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Performance Evaluation Accounting With Inputs Non-Discretionary Factors in an Integrated BSC-DEA Methodology

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Abstract

Measuring the performance of a production system has been an important task in management for purposes of control, planning, etc. The Balanced Scorecard allows us to do just that. BSC is widely used in government and industry because of the clear representation of the relationship and logic between the key performance indicators(KPI) of 4 perspectives - financial, customer, internal process, and learning and growth. in the other hand , Traditional studies in data envelopment analysis (DEA) view systems as a whole when measuring the efficiency, ignoring the operation of individual processes within a system. We present and demonstrate a multi-criteria approach for evaluating every projects in different stages. Our approach integrates the balanced scorecard (BSC) and data envelopment analysis (DEA) and develops an extended DEA model. The input and output measures for the integrated DEA–BSC model are grouped in “cards” which are associated with " B S C ". With efficiency decomposition, the process which causes the inefficient operation of the system can be identified for future improvement. finally we illustrate the proposed approach with a case study involving six banking branches.

Key words:

Data Envelopment Analysis, Balanced Scorecard

Introduction

The key to achieve a state of continuous improvement is dependent on the ability to measure consistently and constantly the performance of key processes within an enterprise (Braam and Nijssen, 2004). Many organizations have realized the importance of constant and consistent measurement and have adopted a variety of performance measurement systems (PMS) over the last few years (Prajogo and Sohal, 2004).

According to Kaplan and Norton (1996), the balanced score card (BSC) is based on the concept that managers must manage and evaluate their business from at least four major perspectives: (1) How do customers view the firm? (2) What business process must we improve and exceed at? (3) Can the firm continue to learn and innovate? (4) How does the firm appear to its shareholders? The BSC translates an organization's mission and strategy into a comprehensive set of performance measures and provides the framework for strategic measurement and management. [1,5]

The balanced scorecard (BSC), a model for the analysis of strategic information for all types of organisation, and since then has been the subject of much research in respect of its possibilities as a tool for strategic management. However, few references have been found to its development and implementation in companies for their strategy. Moreover, there are very few studies in the literature on the management control and new product development in which relationships are established between the results from these activities, measured by means of the BSC, and the efficiency with which they are performed. For this reason, the objective of this article is to propose a framework for the analysis of these relationships.[5,19]

In addition, in order to evaluate the competitive position of the firm, managers need to apply data envelope analysis (DEA) to identify the efficient frontier, benchmarking partners and inefficient slack for the firms. It is important for the firm to understand their relative position in terms of productivity and efficiency. DEA is viewed as a methodology that provides a valid starting point for specifying balanced performance. Previous studies applying both BSC and DEA to evaluate the competitive positions of every organization are not available. Thus further empirical validations are required.[3,11]

The method that we propose in this paper uses an extended DEA model, which quantifies some of the qualitative concepts embedded in the BSC approach. The integrated DEA–BSC model addresses four common goals that firms are trying to accomplish: (1) achieving strategic objectives (effectiveness goal); (2) optimizing the usage of resources in generating desired outputs (efficiency goal); (3) obtaining balance (balance goal); and (4) obtaining Cause and Effect in Perspectives . The model is applicable for every organizations for-profit. The contribution of the model that is presented in this paper is both conceptual, and excutive for any given DMUthat are devoted to specific output/input measures.

The rest of the paper is organized as follows: Section 2 provides dea models and balanced scoredcard . The integrated DEA–BSC simulation model is presented in Section 3,. Section 4discusses a case study that applies the DEA–BSC model. Finally, Section 5 presents concluding remarks..

LITERATURE REVIEW

1-2.Theory of the balanced scorecard

The balanced scorecard (BSC) approach was first identified and implemented by Kaplan and Norton as a performance management tool, following a 1-year multicompany study in 1990. Its aim was to present management with a concise summary of the key performance indicators (KPI) of a business, and to facilitate alignment of business operations with the overall strategy. Kaplan and Norton were keen to provide a medium to translate the vision of the company into a set of clear objectives. These objectives could be translated into a system of performance measurements that effectively communicated a powerful, forward-looking, strategic focus to the entire organization. Kaplan and Norton were motivated by the fact that companies mainly relied on traditional financial accounting measures (like the ROI and payback period) to determine a ‘narrow and incomplete picture of business performance’. As a result, they suggested that financial measures be supplemented with additional indicators that reflected customer satisfaction, internal business processes, and the ability to learn and grow. Their BSC was designed to complement ‘financial measures of past performance with measures of the drivers of future performance’ (Kaplan and Norton, 1996)[1,6]. It can be clearly seen that their intention was to keep score of a set of Key Performance Indicators (KPIs) that could maintain a balance between short and long-term objectives, between financial and non-financial measures, between lagging and leading indicators, and between internal and external performance perspectives. By adopting such a ‘holistic’ view Kaplan and Norton hoped that managers, who were traditionally being overwhelmed with data, would spend more time on decision making rather than on data analysis. The original balanced scorecard design identified the following four perspectives: the financial perspective; the customer perspective; the internal-business-process perspective; and the learning and growth perspective. These perspectives represent three major stakeholders of any business (shareholders, customers and employees), thereby ensuring that a holistic view of the organization is used for strategic reflection and implementation. The success of these perspectives depends on the fact that the perspectives themselves and the measures chosen have to be consistent with the corporate strategy.[5,6]

BSC requires that KPI be classified into four perspectives as shown in Fig. 1 below. It requires that companies categorize its KPI in these four boxes and develop performance measures within each of these perspectives or categories. The technique is based on interviews with mangers by internal or external consultants to identify the ‘strategic objectives’ for each perspective. Then, through meetings with executives, specific measures are developed for these objectives. This list is then edited, leaving the performance measures in the final scorecard. [18,19]

However, there are several major limitations of the BSC approach. First, it is a top down approach only (Kanji and Moura 2001; Malina and Selto 2001). Therefore, the interaction between the top management team and working level employees is limited.

As can be seen from Fig. 1, the intention of the BSC approach was to translate the vision and strategy of a business unit into objectives and measures in four different areas: the financial, customer, internal business-process and learning and growth perspectives.[5]

2-2: Perspectives

In this section ,we will examine each of the four perspectives of the Balanced Scorecard.

2-2-1: Customer Perspective

When choosing measures for the Customer perspective of the Scorecard, organizations must answer two critical questions: Who are our target customers? and What is our value proposition in serving them?

2-2-2:Internal Process Perspective

In the Internal Process perspective of the Scorecard, we identify the key processes the firm must excel at in order to continue adding value for customers and, ultimately, shareholders.

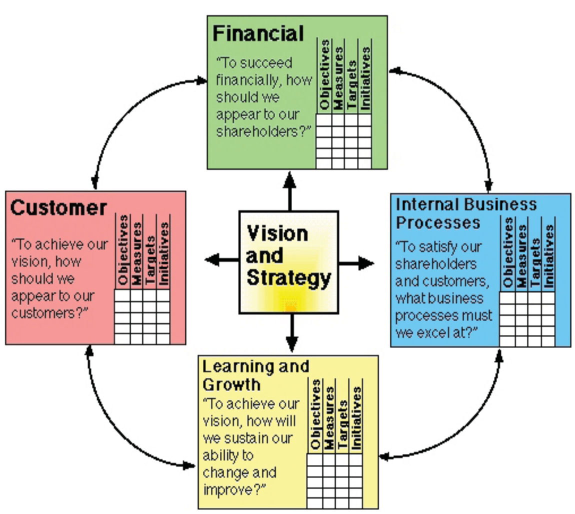
2-2-3:Learning and Growth Perspective

If you want to achieve ambitious results for internal processes, customers, and ultimately shareholders, where are these gains found? The measures in the Learning and Growth perspective of the Balanced Scorecard are really the enablers of the other three perspectives. In essence, they are the foundation on which this entire house of a Balanced Scorecard is built.

2-2-4:Financial Measures

Financial measures are an important component of the Balanced Scorecard, especially in the for-profit world. The measures in this perspective tell us whether our strategy execution, which is detailed through measures chosen in the other perspectives, is leading to improved bottom-line results.

Fig1 – four perspectives of the Balanced Scorecard [1]



Each of these four strategic areas should have both lead and lag indicators, yielding two directional cause-and-effect chains: lead and lag indicators applied horizontally within the areas and vertically between areas. The causal paths from the measure indicators on the scorecard should be linked to financial objectives. This procedure implies that strategy is translated into a set of hypothesis about cause and effect relationships, which are essential because it allows the measurements in nonfinancial areas to be used to predict future financial performance. Thus the claim is that financial measures say something about past performance while non-financial measures are the drivers of future performance. The validity of the model relies, however, on the assumption that the cause-and-effect relationship exists between the areas of measurement suggested.[1,5,6,17]

3-2: Interrelationships among Four Perspectives of BSC

The BSC approach emphasizes that, in order to achieve objectives in the financial perspective, all objectives and measures in other perspectives should be linked (Gosselin, 2005; Laitnen, 2005; Kim & David, 2004). For most organizations, the financial themes of increasing revenues, improving productivity, enhancing assets utilization could provide the necessary linkages. To achieve a synergetic effect, firms should emphasize the cause and effect relationship among the BSC measures. Olve, Roy and Wetter (2000) argued that improved value in human resource and development capital should be the leading indicators of improvement in customer capital and profitability. These authors develop a cause and effect relationshipamong the BSC measures. Their cause and effect model indicates that the measures of human resource development would influence the internal business process of the firm. These interrelationships are shown in Figure2.

Fig2- cause-and-effect relationship

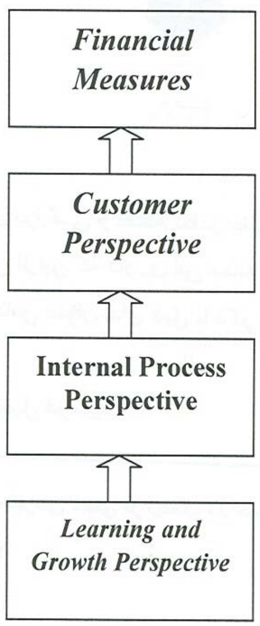
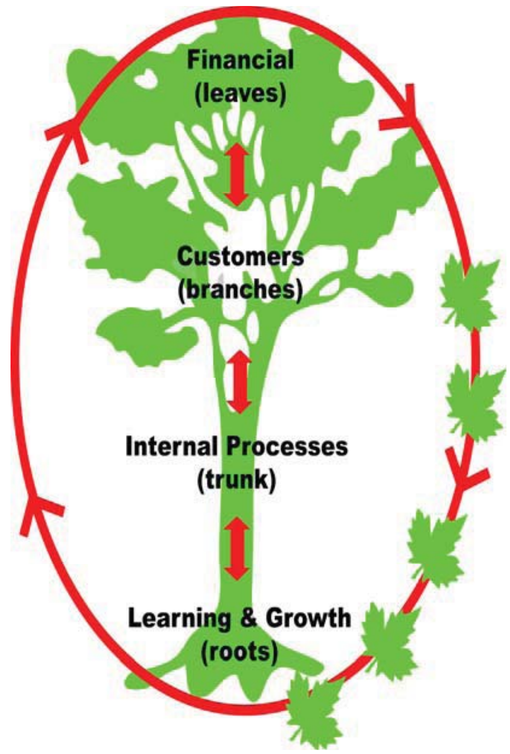


Fig3- cause and effect



In the oder hand Paul Niven's analogy of the Balanced Scorecard is that of a tree (Figure 3). The Learning and Growth perspective are the roots, the trunk is the Internal Process perspective, Customers are the branches, and the leaves are the Financial perspective. Each perspective is interdependent on those below as well as those above. It is a continuous cycle of renewal and growth. Leaves (finances) fall to fertilize the ground and root system, which stimulates growth throughout the organization. In this analogy, learning and growth is the foundation on which all other perspectives are built.[20]

A well-designed Balanced Scorecard should describe your strategy through the objectives and measures you have chosen. These measures should link together in a chain of cause-and-effect relationships from the performance drivers in the Learning and Growth perspective all the way through to improved financial performance as reflected in the Financial perspective. Based on the above literature review, it seems that the interrelationships among the four perspectives of BSC have drawn significant attention. However, scholars seem not to reach a consistent agreement on the interrelationships among the four perspective of the BSC. These interrelationships are as follows: (1) the learning and growth perspective of the balanced scorecard impacts on the internal business process perspective of the balanced scorecard; (2) the internal process perspective of the balanced scorecard has the influence on the customer perspective of the balanced scorecard; (3) the learning and growth, internal business process, and customer perspective of the balanced scorecard will significantly impact on the financial perspective of the balanced scorecard.

4-2: Balance in the Balanced Scorecard

One of the reasons the Balanced Scorecard has been so successful is that it is a balanced approach. This balance includes:

1. Balance between financial and non-financial indicators of success
2. Balance between internal and external constituents of the organization
3. Balance between lag and lead indicators of performance Internal constituents might include employees whereas external constituents might include physician groups or insurers. Lag indicators generally represent past performance and might include customer satisfaction or revenue. Although these measures are objective and accessible, they lack any predictive power. Lead indicators are the performance drivers that lead to the achievement of lag indicators and often include the measurement of processes and activities. For example, ER wait time might represent a leading indicator of patient satisfaction. A Balanced Scorecard should contain a variety of different measures

5-2 :Data Envelopment Analysis (DEA)

One of the major concerns of managers in evaluating the performance of an operation within any type of organization is efficiency. Efficiency measures whether resources, equipment, and/or people are being put to good use. One dimension of the efficiency of an operation of any organization is the manner by which that organization selects and uses resources to produce its products. The more product produced for a given amount of resources the more efficient (i.e., less wasteful) is the operation. In order to evaluate the relative efficiency of comparable components of an organization, Charnes, Cooper and Rhodes [3] proposed an innovative quantitative technique that they named data envelopment analysis (DEA).

DEA utilizes linear programming to produce measures of the relative efficiency of comparable decision making units (DMUs) that employ multiple inputs and outputs. DEA uniquely evaluates all the DMUs and all their inputs and outputs simultaneously, and conservatively identifies the sets of relatively efficient and relatively inefficient DMUs. Thus, the solution of a DEA model provides a manager a summary with comparable DMUs grouped together and ranked by relative efficiency.[2,3,4]

Mathematically, efficiency can be defined as the ratio of weighted outputs to weighted inputs:

$$\text{Efficiency} = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}}$$

The DEA approach identifies the set of weights (all weights must be positive) that individually maximizes each DMU's efficiency while requiring the corresponding weighted ratios (i.e., using the same weights for all DMUs) of the other DMUs to be less than or equal to one.

Let X_{ij}, $i = 1, \ldots, m$, and Y_{rj}, $r = 1, \ldots, s$, be the ith input and rth output, respectively, of the jth DMU, $j = 1, \ldots, n$. The DEA model for measuring the relative efficiency of DMU k under an assumption of constant returns to scale is the CCR model (Charnes et al., 1978):

$$\max \quad E_k^{CCR} = \frac{\sum_{r=1}^{s} u_r y_{rp}}{\sum_{i=1}^{m} v_i x_{ip}}$$

$$S.t \quad \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leqslant 1 \qquad j = 1, \ldots n$$

$$u \geq 0 \qquad , v \geq 0$$

where E_k^{CCR} is the efficiency of DMU k, u_r and v_i are the multipliers associated with the rth output and ith input, respectively, to be determined by this mathematical program, and e is a small non-Archimedean number (Charnes et al., 1979; Charnes and Cooper, 1984) which is imposed to prohibit each DMU to assign zero weights to unfavorable input/output factors. This model is a fractional linear program which can be transformed into the following linear program:

$$\max \quad E_k^{CCR} = \sum_{i=1}^{s} U_r y_{rp}$$

$$S.t: \quad \sum_{r=1}^{s} U_r y_{rj} \quad \sum_{i=1}^{m} V_i x_{ij} \leqslant 0 \qquad j = 1, \ldots n$$

$$\sum_{i=1}^{m} V_i x_{IP} = 1$$

$$V_i \geqslant 0 \qquad i = 1, \ldots . n$$

$$U_r \geqslant 0 \qquad r = 1, \ldots . s$$

For systems composed of several processes interrelated with each other, this model ignores the performance of individual processes. Consequently, the efficiency ECCR k does not properly represent the aggregate performance of the component processes. Certainly, Model (2) can be applied to measure the efficiency of each process independently; however, the relationship between the system efficiency and process efficiencies is not revealed.[10]

Systems with more than one process connected with each other are networks. To measure the efficiency of a network system a network DEA model is needed. Different from the conventional DEA model, the network DEA model does not have a standard form. It depends on the structure of the network in question. Fa¨re and Grosskopf (1996a, 2000) and Fa¨re et al. (2007) developed several network models that can be used to discuss variations of the standard DEA model.

6-2: Series structure

For a system consisting of two processes connected in series, Seiford and Zhu (1999) applied the conventional DEA model to calculate the efficiency of each process independently. Kao and Hwang (2008) developed a relational model to calculate the efficiency of the system taking into account the series relationship of the two processes. The major difference between the independent model and relational model lies in that the latter requires the same factor to have the same multiplier no matter how it is used while the former allows a factor to have different multipliers when it is used in different places. An interesting result of the relational model is that the system efficiency is the product of the two process efficiencies. Their conclusion can be extended to general series systems of more than two processes. Note that a series model may be solved using backward induction.[7,10]

Consider a series system of h processes. As in the preceding section, let Xij and Yrj be defined as the inputs and outputs of the system, respectively. Denote Z_{pj}^{t} as the pth intermediate product, p = 1, . . . ,q of process t,(t = 1, . . . ,h -1) for DMU j. The intermediate products of process t are the outputs of process t as well as the inputs of process t + 1. Note that the intermediate products of the last process h are the outputs of the system. The number of intermediate products, q, can be different for each process. Here, it is assumed that they are the same for all processes just for simplification of notation.

Fig. 1 is a pictorial expression of the series system. Denote $w_p^{(t)}$ as the multiplier, or the importance, associated with the pth intermediate product of process t. The system efficiency of DMU k is calculated by the following model generalized from the tandem system of Kao and Hwang (2008):

$$\max \quad E_k = \sum_{i=1}^{S} U_r y_{rp} \qquad (3\text{-}0)$$

$$ST. \quad \sum_{i=1}^{m} V_i x_{IP} = 1 \qquad (3\text{-}1)$$

$$\sum_{r=1}^{S} U_r y_{rj} - \sum_{i=1}^{m} V_i x_{ij} \leqslant 0 \qquad j = 1, \dots n \qquad (3\text{-}2)$$

$$\sum_{p=1}^{q} W_p^{1} Z_{pj}^{1} - \sum_{i=1}^{m} V_i x_{ij} \leqslant 0 \qquad j = 1, \dots n \qquad (3\text{-}3)$$

$$\sum_{p=1}^{q} W_p^{(t)} Z_{pj}^{(t)} - \sum_{p=1}^{q} W_p^{(t-1)} Z_{pj}^{(t-1)} \leqslant 0 \qquad j = 1, \dots n \qquad t = 2, \dots, h \quad 1 \qquad (3\text{-}4)$$

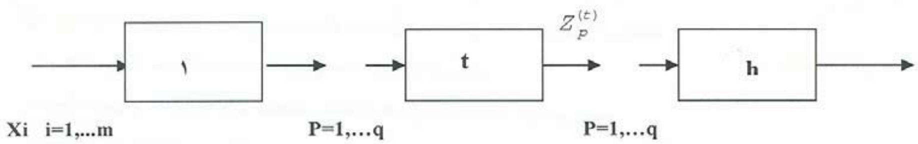
$$\sum_{r=1}^{S} U_r y_{rj} - \sum_{p=1}^{q} W_p^{(h-1)} Z_{pj}^{(h-1)} \leqslant 0 \qquad j = 1, \dots n \qquad (3\text{-}5)$$

$$V_i \geqslant \varepsilon \qquad i = 1, \dots n \qquad (3\text{-}6)$$

$$U_r \geqslant \varepsilon \qquad r = 1, \dots s$$

$$w_p^{(t)} \geqslant \varepsilon \qquad p = 1, \dots q \qquad t = 1, \dots h - 1$$

Fig4 -serice system



where constraint set (3.2) corresponds to the system and constraint sets (3.3), (3.4), and (3.5) correspond to h processes. Note that the sum of the process constraints of a DMU, i.e. constraint sets (3.3), (3.4), and (3.5), is equal to its system constraint (3.2). Hence, the system constraint is redundant and can be omitted. Basically, the number of constraints required in this model is equal to the number of DMUs multiplied by the number of processes in the system.

Let $U_r^{\times}$ $V_i^{\times}$ and $w_p^{(t)\times}$ denote the optimal multipliers solved from Model (3). The efficiency of each process for DMU k is calculated as:

$$E_k^{(1)} = \frac{\sum_{p=1}^{q} w_p^{(1)} z_{pk}^{(1)}}{\sum_{i=1}^{m} v_i x_{ik}}$$

$$E_k^{(t)} = \frac{\sum_{p=1}^{q} w_p^{(t)} z_{pk}^{(t)}}{\sum_{i=1}^{m} w_p^{(t-1)} z_{pk}^{(t-1)}}$$

$$E_k^{(h)} = \frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{p=1}^{q} w_p^{(h-1)} z_{pk}^{(h-1)}}$$

A DMU is efficient only if all its processes are efficient. Mathematically, the system efficiency will be low if there is a process which is very inefficient and will be high only when all processes have high efficiencies. In Model (3), when process constraints (3.3), (3.4), and (3.5) are removed, the conventional CCR model is obtained.

7-2:DEA with non-discretionary factors (Banker and Morey's model)

Banker and Morey (1996a) provided the first DEA model for evaluating efficiency in the presence of "exogenously fixed" inputs. Banker and Morey's model to evaluate the efficiency of any DMU is given by the following modification of the CCR model:

$$\min \quad \theta - \varepsilon\Big(\sum_{r=1}^{s} s_r^{+} - \sum_{i\in n} s_i^{-}\Big) \qquad (4\text{-}0)$$

$$s.t. \quad \sum_{j=1}^{n} \lambda_j x_{ij} + s_i^{-} = \theta x_{io} \qquad i \in D \qquad (4\text{-}1)$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^{-} = x_{io} \qquad i \in ND \qquad (4\text{-}2)$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_i^{+} = y_{ro} \qquad r = 1, \ldots s \qquad (4\text{-}3)$$

where all variables (except θ) are constrained to be nonnegative and $\varepsilon \succ 0$ is a non- Archimedean infinitesimal constant to assure strongly efficient solutions. Here the symbols $i \in D$ and $i \in ND$ refer to the sets of discretionary and non-discretionary inputs, respectively. The dual of model (4) in the form of (modified) multiplier

$$\max \quad \sum_{r=1}^{s} u_r y_{ro} - \sum_{i \in ND} v_i x_{io}$$

$$s.t. \quad \sum u_r y_{rj} - \sum_{i \in ND} v_i x_{ij} - \sum_{i \in D} v_i x_{ij} \leqslant 0 \quad j = 1, \ldots n \qquad (5)$$

$$\sum_{i \in D} v_i x_{io} = 1$$

$$v_i \geqslant \varepsilon \quad i \in D$$

$$v_i \geqslant 0 \quad i \in ND$$

$$u_r \geqslant \varepsilon \quad r = 1, \ldots s$$

***Note* 1:** The variable θ is not applied to the input constraints (4-2) because these values are exogenously fixed and it is therefore not possible to vary them at the discretion of management. Therefore this is recognized by entering all $x_{io}, i \in ND$ at their fixed (observed) values.

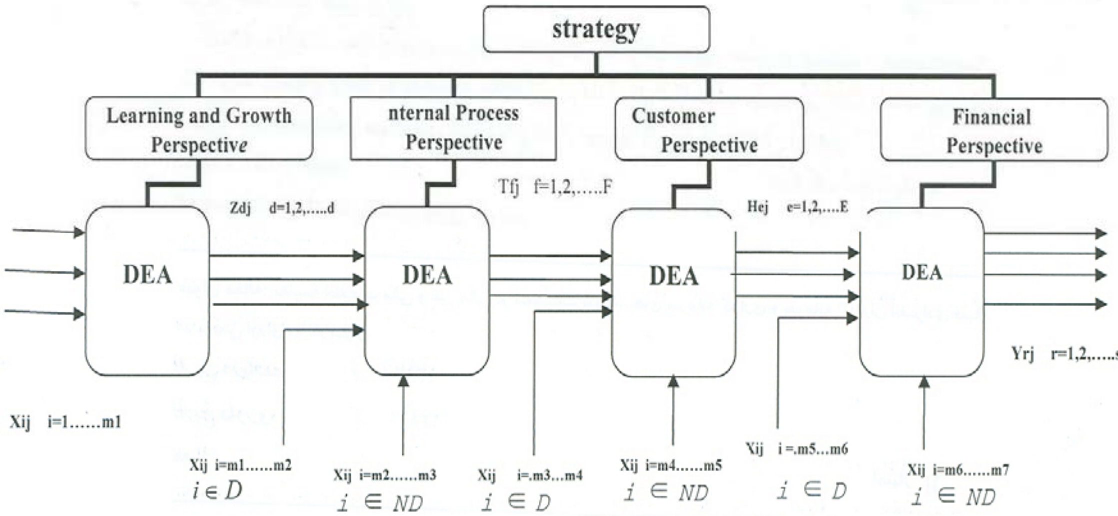
***Note* 2:** Only the non-discretionary inputs enter into the objective (5). The multiplier values associated with these non-discretionary inputs may be zero. If at any optimal solution of (4), $s_k^{-*} \succ 0$ for some $k \in ND$, then $v_k^* = 0$ and this x_{ko} does not affect the evaluation recorded in (4). Also, if $v_k^* \succ 0$ for some $k \in ND$, then the efficiency score recorded in (4) is reduced by the multiplier, x_{ko}, for *DMUo* under evaluation.

3:The integrated DEA and BSC simulation model

The purpose of this study is to find out the relationships among four output perspectives. For such an objective, a structure equation model is employed to test the interrelationships of all the variables in the entire model. The proposed structural equation model is shown in Figure 4.

The techniques such as BSC and DEA are as instruments that can,t be stipulated as an alternative techniques , but the combined use of them in the performance evaluation system appears essential. in the other hand , it can be created a systematic links between two models. It is done so that one of them can be used as a complementary and improve of the weakpoints ,of the model, so using correct and accurate structure of them can be important issues of the performance rating in the organization .

Fig5- combined BSC and DEA model



We introduce the mathematical formulations of the proposed network-DEA model and efficiency measures with non-discrationary inputs in this section. Following the formulation of LP (3) shown earlier, we limit our discussion to the output-oriented measure only, and the technology is assumed to exhibit constant returns-to-scale (CRS). A DEA Model is output oriented if it seeks to increase outputs without increasing inputs. Our approach to the Network DEA Model is an extension of that used in the four-stage DEA Model.

$$\max \quad ep = \sum_{i=1}^{S} U_r y_{rp}$$

$$S.T: \quad \sum_{i=1,\ i \in D}^{m_4} V_i x_p = 1$$

$$\sum_{r=1}^{S} U_r Y_{rj} - \sum_{i=1,\ i\in D}^{m_8} V_i x_{ij} - \sum_{i=1,\ i\in ND}^{m_8} v_i (x_{ij} - x_{io}) \leqslant 0 \qquad j = 1,\ldots n \qquad (6)$$

$$\sum_{d=1}^{D} \eta_d Z_{dj} - \sum_{i=1,\ i\in D}^{m_1} V_i x_{ij} - \sum_{i=m_1,\ i\in ND}^{m_2} v_i (x_{ij} - x_{io}) \leqslant 0 \qquad j = 1,\ldots n$$

$$\sum_{f=1}^{F} \gamma_f T_{fj} - \sum_{d=1}^{D} \lambda_j z_{dj} - \sum_{i=m_2,\ i\in D}^{m_3} v_i x_{ij} - \sum_{i=m_3,\ i\in ND}^{m_4} v_i (x_{ij} - x_{io}) \leqslant 0 \qquad j = 1,\ldots n$$

$$\sum_{e=1}^{E} \pi_e H_{ej} \quad \sum_{f=1}^{F} \gamma_f T_{fj} - \sum_{i=m4}^{m5} V_i X_{ij} - \sum_{i=m7,\ i\in ND}^{m8} v_i (x_{ij} - x_{io}) \leqslant 0 \qquad j = 1,\ldots n$$

$$\sum_{r=1}^{s} U_r Y_{rj} \quad \sum_{e=1}^{E} \pi_e H_{ej} - \sum_{i=m6}^{m7} v_i X_{ij} - \sum_{i=m7,\ i \in ND}^{m8} \mathrm{v_i}(x_{ij} - x_{io}) \leqslant 0 \qquad j = 1, \ldots n$$

$$U_r \geqslant \varepsilon \qquad , V_i \geqslant \varepsilon \qquad \eta_d \geqslant \varepsilon$$

$$\gamma_f \geqslant \varepsilon \qquad , \pi_e \geqslant \varepsilon$$

The processes of measurement and performance rating using of two techniques BSC and DEA can be setforth in the following issues:

1- the identification of organization : in the processes the perposes and strategies of relevant organization identified and using from BSC techniques , the measurments that is designed in every view. The measurments are created in balance and with different views.

2- performance rating :the measurments created by BSC are in two groups, input and output, that is classified and using of DEA horizontal evaluation (during the time period)and ,or vertical evaluation (in comparison with similar units in the chronological period)used.

3- the design of path of modification and recovery : the path of modification and recovery are identified by DEA . the modification and recovery path increased for the output measurments and decreased input measurments .

4-the determination ofgoals of measurement for the next period:
the measurments goals which is determind by DEA and placed as measurmentgoals for the next performance of BSC.

In this method , each time of BSC performance , that is in every time that the data of organization entiered into the BSC system and the results are presented the organization is evaluated by DEA and the goals ofmeasurments are recognized in the following period .if you achieve the determined goals, the organization will be efficient and expected conditions.
In the next two periods of performance evaluation :the condition of organization compared with the expected conditions of the previouse period and the efficiency of new goals are determined.

4: Case study

We have apply our new approach to six bank branches in iran. The data for the case study are presented in Tables (1 &2). We have four stages for production process The evaluation of these units involves many performance aspects; therefore, using 3 finally output measures , two first input measures and 9 intermediate measures for this evaluation is quite reasonable.

Table 1-the case study data

X8**	X7*	X6**	X5*	X4*	X3*	X2*	X1*	
Facilities back-log rate	Cost to income	Competitional value	on line service	High services rate	Electronical service	Incrasing personnel major	motivation cost	
%2.68	%52.84	%15.7	1376	%3.13	1305	12.11	%23.03	DMU1
%9.5	%42.77	%18.9	1896	%3.41	1906	11.96	%18.72	DMU2
%15	%60	%34	1842	%3.25	1758	12.08	%18.5	DMU3
%8.5	%60.20	%33.5	1315	%3.32	1500	12.07	%5.30	DMU4
%7.3	%57.90	%30.4	787	%3.25	745	11.96	%17	DMU5
%14	%96	%14	510	%3.35	517	13.66	%3	DMU6

(discretionary input =* and non discretionary input =**)

Table 2-the case study data

Y3	Y2	Y1	H2	H1	T2	T1	Z2	Z1	
Return of investment	Growth rate of resource	Profit margin	Customer fit of rate	Customer satisfaction	Forward service	High quality services rate	Incrasing services rate	Incrasing personnel skill	
%4.81	%17.42	%1.48	%22.91	%3.25	91	%3.19	800	58.54	DMU1
%7.16	%12.98	%2.62	%25.8	%3.21	57	%3.61	692	30.80	DMU2
%7	%47.59	%8	%29	%3.41	8	%3.34	718	46.25	DMU3
%1.4	%18.9	%2.7	%34.50	%3.12	37	%3.41	682	18.55	DMU4
%1.23	%20.13	%3	%21.8	%3.43	34	%3.93	643	39.10	DMU5
%1.02	%10.28	%4	%13	%3.74	10	%3.74	555	69	DMU6

The information data for the case study are presented in Table 3.We define two kind of inputs (Discretionary and Non-Discretionary)

Table 3 – inputs and outputs of the DEA–BSC model in the case study

Perspective	Discretionary inputs	Non-Discretionary inputs	outputs
Financial Perspective	1-Cost to income 2- Customer satisfaction 3-Customer fit of rate	1- Facilities back-log rate	1- Profit margin 2-Growth rate of resource 3- Return of investment
Customer Perspective	1-High services rate 2-on line service 3-High quality services rate 4-Forward service	1-Competitional value	1- Customer satisfaction 2-Customer fit of rate
Internal Process Perspective	1 - Electronical service 2- Incrasing personnel skill 3- Incrasing services rate	-	1-High quality services rate 2-Forward service
Learning and Growth Perspective	1-motivation cost 2- Incrasing personnel major	-	1- Incrasing personnel skill 2-Incrasing services rate

Table(4) presents the results of the implementation .the first of column shows the results overall efficiency ,and in the anather columns show the each stages efficiency.

Table 4 - DEA–BSC results

DMU	**Overall efficiency**	**First stage efficiency**	**Second stage efficiency**	**Third stage efficiency**	**Fourth stage efficiency**
DMU1	0.947	١	0.917	0.762	1
DMU2	0.976	0.865	1	1	١
DMU3	0.819	0.897	0.953	0.861	1
DMU4	0.466	0.852	0.976	1	1
DMU5	0.925	0.803	0.958	0.678	1
DMU6	0.601	0.723	1	0.438	1

It will be unmistakable to get the satisfactory results which is subject to investment and try in the four prespective , that is a long as in this four Perspective , Learning and Growth, nternal Process, Customer and Financial ,don,t work well , getting the successful results undoubly won of be acquired.

5: Conclusion

This study has demonstrated an analytical technique that can be used in benchmarking about efficiencies to identify the most efficient ``best practice'' organization . The BSC-DEA methodology was designed to accommodate uncertain and qualitative data. Since nonfinancial performance measures, which are qualitative measures, become important it is necessary for decision makers to use techniques that can include measures in evaluation process.

DEA can be a useful tool in setting benchmarks and evaluating BSC results. The DEA–BSC model advances the individual capabilities of DEA and BSC. From the viewpoint of DEA, the model generalizes the standard treatment of the data by splitting the inputs and outputs into subsets (cards), and adding constraints (balancing requirements) that reflect relationships among the cards. From the viewpoint of BSC, the model proposes a new approach to evaluate performance by applying quantitative analysis that combines the measures within each card into a single value. It also addresses some of the difficulties in existing BSC applications, namely, reliance on a known (sometimes arbitrarily chosen) baseline against which performance is evaluated and the fact that BSC does not produce a single, comprehensive measure of performance.

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