Fuzzy Performance focused Activity based Costing (PFABC)

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Abstract

Namazi (2009) introduced the third generation of ABC as Performance Focused Activity Based Costing (PFABC). This system, unlike TDABC that has a great emphasis on time driver, With select the several cost drivers, greater flexibility in allocating costs to activities has created. In fact, PFABC first allocating costs to activities, then allocate costs to products. Also, this system, unlike TDABC, with using appropriate cost drivers allocate the actual costs for each activity separately. However, this system like other costing systems is face with the phenomenon of ambiguity and uncertainty in estimating of standards as system input. To solve this problem, in This article has been trying for the first time using fuzzy logic to reduce of ambiguity and uncertainty in PFABC in estimate of standards, and Finally, the new system will be introduce as Fuzzy Performance Focused Activity Based Costing (FPFABC).

Key Words: Activity Based Costing (ABC); Fuzzy Logic; Performance Focused Activity Based Costing (PFABC); Uncertainty

1. Introduction

Changes in strategies, processes, complexities and varieties in products, weak performance of managers and not being successful in competitive positions have resulted in changing costing systems into novel costing systems with a different approach such as activity based costing (ABC). ABC was posed by Kaplan and Koper in 1980s. This system was used as an inventive and having value added as a strong tool for analyzing the profit and as a catalyst in decision makings through which the costs were appropriated to the activities based on the time spent (Namazi, 1999). The implementation and maintenance problems of the system included high costs of interviews and analyzing the viewpoints of individuals in order to create patterns and the preliminary model for activity based costing, using time
appropriations and costly updating provoked Kaplan & Anderson in the year 2004 to present the second edition of activity based costing, i.e. time driven activity based costing (TDABC) to solve the problem due to ABC, which measures the whole time period spent in different parts. This new system couldn't remove all the limitations of ABC. The most prominent problem of TDABC is the excessive reliance on time period. Also this system uses the same rate (based on the time) to appropriate costs (Kaplan & Anderson, 2004).

In 2009, Namazi introduced the third generation of costing called performance focused activity based costing (PFABC) to accountants for removing the most important problem due to TDABC. This system can unite with organization's resource programming (ORP) and performance management system to identify activities which is thought to be a key step in ABC and is omitted in TDABC. The principal of this method is to use the estimations in calculating products' costs and services such as estimating the resources needed, overcharge appropriation rate, cost drivers and ... . This needed collecting data with high expenses and also the standard estimations needed in this system will be very difficult. This is the greatest disadvantage of PFABC system. In this paper we have tried to use fuzzy logic in order to remove this disadvantage.

2. Performance Focused Activity Based Costing (PFABC)

Managers should permanently administer two separate accounting systems. One for determining the products' expenses and the other is controlling and assessing performance. Maintaining these two systems has always forced management to encounter high expenses and problems. To remove this problem, a unified system called performance focused activity based costing (PFABC) was proposed. This new system is based on a 9 steps process for each cost item (Namazi, 2009).

First Phase: Identifying major activities

This step is similar to the first step in traditional ABC which has been omitted in TDABC. This phase is needed for two reasons: 1- the nature and behavior of costs for each activity is usually different from other activities. 2- It is one of the major components of ABC which should be maintained in order to continue the process of administrative production.

Second Phase: Identifying the actual resources needed for each activity

The staffs who administer a designed activity can recognize the type and amount of resources needed for each activity based on the behavior or companies' data systems, especially accounting data system. Resources may include time, the amount of direct materials, or other suitable measures. But resource should have a definite relationship with cost. This creates a great deal of suppleness in choosing the capacity of different effective resources. This phase includes the determination of the actual resources' behavior resulted for the cost issue regarding two resources: flexible resources and promised resources. Flexible resources have behaviors like variable costs and promised resources have behaviors like fixed costs.

Third Phase: Determining the actual rate of each activity resource

The actual rate of each activity in ABC is determined regarding the time percentage of each activity carried out by the staffs (Namazi, 1999). In TDABC, only one rate of capacity cost has been determined for all parts by dividing the cost of the whole capacity utilized to the practical capacity of the resources used based on the time resource (Beshkoooh, Kazemi). In PFABC, the actual rates of costs are determined separately for each of activities done by the company
based on different drivers through present data systems according to the actual data and regarding the resources and behaviors of its costs.

**Fourth Phase: Determining the cost for each activity**

PFABC determines the cost of each activity regarding the behavior of cost resource. When the resource is a changing cost, the cost of input factors are calculated by multiplying the actual resources used in each activity (AR) and the actual price of the resources used (AP).

The actual price of the resources used \( \times \) the actual resources used = the actual activity cost

\( AC_i = AR_i \times AP_i \)

Here flexible resources such as direct materials, direct work and production overcharge can be identified very easily and are determined as flexible resources with changing cost behavior. Also the promised costs are appropriated by using one of the methods of flexible costs appropriation approach, cost driver appropriation approach, harmonized average, net retrievable value and multi-criteria decision making models.

**Fifth Phase: Calculating standard rate of activity**

This stage is common in ABC and it is not seen in TDABC, but it is a key step in PFABC process administration. In this step standard rate of each activity should be estimated. This estimation can be achieved by different tools such as measurement and job assessment techniques, market mechanisms and internal or external criteria. Also we can administer statistical techniques such as regression analysis and time sequential models. This standard should be calculated accurately because it is used as a criterion for comparison with actual rates and actual costs of operations.

**Sixth Phase: Calculating activity price deviation**

This stage is not common neither in ABC nor is it present in TDABC. Cost managers gain price deviation by calculating actual resources needed for each activity multiplied by standard price for resources consumed and subtracting it from actual cost of each activity. Promised resources can not be changed because their amounts are fixed.

**Seventh Phase: Calculating the cost of activities implemented**

Determining the standard amount of resources consumed in administering an activity is the first thing in order to calculate flexible resources. It is possible to use a job assessment system or statistical tools such as regression analysis to calculate this standard. The authorized flexible budget for actual work carried out regarding capacity cost of employed flexible resources is achieved by multiplying standard resources needed for the product (SR) with accrual work carried out (AW) multiplied by standard price of resources (SP).

\( (SR_i \times AW) \times SP_i = \text{Price of flexible resources utilized} \)

In order to calculate promised resources utilized, first the planned or budgeted level (BL) should be determined. This level usually is based on the concept of practical capacity. Then standard price for each promised capacity consumed is calculated through dividing the budgeted costs by budgeted level. Thus;

\( (SR_i \times AW) \times SP_i = \text{Price of promised resources utilized} \)
The difference between the two equations is related to flexible resources which act as changing costs and are related to standard price of each activity.

**Eighth Phase: Calculating value deviation**

Value deviation shows whether production manager of a company has utilized resources more than standard amount in actual manufacturing of a product or service designed or not. In fact it assesses the performance of manufacturing mangers.

**Ninth Phase: Calculating profitability of each activity**

The sum of efficiency and effectiveness of profitability is shown in this stage. Resources' efficiency can be described as the efficiency of an activity resulted from price deviation and amount deviation. Meanwhile the efficiency of an activity may be presented and introduced as the difference between the actual work done and the budgeted work related to the promised costs. Efficiency deviation shows whether the planned resources have been used efficiently and effectively practically or not? On the other hand, efficiency deviation shows whether planner manager has been successful in achieving the predetermined goals or not? (Namazi, 2009)

3. Fuzzy Logic

The theory of fuzzy logic was first posed by professor Lotfizadeh in 1965 to quantify the non-absoluteness and lack of accuracy. The main goal in fuzzy sets is its ability to express the non-absolute knowledge by quantifying inaccurate data. The fuzzy concept is introduced for modeling and analysis where the complexity of the system is so much that we can not judge with precision and clarity about parameters, indices and the behaviors of the system.

A fuzzy set is shown as follows:

$$A=\{(x, \mu_A(x)) | x \in A, \mu_A(x) \in [0,1]\}$$

In which, $\mu_A(x)$ shows the amount of membership of element $x$ in the set $A$. A real number of $A(x)\mu$ is appropriated for each element $x$ in $A$ from the range $[0, 1]$. The greater amounts of $\mu A(x)$ shows the higher membership degree (Hosseini, 2002).

3.1 Triangular Fuzzy Numbers

Fuzzy numbers are a special type of numbers which are defined by a 3 angled shape of $a_1, a_2, a_3$. In other words, $a_2$ is the strongest membership degree and parameters $a_1, a_3$ are low and high banks, respectively (Azar, 2010).

The main advantage of using triangular numbers is that standard PFABC system is kept unchanged throughout activity based costing analysis based on fuzzy performance as a consistent value.

4. Fuzzy performance Focused Activity based costing

In PFABC the resources needed for each activity should be estimated. Resources may include time, the amount of direct materials or other appropriate measures. Anyhow, the resource should have a definite relationship with cost issues. This phase involves the behavior identification of the resulted resources for cost issues regarding two resources: flexible resources, and promised resources. Thus, to reduce the errors and identify the needed resources more accurately for each activity, we should make flexible resources specifically related to cost issues fuzzy.
To do so, 3 parameters should be defined as: the least amount of resources needed, the most probable resources, and the highest amount of flexible resources. That is, minimum and maximum amounts of resources for each production with predetermined characteristics should be estimated. Previous information is used as the most probable state. It means that by considering that all factors are fixed and there are no significant changes in production process and not considering the technology…, it is supposed that the trend of production with the previous inputs continues.

In PFABC systems, isolated appropriation rates through the present data systems based on actual data and according to resources and costs' behaviors of it are determined. This is the advantage of PFABC over TDABC in which more flexibility in determining resources' appropriation rate for activities is supplied. Appropriation rate is calculated by dividing the sum of warehouse price into the sum of price driver levels. Thus, first we should calculate the resource price for each warehouse.

(1) For resources needed above, 3 input parameters are calculated.

(2) Then resources' price is calculated as 3 parameters as follows: the least probability, the most probable and the highest possibility of the sum of warehouse prices. As it was pointed out earlier, the resources utilized are divided into two categories: flexible resources and promised resources. There are several methods to appropriate promised resources such as: flexible resources' appropriation approach, cost driver appropriation approach, harmonized average, net retrievable value, multi-criteria decision making. Determining the price of flexible resources is done through multiplying the resources needed and their prices. In this case, the least price for each activity, the most probable price of each activity and the highest price of each activity is gained.

(3) In this phase we should make the sum of the levels of the drivers fuzzy. As it was said, PFABC considers different drivers for costs' appropriation for activities. If we suppose costs as price drivers, the least time needed to do an activity, the most probable time needed and the longest time needed to carry out a specific activity should be estimated. We may consider different price drivers for different activities. Suppose that regarding a specific activity, costs are appropriated based on the time spent for each activity to the whole activities. Also in another activity, costs are appropriated based on direct materials spent for activities. Thus, we should calculate the sum of price driver levels. That is the least probable price driver levels' sum, the most probable and the highest possibility of the sum of price driver levels are calculated.

(4) Finally the least probability, the most probable and the highest possibility of the rate of activity resources' appropriations are calculated. By determining different rates of overcharge appropriation with 3 parameters (3 parameters through triangular numbers) for unpredicted conditions, some estimations and predictions are made.

Another phase in PFABC is calculating activity price deviation. It is calculated by multiplying the actual resources used and actual price and subtracting the result from standard price. In this formula we can achieve deviations by altering standard fuzzy rate which has been calculated in the previous phase. In fact we can claim that by making price deviations fuzzy, deviations will decrease because predictions for deviations have been done previously.

Another phase in PFABC is to calculate amount deviation. This deviation is calculated by multiplying standard rate and actual amount and subtracting it from the standard rate. Regarding the fact that the amount and standard rate
have been changed into fuzzy in the previous phases, the amount of price deviation and amount deviation is in the best possible state.

Finally the profit or loss of activities is calculated.

(1) Product price is calculated by summing up the calculated overcharge and materials and direct wages.

(2) The absorbed overcharge is multiplied with three fuzzy appropriation rates calculated. It comprises the least overcharge price expected, the most probable overcharge price and the highest overcharge price.

(3) Then the price for the calculated overcharge with three parameters is added to the price of materials and direct wages, and it comprises the sum price of the product.

(4) Finally, profit or loss is calculated through subtracting the product's price from sales price of the product.

The information resulted from calculating profit or loss for assessing the performance of management, profitability of products and future planning are used.

5. Conclusions

On the whole we can present the following main results regarding the comparison of performance focused activity based costing and fuzzy performance activity based costing:

FPFABC is useful when: 1) The company is active in a non-precise and non-absolute setting. 2) Input data of PFABC are incorrect or insufficient. 3) Amount of the sum of overcharge price (indirect) is large enough to affect the related decision makings. The comparison of activity based costing systems and fuzzy activity based costing systems enables us to gain excessive and valuable information about effective behavior of the price when inaccurate and non-absolute data are present.

Besides product costing we can generalize fuzzy activity based costing systems to management systems based on fuzzy activity (FABM) to be used as powerful management's decision making tools in other areas such as customers' profitability. The most important applications known for fuzzy logic in costing are as follows:

1. Increasing the accuracy and correctness of performance focused activity based costing system through decreasing the ambiguity and lack of assurance about input data to the system.

2. Creating the possibility of investigating and determining the cost of products in new technologies and before product manufacturing regarding the ambiguous environmental conditions.

3. Improving the traditional financial performance assessment systems of companies through removing ambiguities about the type of financial ratios used, setting priorities for them and using non-financial criteria besides financial criteria.

4. Fostering the appropriation of company's limited resources when multi-purpose goals and structures and different organizational conditions are present.
5. Creating the possibility of more exact analysis of the cost relationships, activity amount and profits in ambiguous and non-assurance conditions.

6. Improving and upgrading the traditional models of selecting suppliers through considering the long-term effects of selecting each supplier on the company's value chain through using the present fuzzy value.

Finally, we suggest that this new system is used in a wide range of applications. And future researchers use this method in their researches.

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