

An empirical study based on BSC-DEA to measure the relative efficiencies of different health care centers in province of Semnan, Iran

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ABSTRACT

In this paper, we present an empirical investigation to measure the relative efficiency of seven health care centers in province of Semnan, Iran, which were under the coverage of social security organization of Iran. The proposed model of this paper uses a hybrid of balanced score card and data envelopment analysis for performance measurement. The proposed study uses four perspectives of balanced score card including learning and growth, internal process, customer and financial perspectives and within each perspective, data envelopment analysis is adopted so that the outputs of each perspective are used as inputs of the other perspective. The preliminary results indicate that all seven units perform relatively well and the overall efficiency of all units in this province is 0.769.

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1. Introduction

Performance measurement and efficiency estimation for any organization has been an interesting issue among interested researchers. The process normally concentrates on various parts of an organization plans, processes as well as human resources by necessary performance evaluation system for development and stability in today's competition field. Performance evaluation helps monitoring deviation from necessary goals and target plans. There are literally various reasons for measuring the relative efficiency in health care sector such as:

1. Control and supervision of branches which must be surveyed regarding their status utilizing appropriate standards
2. The performance of managers of health care units must be rewarded by a proper punishment and encouragement system for creating responsibility feeling.

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3. Performance measurement helps set up some standards.
4. It can generate a safe competition among various units by evaluation of health care systems and determine their faults and powers.

Performance measurement has been substantially changed during the past few years. The primary objective of recent models is on growth, development and improvement of assessed capacity. That is, the new measuring systems focus at strategic implementation to determine the critical success factors (CSF) for the present and the future strategic planning. If the CSF factors can be improved, the company will implement and execute its strategy. Data envelopment analysis (DEA) is one of the most popular models used among many people in the world. Charnes et al. (1978) are believed to be the first who introduced the idea of DEA in forms of CCR model and shortly after, they presented an improved one in forms of BCC model (Banker et al., 1984). In DEA model, the performance of similar units are measure based on some common input/output factors and in case more than one single unit appears to be efficient we may used a so called supper efficiency to find the relative efficiency among the most efficient ones (Anderson, 2004).

Kaplan and Norton (1992, 1996, 2001) are believed to be the first who introduced the idea of balanced score card (BSC) as a new technique for measuring the performance of a system. The idea of BSC is to focus on non-financial items affecting the efficiency of an organization. In the past, financial factors were only considered for performance evaluation. However, BSC developed the indices toward four outlooks of growth and learning, internal processes, customer and finance and intends to balance financial goals as the result of past performance (past view indices) and three other indices (future view indices) (Abran & Buglione, 2003). Aryanezhad et al. (2010) explained the relative importance of using BSC-DEA for performance measurement and used it for efficiency estimation in banking industry. Performance evaluation plays an important role in determining faults and difficulties of any organization as well as attempting to increase capabilities and improve activities. In their implementation, they used the outputs of each BSC perspective as inputs for another perspective. Azarbad et al. (2011) used BSC-DEA in their implementation and assumed that there are some uncertainties associated with all input/output parameters. Therefore, they applied fuzzy numbers to handle the uncertainties and considered the model for a real-world case study of banking industry where four major banks were possible candidates of a partnership. The results of this study disclosed some of the issues such as weakness of electronic banking, services and resource allocation as part of their infrastructure problems.

2. The proposed model

A comparative assessment on all health care centers, which are under prudential insurance coverage in province of Semnan, Iran using balanced score card and data envelopment analysis is the primary objective of this paper. There are three important questions associated with the proposed study of this paper, which are as follows,

- 1 Is it possible to develop a hybrid model based on DEA and BSC to measure the performance of different health care centers in province of Semnan, Iran?
- 2 What would be the relative efficiencies of different health care centers using an appropriate hybrid DEA and BSC model?
- 3 Is there a meaningful difference between the relative efficiencies of various units before and after adaptation of the proposed hybrid DEA and BSC?

The proposed model of this paper uses the information of seven health care centers in province of Semnan, Iran to rank different units in year 2011 using the following seven stages,

2.1. Stage 1: Vision, Mission and Values

In the first stage, we create vision and mission in order to reach an appropriate and strategic plan.

2.2. Strategic planning using strength, weakness, opportunities and threats (SWOT)

This step helps determine strength, weakness, opportunities and threats associated with an organization. An appropriate strategic planning helps determine the right directions to achieve company's objectives.

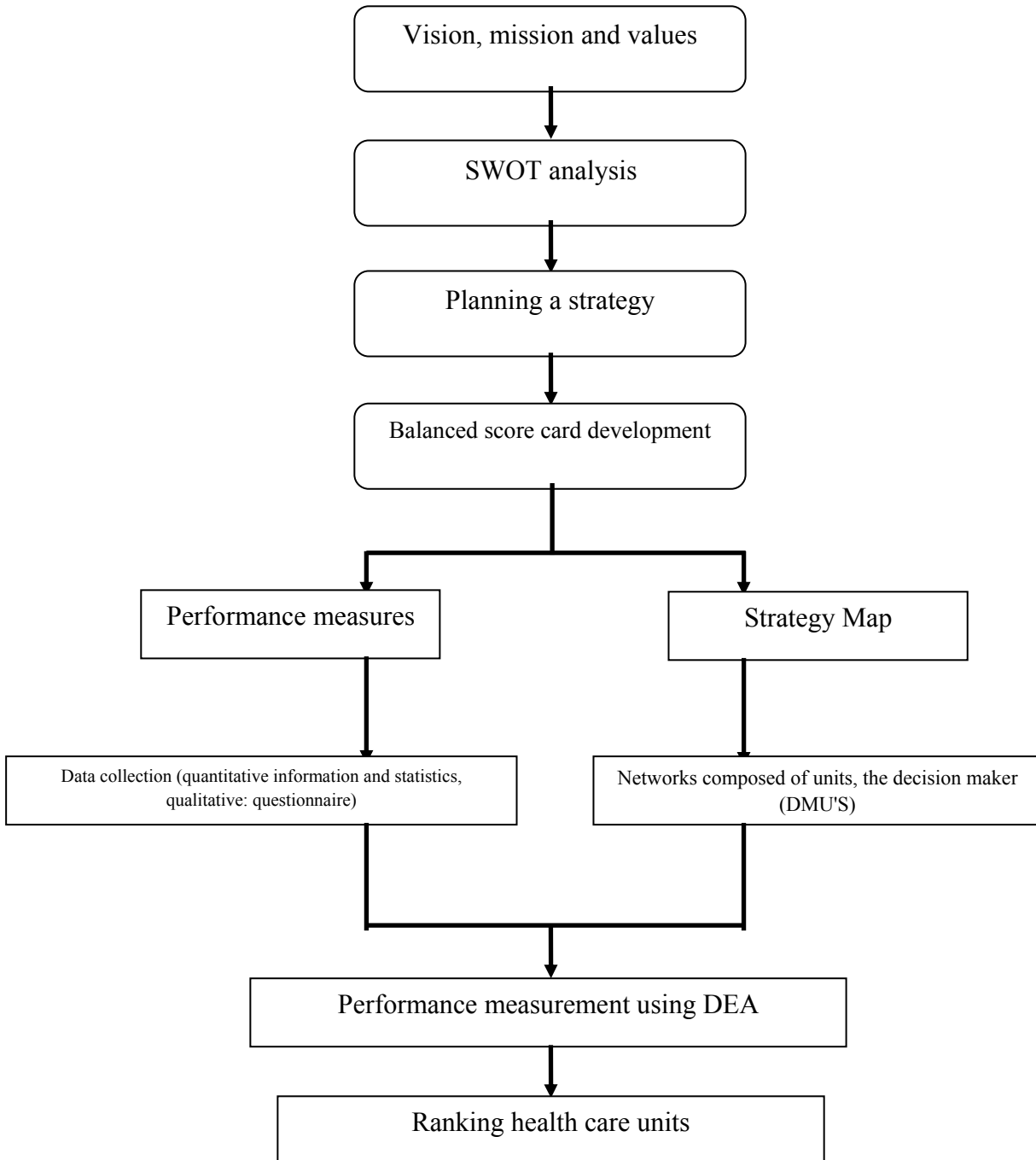


Fig. 1. Framework structure

2.3 Balanced score card development

BSC is a management tool, used for investigating an organization in terms of four perspectives including financial, customer, internal processes and growth and learning (Chand et al., 2005). The balanced scorecard consists of four interdependent components including, 1. Strategy map that identifies and explains the strategic objectives. 2. The performance measures that show progress toward strategic goals. 3. Quantitative targets are set for each measure. 4. Selection and implementation of strategic initiatives for the quantitative performance targets to be connected. In this stage, we only need to setup strategy map and performance measures. The pioneers of BSC method believe that strategy map plays an essential role for extracting strategic keys performer objectives, which makes it possible to draw a cause and effect relationships. This map also makes it possible to implement DEA method within BSC framework. Performance measures determine short-term objectives and any organization needs to reach its long term goals through short terms objectives.

2.4 Fourths stage: Data collection

For the proposed plan of this paper, we have gathered the necessary information through all existing documents in social security organization of the city of Semnan, Iran. We have also performed some detailed interviews with experts and gathered all necessary information for year 2011.

2.5 Decision making unit network

A good network of decision makers could help find the best input/outputs of the proposed framework based on the objectives determined in strategy map.

2.6. Selection of the best DEA technique

Selection of the best DEA model depends on how control management team have on their decision units. There are literally various DEA methods such as constant return to scale, variable return to scale, etc. and we chose a special model explained in the next section.

2.7 DEA implementation

In this section, we gather the necessary data for inputs/outputs of the DEA model measure the performance of each seven units, accordingly (See Fig. 1).

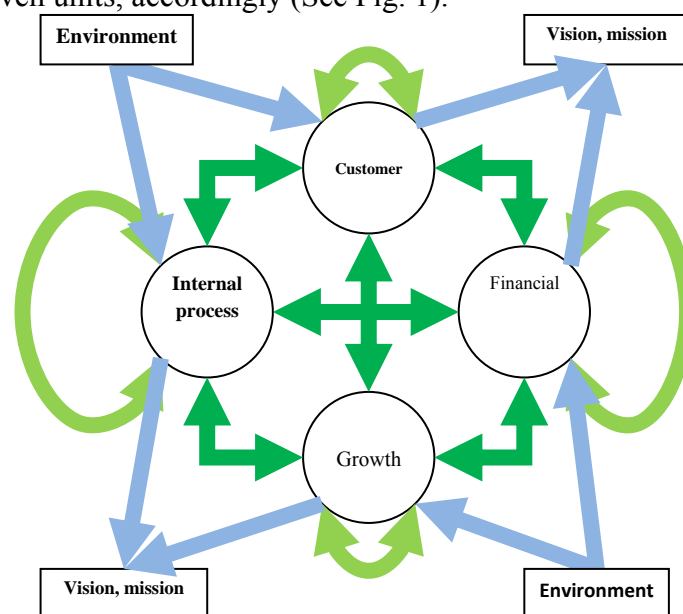


Fig. 2. Framework of BSC

3. The results

In this section, we present details of the proposed model of this paper, which is applied for ranking of seven health care units. Table 1 shows strategy map in terms of four BSC perspectives.

Table 1
Different strategies in terms of BSC perspectives

BSC perspective	Strategy
Financial	S1- Operating performance improvement
Customer	S2- Customer satisfaction in terms of different services S3- Developing brand by providing high quality services
Internal Process	S4- Developing service network S5- Productivity improvement
Learning and growth	S6- Acting as leading edge organization in information technology S7- Improving staff competence

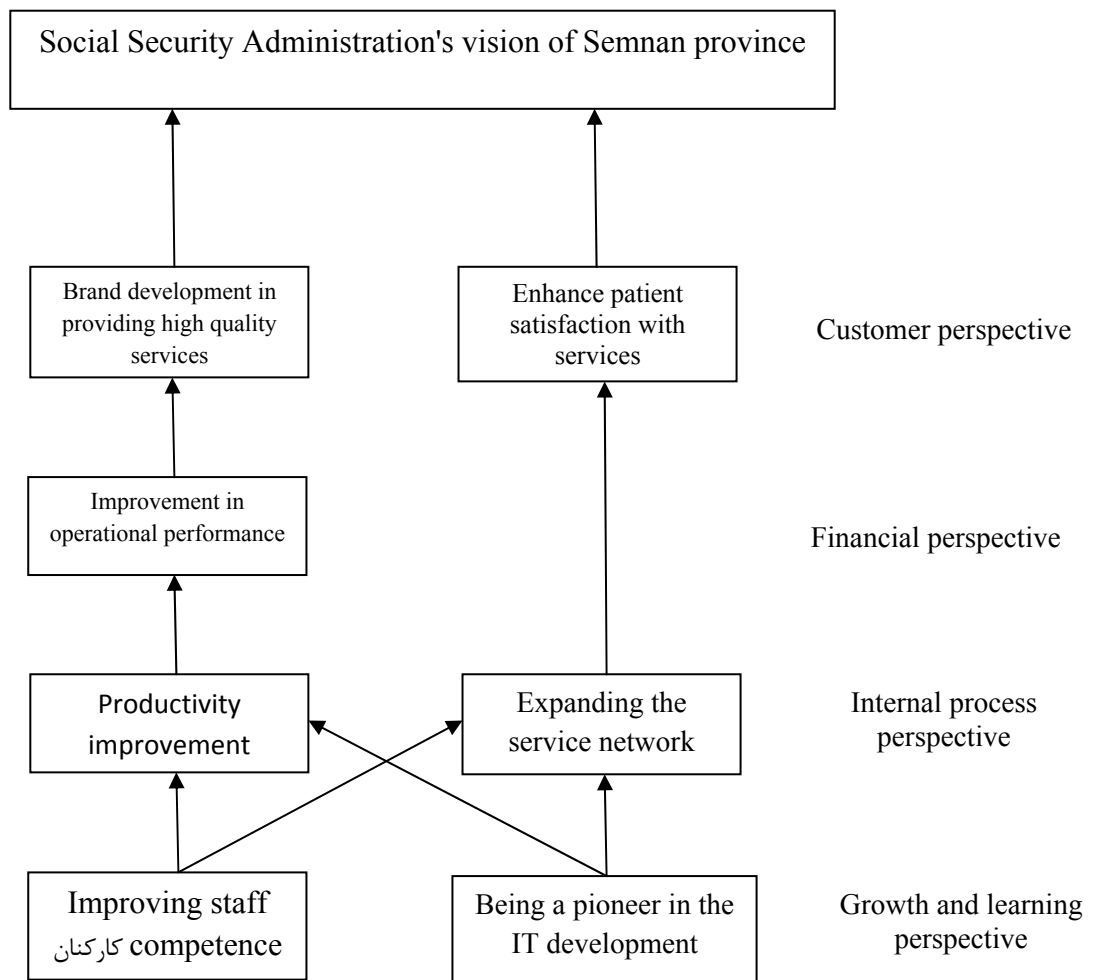


Fig. 2. Social care management strategy map Semnan

Fig. 2 shows details of the relationships among various BSC perspectives and as we can observe from the figure, the output of each perspective is considered as the input for the other perspective and this shows the cause and effect relationship among four components of the proposed framework. Table 2 shows the inputs and the outputs of the proposed DEA model used for this study.

Table 2

Input/output of DEA model

BSC perspective	Input	Output
Learning perspective	Environmental effects	Training of personnel per capita Information Technology development budget
Internal process	Training of personnel per capita Information Technology development budget	Cost of medicines and medical equipment Employment cost The number of referrals during the year
Financial perspective	Cost of medicines and medical equipment Employment cost	Employee productivity Doctor visits in an average working hour
Customer perspective	The number of referrals during the year Doctor visits in an average working hour	Service diversity Patient satisfaction

Table 3 shows details of input/output information used for the proposed study of this paper. Note that the numbers have been normalized due to Confidentiality purpose.

Table 3

The input/output factors for the proposed DEA model

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7
Employment cost	3,653,412	2,317,961	774,611	1,155,364	1,785,159	2,818,182	513,287
Medical expenses	578,459	613,244	208,783	278,849	412,202	604,357	127,344
Patient satisfaction	68.85	62.74	82	70.82	72.84	67.4	62
The number of referrals during the year	44,405	43,325	13,790	18,548	29,480	46,883	9,141
Diversity of services	19	16	17	9	13	14	5
Employee productivity	28,091	39,865	38,731	37,787	38,733	23,813	31,287
Average doctor visit per hour	11.56	10.58	9.01	10.04	8.13	9.09	6.44
IT budget	130	80	40	50	80	120	30
Training of personnel per capita	54.17	36.32	41.5	37.32	31.23	48.78	29.61

We have used both popular models of CCR (Charnes et al.) and BCC (Banker et al., 1984) and since both yielded the same results, we have decided to use CCR for all our computations. Table 4 shows details of efficiencies measure by DEA for all four BSC perspectives.

Table 4

The results of the implementation of DEA method

Unit	Learning	Rank	Internal process	Rank	Financial	Rank	Customer	Rank
1	1	1	0.690	7	0.395	4	0.871	4
2	0.670	5	1	1	0.362	6	0.805	6
3	0.766	3	0.840	4	0.927	2	1	1
4	0.689	4	0.785	6	0.710	3	0.763	7
5	0.615	6	0.914	3	0.390	5	0.978	3
6	0.923	2	0.805	5	0.297	7	0.816	5
7	0.547	7	1	2	1	1	1	1
Mean	0.745		0.848		0.583		0.890	4

Finally, Table 5 shows details of the ranking of seven units in terms of the average of efficiencies we have computed in Table 4.

Table 4

The average ranking of different unit along with the efficiency of the province

Rank	1	2	3	4	5	6	7	Province
Unit	7	3	1	4	5	6	2	
Average	0.886	0.883	0.739	0.736	0.725	0.710	0.709	0.769

As we can observe from the results of Table 4, unit seven and unit three represent the highest efficiencies compared with other units and unit two and six operate relatively less efficient compared with other units. However, they were mostly in close competition and none of them seems to be extremely inefficient. The whole seven units maintain an average efficiency of 0.769, which is acceptable in this sector. However, it is always possible to improve the performance of all units by reducing the inputs and increasing the outputs and creating more efficient unit.

4. Conclusion

In this paper, we have presented an empirical study to measure the performance of seven health care units located in city of Semnan, Iran. The proposed model of this paper took advantage of balanced score card combined with data envelopment analysis to measure the relative efficiency of these units. The method used the outputs of each four balanced score card perspective as inputs of the other perspectives. In learning and growth stage, we environmental effects are considered as input and training of personnel per capita and information technology development budget are considered as the outputs. The internal process uses the outputs of growth stage and considered cost of medicines and medical equipment, employment cost and the number of referrals during the year as the outputs. The outputs of financial perspective included employee productivity and doctor visits in an average working hour while customer perspective used service diversity and patient satisfaction as the primary outputs of the DEA implementation within each stage of BSC method.

This paper can be extended into a more realistic survey by considering uncertainty on all input/output data and implementing robust DEA within BSC method and we leave it for interested researchers as future study.

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