments through matrix algebra with precision. The use of matrix theory is of eat advantage to management, when carefully applied.

INTRODUCTION

Overhead distribution is a basic problem of a cost accountant. The results of overhead distribution influence almost all major decisions in an organization. Cost distribution should be based on benefits received by specific departments and cost centre. For this purpose, it is necessary that inter-departmental relationship is expressed quantitatively as far as possible. After the reciprocal relationship among different departments is established, the problem of arithrnetical distribution of cost in previously established ratio arises. This problem increases geometrically with increase in the number of reciprocally related departments. The use of matrix theory can be of considerable help to a cost accountant in this phase of cost distribution. The use of matrix theory promote calculational simplicity and clearer understanding of the basic structure of inter-related elements.

ADAPTABILITY —

The two major constituents of this problem are — structuring the reciprocal relationship and the solution techniques

STRUCTURING THE RECIPROCAL RELATIONSHIP: Suppose allowable bonus of workers is computed as a percentage of net profit after tax and allowable bonus is to be deducted for determining the tax liability. This relationship can be expressed as:

$$B = x(P-T)$$

$$T = y(P-B)$$

Where B is bonus; P is net profit before bonus and tax, T is income tax, x is bonus percentage and y is income tax rate.

SOLUTION TECHNIQUES: A matrix is a rectangular array of numbers arranged in rows and columns enclosed by a pair of brackets and subject to certain rules of presentation. The number can be substituted by symbols with the appropriate suffixes indicating the rows and column numbers. It will be possible to identify the exact location of a number or a symbol in a whole arrangement of matrix. In matrix algebra, the elements are ordered numbers and therefore, operation on matrices have to be performed in a manner in which an array sergeant gives drill to the platoon. Every cadet has to maintain his position with reference to the position of his fellow cadet. The main operations to be performed on matrices are addition and multiplication. The subtraction and division are derived.

In matrix addition and subtraction, each matrix must be of the same size and corresponding elements are added or subtracted. In matrix multiplication by scalar, any size matrix can be multiplied by a number, a scalar, each element being multiplied by the scalar. In matrix multiplication, a matrix of size **m x n** can be multiplied by a matrix of size **n x p** producing a matrix size **m x p.** Each row of matrix **A** is multiplied by each column in matrix **B, AB = BA**.

Two special matrices are the **zero** matrix i.e. any square matrix where all elements are zero and the unity matrix **(1)** i.e., any square matrix with **1**, in a diagonal from top left to bottom right with the rest of the elements being zero.

The matrix invasion, which is denoted $\mathbf{A}^{-1}$ or $\mathbf{C}^{-1}$ etc is determined by carrying out row operations on the original matrix and a unity matrix with the objective of changing the original matrix into **1**. The inverse is the matrix used to replace the original unity matrix

Data	Service Department		Production Department	
	Maintenance	Electricity	Machining	Assembly
Man hrs of maintenance time	-	3000	16000	1000
Units of electricity consumed	20,000	-	130,000	50,000
Department costs before any allocation of service departments	50,000	4,000	140,000	206,000

APPLICATION: The apportionment of service departments cost to production departments and other service departments is one area where matrix algebra can be usefully applied. Considering the data procured from an organization for this purpose:The first step is to set out the information given in the form of simultaneous equation which can be re-oriented using matrix algebra.

Let M = total cost of maintenance department including allocation of electricity cost

Let E = total cost of electricity department including an apportionment of maintenance cost.

Proportion of maintenance time consumed by electricity department is:

$$\frac{3000 \text{ hrs}}{3000 + 16000 + 1000 \text{ hrs}} = 0.15$$

i.e. 15% or $^{3}/_{20}$ of maintenance department costs should be apportioned to electricity department.

E = N4000 + 0.15rn............................. (1)

Similarly, the proportion of electricity consumed by maintenance department is:

$$\frac{20{,}000 \text{ units}}{20{,}000 + 130{,}000 + 50{,}000 \text{ units}} = 0.10$$

i.e. 10% or $^{1}/_{10}$ of electricity cost should be apportioned to the maintenance department:

M = N50,000 + 0.10 E ……………………. = (2)

Setting out equations 1 and 2 in the normal simultaneous manner gives:

- 0.15M + E = 4000

M - 0.1E = 50,000

Check for feasibility of solution

- Does number of equations = number of unknowns? Yes. Therefore, matrices to be solved are:

$$\begin{bmatrix} -0.15 & 1 \\ 1 & -0.1 \end{bmatrix} \qquad \begin{bmatrix} 4000 \\ 50{,}000 \end{bmatrix}$$

Further similar steps will be:

Row 1 multiplied by — 1/0.15 gives

$$\begin{bmatrix} 1 & - 6.6 \\ 1 & -0.1 \end{bmatrix} \quad \begin{bmatrix} -26,666.66 \\ 50,000 \end{bmatrix}$$

Row 2 — Row 1 gives:

$$\begin{bmatrix} 1 & -6.66 \\ 0 & 6.56 \end{bmatrix} \quad \begin{bmatrix} -26, 666.66 \\ 76,666.66 \end{bmatrix}$$

Row 2 divided by 656 gives:

$$\begin{bmatrix} 1 & -6.66 \\ 1 & 1 \end{bmatrix} \quad \begin{bmatrix} -26,666.66 \\ 11.675 \end{bmatrix}$$

Finally Row 1 + (6.66 x Row 2) gives:

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad \begin{bmatrix} 51,168 \\ 11,675 \end{bmatrix}$$

The value of M = N51, 168 and E = N11, 675

Having obtained the service departments costs, including apportionments between themselves, the apportionments to the production departments can be determined.

Proportions of maintenance and electricity consumed by production departments:

	Maintenance	Electricity
Machining =	$\frac{16,000}{20,000} = 0.8$	$\frac{130,000}{200,000} = 0.65$
Assembly =	$\frac{1000}{20,000} = 0.05$	$\frac{50,000}{200,000} = 0.25$

Accordingly, the apportionment of maintenance department costs to the production department is:

$$\begin{bmatrix} 0.8 & 0.65 \\ 0.05 & 0.25 \end{bmatrix} \begin{bmatrix} M \\ E \end{bmatrix}$$

$$= \begin{bmatrix} 0.8 & 0.65 \\ 0.05 & 0.25 \end{bmatrix} \begin{bmatrix} 51,168 \\ 11,675 \end{bmatrix}$$

$$= \begin{bmatrix} 0.8x51, 168 + 0.65 \text{ x } 11,675 \\ 0.05 \text{ x } 51,168 + 0.25 \text{ x } 11,675 \end{bmatrix} = \begin{bmatrix} N48,523 \\ N5,477 \end{bmatrix}$$

i.e. N48,523 to machining and N5,477 to Assembly, a total of N54,000

CONCLUSION

Application of matrix theory in determination of cost allocation and cost apportionment is a mathematical induction which must be clearly understood by cost accountant in order to adhere to its methodological norms. Where the application is comprehensible and fully understood, it will facilitate easy preparation of periodical statement of accounts.

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