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Research Article

EVALUATION AND ALLOCATION OF RESOURCES USING MULTI-PHASES DATA ENVLOPMENT ANALYSIS IN THE FIXING COMPANY OF FARS ELECTRICITY POWER

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ABSTRACT
The present study has been done in 2014 aiming at evaluating and allocating resources using Multi-phases Data Envelopment Analysis in the maintenance office of Fars electricity power. Efficiency evaluation of multi-phases system and allocation of resources using the model of Huwang has been investigated. And in the end applying a numerical example it has been shown that A2, B2, and C2 units are more efficient comparing A1, B1, and C1. Also accounting the efficiency assessment of performing the program, defect, showed that allocation of second hand resources (allocation based on function) has relatively more efficiency than allocation of first kind of resources (allocation based on influential presence).

Keywords: *Covering Analysis of the Data, Covering Analysis of Multi-phases Data and Efficiency*

INTRODUCTION
As one of the most basic principles of stable development, function assessment is of great significance. The issue of function evaluation and allocation of the resources has been in the center of attention here and would help the managers in improving the function and programming in order to allocating of resources in the best way.
Function evaluation in today's meaning has entered the management literature since early 20th century, although its simple process has existed in the organizations of the rulers and kings since a long time ago. Literally, the term "evaluation" means identifying the value of something (Alkin and Dewy, 1998), or the identifying factor or value of something (Bakhtiari, 2004). As some sahebnazaran believe the term "assessment" is synonymous with two other terms "evaluation" and "measurement" and it is impossible to see differences among the meanings and concepts of these three terms (Baazargaan, 2004).

The first recorded definition of "assessment" is by Ralf Tyler; he knows assessment as a means of identifying the rate of gaining the educational goals of the programs.In this definition, the educational purposes point to ideal changes that are expected to be obtained in the learners' behavior as a result of implementation of educational programs (Baazargaan, 2004). Gordon *et al.*, (1992) believe that assessing of efficiency analysis depends on the cost of a plan after its implementation (Moien, 1991). Marvin (1998) knows "assessment" as a process for collecting suitable information in order to decision making in different levels of management (Brown and Sevenson, 2000).

Data envelopment analysis DEA is a great tool for evaluating the function of the units. The amount of efficiency is calculated using the input and output amounts of decision maker units in the presented models. Since the data are not exactly identified in the real problems and mostly are inaccurate, so developing the theory of basic models of data envelopment analysis seems necessary in the cases where some or all of the inputs and outputs are inaccurate.

How can one calculate the amount of efficiency of the units and distinguish the efficient and inefficient units and also distinguish different efficient units? Our goal in this survey is to evaluate the function of maintenance office of Fars Electricity Power using data envelopment analysis and allocation of the limited resources among them.

Literature Review

Function

Function means the process of explaining the effectiveness and efficiency of the past actions. Measurement of organizational function is actually the measurement of financial function and valuing the staff of the organization (Neill and Rose, 2005). Nowadays the businesses in the competitive environment are trying to brisk up and adjust themselves to the changes through improving organizational function.Most studies in the past on organizational function were based on financial function 13, although the financial experts are not that coherent with the long term goals of a business and cannot create a point for the organization in the serious competitive situations. Therefore the Expert Accountant Association of America in 1994 suggested that the functional indicators include non-financial information, too. Such information would reflect the thoughtful capital, social accountability and increasing the level of organizational knowledge (Wu and Liu, 2009). In order to know different aspects of organizational function measurement, one needs to analyze various methods of function (Lye *et al.,* 2005). Every organization is responsible toward the community of its clients and beneficiaries regardless of goals, missions, perspectives and strategies. So the investigation of the results of organizational functions in these aspects is considered a significant strategic process.

Providing services and producing proper goods and delivery costs from resources needs the management and staff's more attention and more efficient function of the organization in order to achieve the goals, constant improvement of quality and raising the customers' and citizens' satisfaction. In the case that function evaluation is done with a process view and correctly and continuously, causes improvement and accountability of executive organizations and public trust on function of the organizations and efficiency and effectiveness, improving management resources, clients' satisfaction, helping to national development, creating new capabilities, stability and raising universal level of the companies and institutions (Darbaani *et al.*, 2007).

Efficiency

The simplest and by the way the most general definition of efficiency is provided by Peter Draker. Efiiciency in Draker's view is great implementation of the work or "the perfect implementation of duties" (in the view of Katez and Kaan, 1978). Efficiency is the ratio of produced outputs to required data to produce these setadehaa. These two researchers make differences between dynamic and potential efficiency (Colombeer, 2008). Potential efficiency shows that how much an organization would be able to produce if it acts its best while dynamic efficiency is the real ratio of outputs to the real data.

Richard (2001) know efficiency as the amount of resources that are used to produce a unit of production and it can be accounted based on the ratio of consumption to production. Generally, efficiency refers to the way of using resources or the amount of costs spent for the job; it means that how much of the resources and facilities have been used properly. Efficiency has to do with the quality of the function of each current economic unit related to the process of production. Efficiency is the mean of the quality of function of production elements and its perfect combination in reaching the optimum amount of production.

Data Envelopment Analysis

Multi-phases systems are generally special cases of networking systems and therefore could be studied by the developed models Tone and Tsutsui (2009). The (SBM) measurement method is specifically used for measuring the efficiency of the process and the profitability of the system is defined as a weight-arithmetical mean from efficiency of the process in input model and weight- harmonic in output model.

Also an other-directed method is proposed in which the system efficiency is defined as a function of input and output of the process. The weights in this model have been identified in advance. Instead of sum of process efficiency in this study, in order to get the system efficiency through weight that is identified in advance, a relationship between the measured efficiency of the system and the process will be extracted through common definitions.

To the extent that it is related to the system structure the searching systems where a DMU operations are moved from one period to the other and tow continuous periods are connected together is also a kind of

multi-phases system. There are various models suggested for measuring these (Chen and Van, 2010; Jaenicke, 2000; Kao, 2013; Nemoto and Goto, 1999; Tone and Tsutsui, 2010).

Among these, the Kao model (2013) is capable of analyzing the factors of system efficiency to a linear combination of process efficiency. By the way, these results cannot be generalized to a general multi-phases system. However, the properties obtained from multi-phases systems could be implemented in searching systems. Something that should be taken into consideration here is that where the system efficiency is a production of improved process efficiency is not illustrated in Kao model. In addition, the multi-phases model presented in this study is also capable of investigating series system or common inputs. While it is impossible on the developed Kao model.

The Research Question

The best way of allocation of the resources in the fixing company o Fars Electricity Power?

MATERIALS AND METHODS

In this research the multi-phases data envelopment analysis has been done in the maintenance office of Fars Electricity Power. The kind of research regarding the goal is applicable and regarding the data gathering is descriptive. Data analysis has been done using Gomez software and in the fixing company of Fars Electricity Power.

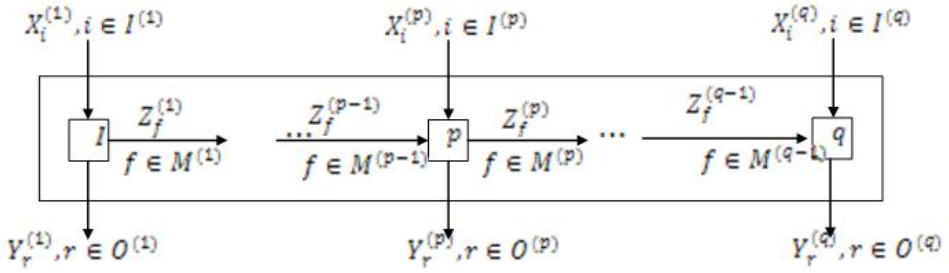

Figure 1: Multi-Step System Overview

$$E_k = max. \sum_{r=1}^{s} u_r Y_{rk}$$

$$s.t. \sum_{i=1}^{m} v_i X_{ik} = 1$$

$$\sum_{r=1}^{s} u_r Y_{rj} - \sum_{i=1}^{m} v_i X_{ij} \leq 0 \quad , \quad j = 1, \dots, n$$

$$\left(\sum_{r \in O^{(1)}} u_r Y_{rj}^{(1)} + \sum_{f \in M^{(1)}} w_f Z_{fj}^{(1)} \right) - \sum_{i \in I^{(1)}} v_i X_{ij}^{(1)} \leq 0 \quad , \quad j = 1, \dots, n$$

$$\left(\sum_{r \in O^{(p)}} u_r Y_{rj}^{(p)} + \sum_{f \in M^{(p)}} w_f Z_{fj}^{(p)} \right) - \left(\sum_{i \in I^{(p)}} v_i X_{ij}^{(p)} + \sum_{f \in I^{(p-1)}} w_f Z_{fj}^{(p-1)} \right) \leq 0 \,,$$

$$p = 2, \dots . q-1, j = 1, \dots, n$$

$$\sum_{r\in O^{(q)}} u_r Y_{rj}^{(q)} - \left(\sum_{i\in I^{(q)}} v_i X_{ij}^{(q)} + \sum_{f\in M^{(q-1)}} w_f Z_{fj}^{(q)} \right) \le 0 \quad , \quad j = 1, \dots, n$$

$$u_r, v_i, w_f \ge \varepsilon \quad , \quad r = 1, \dots, s \quad , \quad i = 1, \dots, m \quad , \quad f = 1, \dots, g \qquad (2)$$

Where w_f is the ratio of f[th] product. A set of limitations related to process q in model 2 equals the limitations related to the system for each j: DMU

$$\left[\left(\sum_{r\in O^{(1)}} u_r Y_{rj}^{(1)} + \sum_{f\in M^{(1)}} w_f Z_{fj}^{(1)} \right) - \sum_{i\in I^{(1)}} v_i X_{ij}^{(1)} \right]$$

$$+ \sum_{p=2}^{q-1} \left[\left(\sum_{r\in O^{(p)}} u_r Y_{rj}^{(p)} + \sum_{f\in M^{(p)}} w_f Z_{fj}^{(p)} \right) - \left(\sum_{i\in I^{(p)}} v_i X_{ij}^{(p)} + \sum_{f\in M^{(q-1)}} w_f Z_{fj}^{(p-1)} \right) \right]$$

$$+ \left[\sum_{r\in O^{(q)}} u_r Y_{rj}^{(q)} - \left(\sum_{i\in I^{(q)}} v_i X_{ij}^{(q)} + \sum_{f\in M^{(q-1)}} w_f Z_{fj}^{(q-1)} \right) \right]$$

$$= \sum_{p=1}^{q} \sum_{r\in O^{(p)}} u_r Y_{rj}^{(p)} - \sum_{p=1}^{q} \sum_{i\in I^{(p)}} v_i X_{ij}^{(p)} = \sum_{r=1}^{s} u_r Y_{rj} - \sum_{i=1}^{m} v_r X_{ij}$$

The mediating products that are produced in each period are used in the next period. So the limitations related to the system for *n* numbers of DMU and $\sum_{r=1}^{s} u_r Y_{rj} - \sum_{i=1}^{m} v_i X_{ij} \le 0$ are canceled and could be omitted. Furthermore, the aid variable of system limitation, s_j, its sum will be the limitations related to the process. $s_j^{(p)}$ $p = 1, \dots, q$.

The meaning of (u_r^*, v_i^*, w_f^*) is as a perfect way for model 2 and s_k^* and $s_k^{(p)}$ are the aid variables added to the limitations related to the system and process *p*. the system efficiency is (E_k) and the process efficiency is $\left(E_k^{(p)}\right)$:

$$E_k = \frac{\sum_{r=1}^{s} u_r^* Y_{rk}}{\sum_{i=1}^{m} v_i^* X_{ik}} = \sum_{r=1}^{s} u_r^* Y_{rk} = 1 - s_k^*$$

$$E_k^{(1)} = \frac{\sum_{r\in O^{(1)}} u_r^* Y_{rk}^{(1)} + \sum_{f\in M^{(1)}} w_f^* Z_{fk}^{(1)}}{\sum_{i\in I^{(1)}} v_i^* X_{ik}^{(p)}}$$

$$E_k^{(p)} = \frac{\sum_{r\in O^{(p)}} u_r^* Y_{rk}^{(p)} + \sum_{f\in M^{(p)}} w_f^* Z_{fk}^{(p)}}{\sum_{i\in I^{(p)}} v_i^* X_{ik}^{(p)} + \sum_{f\in M^{(p-1)}} w_f^* Z_{fk}^{(p-1)}} \quad , \quad p = 2, \dots, q-1$$

$$E_k^{(q)} = \frac{\sum_{r\in O^{(q)}} u_r^* Y_{rk}^{(q)}}{\sum_{i\in I^{(p)}} v_i^* X_{ik}^{(q)} + \sum_{f\in M^{(q-1)}} W_f^* Z_{fk}^{(q-1)}}$$

In addition to this, the aid variable of the system equals the sum of aid variables of the process $s_k^* = \sum_{p=1}^{q} s_k^{(p)^*}$ and this is a property of a general multi-phases system.

Characteristic 1: the aid variable of system efficiency for the general multi-phases system equals the sum of variables related to the process $s_k^* = \sum_{p=1}^{q} s_k^{(p)^*}$.

This characteristic means that the system is efficient if and only if all the processes exist. Note that it is not necessary that $E_k^{(p)} = 1 - s_k^{(p)}$ unless $E_k = 1 - s_{k.}^*$

So the relationship between E_k and $E_k^{(p)}$ is not directly obtained through $s_k^* = \sum_{p=1}^{q} s_k^{(p)^*}$ and other concepts should be applied.

The network systems include different structures. By the way, there are two basic types, linear and parallel by which every network systems are expressed. The analysis of the efficiency for network systems are obtainable if the analysis of the efficiency is known for these two types.

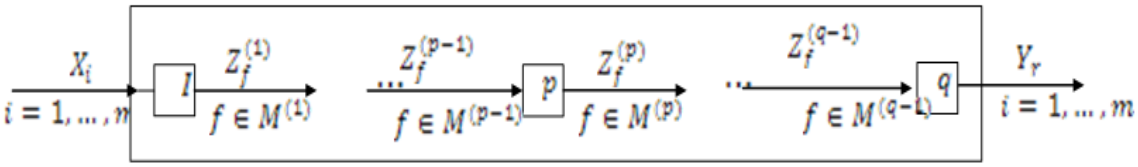

Figure 2: The system of linear structure

$$E_k^{(p)} = \frac{\sum_{f\in M^{(p)}} W_f^* Z_{fk}^{(p)}}{\sum_{f\in M^{(p-1)}} W_f^* Z_{fk}^{(p-1)}}$$

$$E_k^{(q)} = \frac{\sum_{r=1}^{s} u_r^* Y_{rk}}{\sum_{f\in M^{(q-1)}} W_f^* Z_{fk}^{(q-1)}}$$

The product of process efficiency q is as follows:

$$\prod_{p=1}^{q} E_k^{(p)} = \left[\frac{\sum_{f\in M^{(1)}} W_f^* Z_{fk}^{(1)}}{\sum_{i=1}^{m} v_i^* X_{ik}}\right]\left[\prod_{p=2}^{q-1} \frac{\sum_{f\in M^{(p)}} W_f^* Z_{fk}^{(p)}}{\sum_{f\in M^{(p-1)}} W_f^* Z_{fk}^{(p-1)}}\right]\left[\frac{\sum_{r=1}^{s} u_r^* Y_{rk}}{\sum_{f\in M^{(q-1)}} W_f^* Z_{fk}^{(q-1)}}\right]$$

$$= \frac{\sum_{r=1}^{s} u_r^* Y_{rk}}{\sum_{i=1}^{m} v_i^* X_{ik}}$$

which is the system efficiency. So the following characteristic will be gained:

Characteristic 2: the system efficiency for systems with linear structure is the process efficiency: $E_k = \prod_{p=1}^{q} E_k^{(p)}$

One way to analyze the system efficiency in a general network system is to transform the system to one of the linear or parallel subsystems. So the analysis of the efficiency can be obtained for the original system based on the analysis of the efficiency for linear and parallel structures.

Data Analysis

Based on what expressed in the methodology of the research, our research method is a multiple approach. According to the investigations and the collected data and the model we used the stages of the research were done in three phases and the explanation of each stage will be mentioned in the following. In the present study, We use indexes indices 1 and 2 for each allocation considering two kinds of used allocation in this organization and based on the kind of allocation of resources and the ease and exact understanding, that indices1 is based on effective presence and index 2 is based on the function.

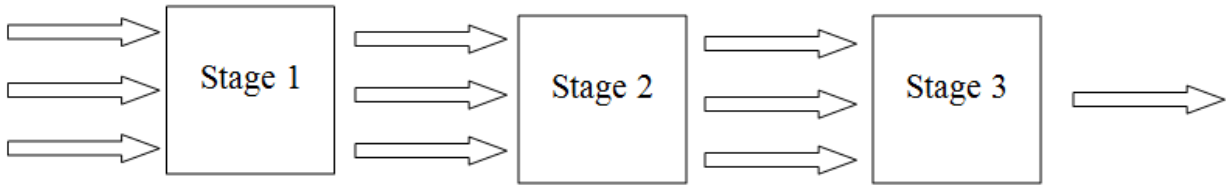

Figure 3: The stages of the research

Stage One

In this stage that is the first stage of multiple phases of initial input includes (some machines and human forces) and its mediating output that is the number of activities implemented by each unit. The software gives us an efficiency regarding input and output. But indeed it is not the final efficiency.

In the second stage that is a mediating stage, the input includes the payment costs and costs of purchasing machines. The output of the previous part is used as the input in this stage in the form of the number of applicable plans by the units. And the output of this stage is the number of deficiencies or damages that every unit may encounter regarding the type of work, and these damages are considered as expenses for the organization. We gain efficiency in this stage, too. But we haven't got the final efficiency in this stage, yet. Another stage remains in which the output is used as the input for the third stage. In this pace we have two inputs one of which is the input of the number of output deficiencies in the second stage of the process and the other one that is used in this stage is the expenses resulted from these deficiencies, and the final output of the study is the income that the plan has for the related organization. This stage also has efficiency. We use the efficiencies of these three stages as the final efficiency in our research at fixing company of Fars Electricity Power. The results of the implemented operations are given in table 1.

Table 1: The results of efficiency of the research

DMU	Efficiency of stage 1	Efficiency of stage 2	Efficiency of stage 3	General efficiency	Rank
A1	0.79509434	1	0.469208211	0.7548	5
A2	1	0.91566998	0.84040404	0.9187	3
B1	0.658201058	0.961601494	0.601590699	0.7405	6
B2	1	0.80250658	1	0.9342	2
C1	0.811390666	0.980564263	0.590347924	0.7941	4
C2	0.963563137	1	0.967748918	0.9771	1

Conclusion

Findings in the First Stage

A2 and B2 were introduced as efficient units in this stage. Regarding the input and output given to this stage and using linear system their efficiency was 100% that exactly investigate the internal stages of current processes through separation of the stages.

Findings in the Second Stage

C2 and A1 were introduced as efficient units and other units were inefficient or they had weak efficiency. We have three inputs in this stage one of which is the output of the previous stage that makes the number of defects with the other two new inputs and are used as the input for the next stage.

Findings in the Third Stage

B2 is introduces as the efficient unit in this stage that is the basic and final stage in this research. Other units have to get close to this unit in efficiency, generally.

The final output and the principle goal of this study is to increase the income for the maintenance office of the electricity which considers the research question expressing that which approach is suitable to allocation of the resources in the maintenance office of the electricity power? To answer this question from the final stage we get this result that the units where allocation of resources in them is based on performance would earn more income for the organization and the expenses are useful expenses since they have improved the efficiency.

Suggestions

- Identification and definition of all activities and executive operations of the groups so that they have the capability of measurement and changing to units. This needs an exact investigation of the activities and participation and cooperation of experts and technical agents.The efficient data banks are required to execute this plan.
- In addition to evaluation of the efficiency of technical units, the evaluation of the function of output parts and management of the organization in needed to improve the organization function.
- Data envelopment analysis has been used in this research in order to evaluate efficient units. It is suggested to the future researchers to use intersecting efficiency method for this aim.

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REFERENCES

Alkin MC and Dewy A (1998). *Three Decades of Curriculum Evaluation: An Introduction*, in Lewy (ed.) (London: Pergamon).

Brown L and Sevenson W (2000). Structure Is Not Organization. *Business Horizons* **3**.

Baazargaan A (2004). *Higher Education Evaluation, Higher Education Encyclopedia*. Tehran: The Great Persian License Foundation.

Baazargaan A (2004). *Educational Evaluation (Concepts, Patterns and Operational Processes)* (Samt Publications) Tehran.

Chen CM and Van Dalen J (2010). Measuring dynamic efficiency: Theories and anintegrated methodology. *European Journal of Operational Research* **203**(91) 749–760.

Colombier C (2008). Efficiency in public infrastructure provision: a theoretical note. *Journal of Economic Studies* **35**(6) 528-543.

Dariani MA, Rafi Zade A and Ronaq M (2007). *Function Management (with a Look at Evaluation of the Function of Executive Organizations of the Country)* (Aharaan: Farmanesh).

Jaenicke EC (2000). Testing for intermediate outputs in dynamic DEA models: Accounting for soil capital in rotational crop production and productivity measures. *Journal of Productivity Analysis* **14**(5) 247-266.

Kao CH (2013). Efficiency measurement for general multi-stage systems in data envelopment analysis.

Kaplan SR and Norton P David (2004). *Strategy-directed Organization*, translated by Parviz Bakhtiari (Publication: Publication of Industrial Management Organization).

Lai KH and Cheng TCE (2005). Effects of quality management and marketing on organizational performance. *Journal of Business Research* **58** 446-456.

Moien M (1991). *Mien Encyclopedia*, 13th edition (Amir Kabir Publication Institution) Tehran.

McAdam R, Hazlett SA and Gillespie KA (2008). Developing a conceptual model of lead performance measurement and benchmarking: A multiple case analysis. *International Journal of Operations & Production Management* **28**(12) 1153-1185.
Nemoto J and Goto M (1999). Dynamic data envelopment analysis modeling intertemporal behavior of a firm in the presence of productive inefficiencies. *Economics Letters* **64**(11) 51–56.
Neill S and Rose GM (2005). The effect of strategic complexity on marketing strategy and organizational performance. *Journal of Business Research* **13** 1–10.
Taticchi P, Tonelli F and Cagnazzo L (2009). A decomposition and hierarchical approach for business performance measurement and management. *Measuring Business Excellence* **13**(4) 47-57.
Tone K and Tsutsui M (2009). Network DEA: A slacks-based measure approach. *European Journal of Operational Research* **197**(8) 243-252.
Tone K and Tsutsui M (2010). Dynamic DEA: A slacks-based measure approach. *International Journal of Management Science* **38**(51) 145-156.
Wu C and Liu Y (2009). Development and evaluation of an ergonomic software package for predicting multiple-task human performance and mental workload in human–machine interface design and evaluation. *Computers & Industrial Engineering* **56**(1) 323-333.