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A HYBRID METHOD BASED ON BSC AND DEA FOR ORGANIZATIONAL RANKING AND BENCHMARKING

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ABSTRACT

Nowadays, managers tend to compare their organizations with the others as well they want to have benchmarks. Benchmarking should be based on correct updated organizational critical factors. Balanced scorecard (BSC) is the tool to translate the organizational strategic goals into the operational critical factors by its strategy map. It individually may not use as the tool for organizational comparison. Data envelopment analysis (DEA) is essentially used to evaluate decision making units (DMUs) from the best possible relative efficiency. But it's incapable of defining its input and output indexes efficiently. So, in this paper the most important strategic factors obtained from BSC are employed as the input data for DEA. This may lead us to a comprehensive benchmarking method to attain the reliable appropriate results for each organization in each period. Finally, the proposed method is practically tested and the results are illustrated in the following paragraphs.

Keywords: Balanced Scorecard, DEA, Ranking method, Logistic regression.

1 INTRODUCTION

The BSC model is a widely used method for organizational performance measurement. The method is first introduced by R. Kaplan in 1980 and by Kaplan and Johnson in 1987 [1]. But its university based idiom was denoted by Kaplan and Norton in 1992 [2,3]. Despite, it is not completely emphasized on balanced measurement and related factors in any publication of Kaplan and Norton, Cobbole, and Lawrie [4] highlighted it in 2003 and finally, the strategy plan is used to complete the model in 2004 [3,6].

The model is based on four fundamental factors: (1) Financial (2) Internal business process (3) Customer (4) Innovation and learning to found a relation between strategic goals and operational controls [2-6]. The model is establishes balance between financial and nonfinancial, short term and long term and internal and external goals. It balances the anterior and posterior factors in some cause and effect chains [7].

The key practical steps involved in developing a BSC are: (1) Develop organization mission, vision and strategy (2) Confirm the BSC role in performance management framework (3) Select the scorecard viewpoint (4) Review suitable background materials (5) Conduct executive interviews (6) Create strategy map (7) Gather feedback (8) Improve performance measures (9) Develop initiatives (10) Develop the continuing implementation plan [5,6].

Data envelopment analysis (DEA) introduced by Charnes, Cooper, and Rhodes [8], often evaluates decision making units (DMUs) from the best possible relative efficiency [9]. Entani, Maeda, and Tanaka [10] and Wang, Greatbanks, and Yang, [11] developed the model to consider both the optimistic and pessimistic points, until Wang and Luo [9] proposed their model based on the relative closeness (RC) to the ideal DMU (IDMU) that uses the two distinctive efficiencies as well as the TOPSIS model in multi-attribute decision making (MADM). Then the RC factor may be used for overall ranking of all DMUs, easily [9].

One of the most important drawbacks of the DEA is its weakness on identifying factors to rank the DMUs. In this paper, the BSC method is used to determine two or three most important factors in any field of its four basic fundamental factors. The factors are then used as the input data for the DEA method to rank complex organizations and enhance the reliability and flexibility of the method for benchmarking.

2 OUR PROPOSED MODEL

The DEA has no tools to finding effective factors, especially in the field of organizational ranking and this weakness may decrease its reliability in the field of ranking and benchmarking.

In this paper, the strategy map that is established by BSC is used to solve this weakness by defining most relevant factors as the input of the DEA model as follows:

Assume that there are n DMUs to be evaluated. Each of them consumes m inputs, denoted by $x_{ij}(i=1,...,m, j=1,...,n)$, to produce s outputs denoted by $y_{rj}(i=1,...,s, j=1,...,n)$. Then, an IDMU may be defined

as a virtual DMU that can use the least inputs, $x_i^{\min}(i=1,...,m)$, to produce the most outputs, $y_r^{\max}(r=1,...,s)$, while an anti-ideal DMU (ADMU) may defined as a DMU, which consume the most inputs, $x_i^{\max}(i=1,...,m)$, to generate the least outputs, $y_r^{\min}(r=1,...,s)$. To completing the model, the LP model shown in (1) and (2) must be solved for all DMUs such as DMU_0 to calculate the $\theta_{j0}^*, \varphi_{j0}^*$, where j_0 is the DMU under evaluation (denoted by DMU_0), u_r, v_i are decision variables, ε is the non-Archimedean infinitesimal, θ_{IDMU}^* is the optimum efficiency of IDMU that may calculated by (3) and φ_{ADMU}^* is the worst efficiency of the ADMU that may calculated by (4).

$$
\begin{aligned}
&Max \quad \theta_{j0} = \sum_{r=1}^{s} u_r y_{rj0} \\
&S.T. \quad \sum_{i=1}^{m} v_i x_{ij0} = 1 \\
&\sum_{r=1}^{s} u_r y_j^{\max} - \sum_{i=1}^{m} v_i (\theta_{IDMU}^* \; x_i^{\min}) = 0 \\
&\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \qquad j = 1,..., n \\
&u_r, v_i \ge \varepsilon \qquad \forall r, i
\end{aligned}
\tag{1}
$$

$$
\begin{aligned}
&Min \quad \varphi_{j0} = \sum_{r=1}^{s} u_r y_{rj0} \\
&S.T. \quad \sum_{i=1}^{m} v_i x_{ij0} = 1 \\
&\sum_{r=1}^{s} u_r y_j^{\min} - \sum_{i=1}^{m} v_i (\varphi_{IDMU}^* \; x_i^{\max}) = 0 \\
&\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \qquad j = 1,..., n \\
&u_r, v_i \ge \varepsilon \qquad \forall r, i
\end{aligned}
\tag{2}
$$

$$
\begin{aligned}
&Max \quad \theta_{IDMU} = \sum_{r=1}^{s} u_r y_r^{\max} \\
&S.T. \quad \sum_{i=1}^{m} v_i x_i^{\min} = 1 \\
&\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \qquad j = 1,..., n \\
&u_r, v_i \ge \varepsilon \qquad \forall r, i
\end{aligned}
\tag{3}
$$

$$
\begin{aligned}
&Min \quad \varphi_{ADMU} = \sum_{r=1}^{s} u_r y_r^{\min} \\
&S.T. \quad \sum_{i=1}^{m} v_i x_i^{\max} = 1 \\
&\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \qquad j = 1,..., n \\
&u_r, v_i \ge \varepsilon \qquad \forall r, i
\end{aligned}
\tag{4}
$$

$$
RC_{j0} = \frac{\varphi_{j0}^* - \varphi_{ADMU}^*}{(\varphi_{j0}^* - \varphi_{ADMU}^*) + (\theta_{IDMU}^* - \theta_{j0}^*)} \tag{5}
$$

It is clear that the bigger the RC_{j0} value is the-better-the-performance of DMU_0. Then it can be used as an index for organizational ranking and benchmarking.

This hybrid method is successfully installed in 10 sub organization of Kermanshah Regional Water Organization Company which is illustrated as follow.

3 EMPIRICAL EXAMPLE AND CONCLUSION

The data for this study are collected in winter 2011 in Kermanshah, Iran. The data included 53 creditable performance indexes that factor analyzing in SPSS software classifies them into four levels of factors. Data are shared as: (1) 15 financial indexes, (2) 7 internal business process indexes, (3) 7 customer Indexes, (4) 24 innovation and learning indexes.

Indexes are given to experts to give a privilege to them according to organizational predefined strategies. Consequently, Five Point Likert and Factor analysis methods are used to demonstrate the classification. Then the most important indexes in each four levels are chosen by using Logistic regression. After linking the factors in BSC procedure, the strategy map is given as shown in Fig. 1.

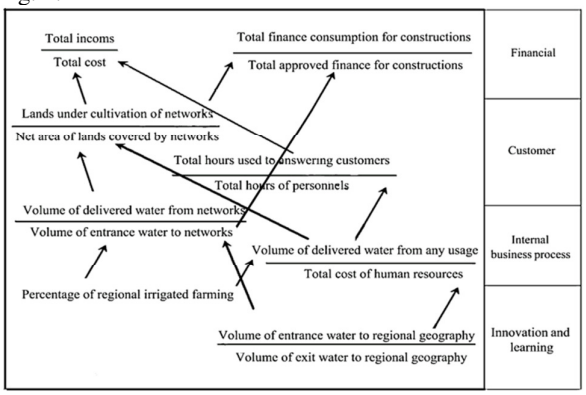

Figure 1. Strategy map of Kermanshah Regional Water Organization

Finally, DEA is used to rank 10 sub organization using factors which are indicated in strategy map. The results are illustrated in Table 1.

What is indicated in column five (RC) of Table 1 shows the difference of the sub-organizations. One can see that the differences between the ranks are significant. So managers not only can clearly recognize the differences between their organizations and the others, but also the related distances can show the intensity of these differences. This information helps the manager to have a better view to perceive the position of his/her organization

and enhance an ability to compare it with other similar ones in terms of the organizational strategic goals that may change and updated over its life cycle.

TABLE I. DEA RESULTS

	DMU	φ*(ADMU)	Θ*(IDMU)	RC	Rank
1	Kermanshah	1	1	0.0792427	4
2	Eslam abad	1.5478	1	0.1237267	1
3	Harsin	1	0.6503	0.0767553	7
4	Sahne	1	0.5968	0.0763885	8
5	Songhor	1	0.7576	0.0775017	6
6	Kangavar	1	0.5958	0.0763816	9
7	Ravansar	1	0.4565	0.0754429	10
8	Sar pol zahab	1	0.8932	0.0784661	5
9	Gilan gharb	1.1951	1	0.0955944	3
10	Ghasre shirin	1.3021	1	0.104318	2
IDMU		-	10.9358	-	-
ADMU		0.1449	-	-	-

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