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Al-Jo'ane Company: support department cost allocations with matrices, to improve decision making

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Abstract :

The aim of this paper is to solve the complexity of cost allocation problem where the support center at Al-Joa'ane company have a reciprocate services along with the production (operation) centers. The study used a spread sheets of excel to apply matrices to allocate the indirect costs. The company has seven centers in which two of them are production centers; the rest are called the supporting centers where they work to facilitate the production process. Many methods in cost accounting have been proposed, Via the direct method, the step-down method, the individuality method and the reciprocal methods. However not all the methods has the same applications at the process of cost allocation on the production methods, for instance, the direct methods assume there is no inter-services among the support centers. The proposed methods though has its own complexity for application but it can solve the problem of reciprocate services among the support centers. The study has proposed a systematic approach to apply the reciprocal method for Al Al-Jo'ane Company.

المستخلص

الهدف من هذه الورقة هو حل مشكلة تعقيد التكاليف حيث يوجد لدى مركز الدعم في شركة الجوعاني خدمات متبادلة مع مراكز الإنتاج (التشغيل). استخدمت الدراسة ورقة انتشار من التفوق لتطبيق المصفوفات لتخصيص التكاليف غير المباشرة. الشركة لديها سبعة مراكز فيها اثنان من مراكز الإنتاج. ويطلق على البقية مراكز الدعم التي يعملون فيها لتسهيل عملية الإنتاج. تم اقتراح العديد من الطرق في محاسبة التكاليف ، عبر الطريقة المباشرة ، وطريقة التخفيض ، والطريقة الفردية والطرق التبادلية. ومع ذلك ، لا تملك جميع الأساليب نفس التطبيقات في عملية توزيع التكلفة على طرق الإنتاج ، على سبيل المثال ، تفترض الطرق المباشرة عدم وجود خدمات داخلية بين مراكز الدعم. على الرغم من أن الأساليب المقترحة لها تعقيد خاص بها للتطبيق ، إلا أنها تستطيع حل مشكلة الخدمات التبادلية بين مراكز الدعم. اقترحت الدراسة مقارنة منهجية لتطبيق الطريقة المتبادلة لشركة الجوعاني.

1. INTRODUCTION

Support center costs are allocated to operating centers that produce the company products and generate revenues. Hence, service centers cost allocations are mainly used to serve the managements by adequate information for economic decisions, for instance it can motivate managers of the company and other employees, and also it may justify cost streaming in the company production and value chain, and finally it can help in accurate measurement of the company income and subsequently can provide sufficient financial reporting (Horngren et al., 2006). The general perception regarding the overhead costs at any firm that there is no unique generalized method can be used to allocate the costs in accurate way, the reason behind this statement stands for the way of choosing the allocation base and the estimated total overhead costs. Moreover, there yet to be a unified method to allocate the support center costs to the production centers, the overhead costs have been increasing significantly in the age of technology and information. Therefore, it is a necessity to look for a method fulfills the management requirement of accurate cost allocation to the production centers and the accounting literature by providing a systematic solution for the way of applying the reciprocal method using matrices. The consideration of reciprocal services among the service centers advocate for applying the reciprocal method. However, many companies are still using the direct and step-down methods due to the simplicity of application. Simultaneous equations have been used in order to allocate the indirect costs among the company service and production centers. The problem increases when the allocation of the service enters with the costs from the other service center. (Kaplan 1973). Therefore, many researches in the cost accounting literature have been used matrices to

allocate the support centers reciprocal costs (Churchill 1964, Manes 1965, Esmalifalak et al, 2013, Togo, 2013) and they have proven from the literature that using this method of cost allocation give the firms the ability to improve the decision making.

The core of cost accounting section in the company is calculating the cost of product at different stages in the production process. Moreover, the cost measurement is not important until the accuracy been taken into consideration. The work complexity of cost allocation increases by increasing the number of serves and production centers of the company and the reciprocate services among them (Barfield et al., 2001). According to Yukcu (2007) four main methods are used for allocation the service centers costs to the production centers namely the direct method, the step-down method, the planned allocation method and the reciprocal method (Colins, 2003; Horngren et al, 2006; Jacobs and Marshall, 1999). Yukcu (2007) stated that using the direct method of cost allocation the service centers have no importance of allocation. However the production centers is the main objective of the allocation process. While the step-down method of cost allocation have a limitation of inter services among the serves centers. Nevertheless, a sequence of which service center must be consider for allocation start up based on the quantum of services which been provided to other cost centers. However, none of the cost allocation method could overcome the issue of inter service among the service centers of the company. Thus, the reciprocal method was adopted in many companies despite of the complexity of its application but for its accuracy in cost allocation (Blayney and Yokohama, 1991; Jacobs and Marshall, 1999; Christensen, 2000; Barfield et al., 2001; Szychta, 2002; Colins, 2003; Alan and Yeilyurt, 2004; Horngren et al, 2006 ; Franz, 2007; Yukcu, 2007; Yukcu and Ozkaya 2010; Hansen and Mowen, 2011; Esmalifalak et al, 2013, Togo, 2013) The paper therefore has been structured to serve its objective as, data and methodology was discussed in section 2 and section 3 has been allocated to the paper for the result and discussion.

2. DATA AND METHODOLOGY

Al-jo'anee Company is a presumptive metaphoric proposed company for the purpose of applying the reciprocal method of cost allocation of service centers. Data was assumed that the company has seven cost centers, five of them are service centers and having a reciprocate services along with the production centers services. The company manufactures air-conditioning equipment in the Middle East. The demand for its products is increasing very quickly as more people are able to afford air conditioning. Hence, Al-Jo'anee has had to expand its product line to meet the new demand. As a consequence, the service centers of the proposed company have higher costs than before. The service centers of the company are Center A, Center B, Center C, Center D and Center E. The model of the paper has been proposed as a set of set of simultaneous equations (model 1) applied proposed to be solved algebraically in a spread sheets of excel 2010.

$$\text{Center A:} \quad + 1 A = 1000000 = +06 B + 0.05 C + 0.07 D + 0.03 E$$

$$\begin{array}{l} \text{Center A:} \quad + 1 A - 0.06 B - 0.05 C - 0.07 D - 0.03 E = \\ \text{Center B:} \quad - 0.04 A + 1.00 B - 0.06 C - 0.05 D - 0.04 E = 800000 \\ \text{Center C:} \quad - 0.08 A - 0.09 B + 1.00 C - 0.05 D - 0.07 E = 600000 \\ \text{Center D:} \quad - 0.09 A - 0.07 B - 0.06 C + 1.00 D - 0.05 E = 400000 \\ \text{Center E:} \quad - 0.07 A - 0.08 B - 0.09 C - 0.08 D + 1.00 E = 200000 \end{array} \quad \begin{array}{c} | \\ 1000000 \\ \dots \text{Model (1)} \end{array}$$

$$\begin{array}{l} \text{Center C:} \quad - 0.08 A - 0.09 B + 1.00 C - 0.05 D - 0.07 E = 600000 \\ \text{Center D:} \quad - 0.09 A - 0.07 B - 0.06 C + 1.00 D - 0.05 E = 400000 \\ \text{Center E:} \quad - 0.07 A - 0.08 B - 0.09 C - 0.08 D + 1.00 E = 200000 \end{array}$$

In general the cases proposed in the textbook examples and empirical cases having a limited the number of support centers (less than four). Therefore, such cases are considered as straight path in method application in case of solving for the reciprocated costs of each support center. Nevertheless, practically the number of service centers is exceeding the limited number. Thus, it has a difficulty in application for the accountants of using the reciprocal method in order to solve the proposed simultaneous equations in model (1).

The present paper therefore is using the Microsoft Excel spreadsheets to solve the simultaneous equations in model (1) with the use of matrices. The following case presents the matrix functions needed to model the reciprocal relationships among many service and production centers of the company.

AL-JO'ANEE COMPANY BACKGROUND

During the last financial years of the company, the accounting department of the company has used different methods of cost allocation other than the reciprocal method in order to calculate the total production cost accumulated and assigned on the final product of the company. After the huge development in the cost structure during the transformation in the technical and information era the company managers are not stratified any more with the other allocation method of indirect costs. Based on this the top management has also recognized and understood the viewpoint of the production centers. Thus, it was a challenge for the accounting and finance department of Al-Jo'anee Company to use the reciprocal method for allocating the indirect costs of service centers. Even though it was obvious for the accounting and finance department this method requires more work and accuracy but it has the advantage that will be accepted by the management of the company through fulfilling the production manager's requirements.

Data

The company has seven cost centers (five service centers and two production centers). The service center A provides services for one service (B) center and one production center (Y) by 0.04 and 0.4 successively. Using the matrices method requires considering that the service center services has be equal to zero. However the total services of the service center is proposed to be equal to 1. Since the service

center costs will be allocated eventually to the production centers it's assumed to be -1 in the metrics as shown in the table (1).

Table (1)

The service and production centers of the company

Total	Center Y	Center X	Center E	Center D	Center C	Center B	Center A	
								Allocated
		1,200,000	200,000	400,000	600,000	800,000	1,000,000	Costs:
						6,000,000	1,800,000	
								Services:
0.00	0.40	0.32	0.07	0.09	0.08	0.04	-1.00	Center A
0.00	0.50	0.20	0.08	0.07	0.09	-1.00	0.06	Center B
0.00	0.24	0.50	0.09	0.06	-1.00	0.06	0.05	Center C
0.00	0.50	0.25	0.08	-1.00	0.05	0.05	0.07	Center D
0.00	0.40	0.41	-1.00	0.05	0.07	0.04	0.03	Center E

Source: proposed by the researcher for the use of this paper

3. RESULTS AND DISCUSSION

Reciprocal Method Simultaneous Equations

The model of the paper presents the support centers of the company. the company has five service centers as mentioned before. The reciprocated cost of the service center A is equivalent to the total costs of the center itself i.e \$ 1000000 and 0.06 with additional of 0.05 from the service center B was reciporocated to the service center A and 0.05 of the service center C, .and 0.07 of the service center D, and lastly 0.03 of the cervice E. The model can then be placed in a format of matrix multiplication among the service centers reciprocated services and the total costs of each service center. Likewise, the sub-formulas of the other service centers to allocate the reciprocated costs of all the 5 service centers are shown hereunder.

$$\text{Center A: } + 1.00A = 1000000 = +0.06B + 0.05C + 0.07D + 0.03E$$

$$\text{Center A: } + 1.00A - 0.06B - 0.05C - 0.07D - 0.03E = 1000000$$

$$\text{Center B: } - 0.04A + 1.00B - 0.06C - 0.05D - 0.04E = 800000$$

$$\text{Center C: } - 0.08A - 0.09B + 1.00C - 0.05D - 0.07E = 600000$$

$$\text{Center D: } - 0.09A - 0.07B - 0.06C + 1.00D - 0.05E = 400000$$

$$\text{Center E: } - 0.07A - 0.08B - 0.09C - 0.08D + 1.00E = 200000$$

Matrix for Simultaneous Equations

An equivalent matrix equation for the formulas above is $K = I * J$ as shown below. The (I) 5*5 matrixes is from the simultaneous equations above, which is the negative transposition of centers services which was provided among the service centers. The J=5x1 matrix is the reciprocated cost variables of the five service centers starting from the service center A upto the service center E. The K=5x1 matrix is representing the service center total costs of the service centers of the company separately where each value within a matrix has been specified the model (Matrix) through different rows and columns. For instance, $(I_{2,4})$ is equal to -0.05 where is correspond the row 2 and column 4 in the (I). The total structure of the matrix (I) is specified as as $(I_{1,1}:I_{5,5})$ in the excel spreadsheet, as presented in the table (2) hereunder.

Table (2)

The matrix structure

		(I)	x	(J)	=	(K)
A	=	1000000	-0.03	-0.07	-0.05	-0.06 +1.00
B	=	800000	-0.04	-0.05	-0.06	+1.00 -0.04
C	=	600000	x -0.07	-0.05	+1.00	-0.09 -0.08
D	=	400000	-0.05	+1.00	-0.06	-0.07 -0.09
E	=	200000	+1.00	-0.08	-0.09	-0.08 -0.07

Source: Calculated by the researchers.

Solving For Reciprocated Costs

Using the excel spreadsheet the reciprocated costs of the company service centers is computed by using the inverse multiplication of the matrix (I). Thus, the $[I^{-1}] \times [I] = [K]$ and using the matrix $[Q] \times [J] = [J]$.

$$[J] = [K] \times [I] \quad \text{Where:}$$

$$[K] \times [J] = [I^{-1}] \times [I] \times [I^{-1}]$$

$$[K] \times [I] \times [M] = [I^{-1}]$$

$$[K] \times [J] = [I^{-1}]$$

In excel spreadsheet pressing Ctrl + Shift + Enter keys all together in order to generate the matrix (J). That not happened until selecting the (J) matrix. After executing the last step the results are shown in the table (3).

Table (3)**The results of the matrix application**

	1158867
	948678
[J] =	844296
	645596
	484649

Reciprocating the service centers costs to the productions centers

The results of the reciprocated costs of the service centers to the centers that has been benefited by the specific service centers is calculated by multiplying two matrices that shown in the table (4). For

$[T] = [H]$ that shown below. *that the matrix multiplication of $[Si]$

The Microsoft Excel spreadsheet formula:

$$H = \text{MMULT} (\text{MINVERSE} ([Si]), [T])$$

$$H = \text{MMULT} (\text{MINVERSE} (Si_{1,1}:Tj_{5,5}), T_{11}:T_{5,7})$$

Table (4)
Matrix inverse results

[Si]						x				[T]		= [H]
0.07	0.09	0.08	0.04	-1.00	0.00	x	0.00	0.00	0.00	1158867		
											0.40	0.32
0.20	0.08	0.07	0.09	-1.00	0.06		0.00	0.00	0.00	948678	0.00	
											0.50	
0.50	0.09	0.06	-1.00	0.06	0.05		0.00	0.00	844296	0.00	0.00	
											0.24	= [H]
0.25	0.08	-1.00	0.05	0.05	0.07		0.00	645596	0.00	0.00	0.00	
											0.50	
0.41	-1.00	0.05	0.07	0.04	0.03		484649	0.00	0.00	0.00	0.00	
											0.40	

Source: calculated by the researchers

The resultant 5x7 [H] matrix is the allocation of reciprocated costs of support centers to all other centers. The [A] matrix is placed in the cost allocation table below. The cost allocation is complete for all the five service centers eventually will reach zero balances of the total cost of all the centers. However the total costs of the cost centers that been allocated will not be different from the total cost of the service costs that was the target of the allocation i.e. \$6000000 as shown in table (5).

Table (5)
Coast allocation using the reciprocal method

Total	Center Y	Center X	Center E	Center D	Center C	Center B	Center A	
	1,200,000	200,000	400,000	600,000	800,000	1,000,000	Costs:	
							6,000,000	1,800,000
							Services:	
0.00	463,547	370,837	81,121	104,298	92,709	46,355	-1,158,867	Center A
0.00	474,339	189,736	75,894	66,407	85,381	-948,678	56,921	Center B
0.00	202,631	422,148	75,986	50,658	-844,296	50,658	42,215	Center C

0.00	322,797	161,399	51,648	-645,596	32,280	32,280	45,192	Center D
0.00	193,860	198,706	-484,649	24,233	33,926	19,385	14,539	Center E
	2,542,8260			0	0	0	0	Total
						6,000,000	3,457,174	

Source: calculated by the researchers

Based on the results above, the company has used the reciprocal cost allocation of the service centers to the production centers. Five service centers have been considered to be allocated by using the matrix with the help of Microsoft excel spreadsheets. The results depict the accuracy of the method application though using a systematic approach by specific steps which have been explained during the results calculations. The information of the proposed method is more proper than the information of the other methods of cost allocation hence it can allocate the cost accurately and subsequently helping in decision making of the management. Hence the accuracy of the decision will increase by increasing the accuracy of cost allocation.

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