BSC-TOPSIS; A New Management Tool for Performance Measurement

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Abstract: The balanced scorecard (BSC) method, is a strategic, goal directed and multi-dimensional model for performance measurement. Unlike traditional profit-driven performance measurement, the balanced scorecard method provides a management, learning and control framework that aligns activities to the goals and strategies of an organization and translates the strategies into coherent set of performance measures for the implementation of the strategies. BSC assess the organization's performance from four perspectives of financial, customer, internal process, growth and learning. This research investigates the usage of integrated BSC-TOPSIS in public sector organizations in Iran. For this purpose, the organizations containing traffic, transportation of passengers terminal, bus driving and taxi driving which are dependent on municipality of one of the largest cities in Iran (Mashhad) and active in transportation area have been studied in the present research. This research first shows the assessment of the organizations with BSC and their ranking based on TOPSIS technique. The result of the present research will introduce performance criterions and develop integrated BSC-TOPSIS approach in public sector organizations and also will show the significant difference between the performance of organizations dependent on Mashhad municipality organizations from the different BSC aspects. Research is based on a single case study. However it tries to examine how the BSC-TOPSIS approach can be successfully implemented in a public sector organization.

Key words: Performance Assessment · Balanced Score Card · Topsis

INTRODUCTION

Over the past few decades, the complex global business environment and increasing business competitiveness have highlighted the importance of performance measurement [1].

There are different opinion about the value of implementing performance appraisal (PA). From the perspective of total quality management, PA is considered an out of date managerial premise. From the perspective of using standardize job competencies linked to recognition, PA has been shown to improve corporations financial performance as well as employees development [2].

Measuring organizational success has been a continuous challenge for both managers and researchers [3]. Performance evaluation is an essential function in any organization. Consequently , it is important to understand

how performance measurement systems influence such appraisals [4]. In the late 1940s, lots of articles were published in management magazines in America and Europe about the inefficiency of different performance measurement tools at companies. Based on the researches which were made in 1987 by *National Association of Accounting (NAA)* institute in America, 60% of 260 accountant manager and 64 executive managers in the US companies are dissatisfied of their performance measurement tools [5]. Balanced Score Card is a relatively new attitude in performance assessment and strategic management [6]. BSC which is an strategic method would be an strong one to show the connection among the whole aspects of organizational performance [7]. BSC assess the organization's performance from for different perspectives of financial, customer, internal process, growth and learning [8].

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Purpose of present study is to develop the BSC approach in performance assessment of municipalities. The organizations' performance, which is dependent on Mashhad municipality in transportation area, is investigated as a case study from different four BSC aspects in this research.

Literature Review

Performance Assessment in Public Sector: Recently because of financial limitations public sector organizations try to review their activities, manage cost, assess performance and apply some mechanisms for continuous development. These kinds of attempts sometimes cause to reconstruction of public sector organizations. Operational and structural changes usually needs to reconsider in management tools and performance measurement. If the Performance appraisal systems can get accompanied with the motivational mechanisms, they will be able to prepare beneficial tools for reconsideration of activities and performance management of organization. Public sector organizations (like municipalities) follow multiple purposes. Therefore definition of both financial and nonfinancial criterions is so important for these kinds of organizations [9].

What Is the Balanced Score Card: The balanced scorecard (BSC) allows firm to place importance on both financial and nonfinancial performance measures in four perspectives for developing and implementing corporate strategy and performance evaluation [10]. The balanced scorecard is balanced in another dimension - not just a balance of measures of essential areas of the business, but also a balance of goals versus accountability [11]. Although in the past years financial criterions were used for performance evaluation of organizations, recently new methods which can assess both traditional financial and nonfinancial criterions are going to be more considered [3]. Robert Kaplan and David Norton [12] introduced an assessment tool that is named "Balanced Score Card". This model shows some performance measures which can be classified in four categories of financial performance, customer relations, internal process and finally growth and learning activities. Norton and Kaplan implied that organizations can put 4 to 7 measurement criterion in every four categories. Therefore organizations should customize BSC with their conditions. So we can assess various criterions simultaneously by using the BSC and consider different aspects in strategic planning [13].

BSC is a performance measurement tool that is able to reveal organizational intangible assets. This model is used for strategic planning and performance appraisal [5].

Researches which have been done by Kaplan and Norton show that implication and implementation of strategy are more important than planning methods. The most important obstacles of strategy implementation are limitation in needed resources, shortage of management obligation, making connection among strategies and people and also connection among strategies and low levels of the organization. Experiences of successful organizations prove the ability of this model in resolution of above obstacles. Therefore BSC is a a strong management tool for measurement of organization performance [5].

Although BSC is used in industry frequently, just few researches have been done about using BSC in municipalities. We will refer to some examples: Hou Yongping [14] studied signs of BSC in Quingdao (a city in china) [14]. A done study shows that only 11% of local council in Sydney (Australia) use BSC [15]. In another study municipalities of many Canadian cities were examined. This study has compared current and ideal situation with each other [16]. Niven [17] with comparison of BSC aspects shows that importance degree of BSC aspects in public organizations and private companies are not the same [18]. Siverbo and Johnson [19] in their study show that only 24% of Swedish local government use BSC for performance assessment [19]. Another study indicates that managers of 30 cities (of 45 selected cities)in United State use BSC for assessment of municipalities [15]. Chan [20] shows that 14% of Canadian public organizations use BSC [20]. Porporato and Wawero [21] found that 36% of public organizations use BSC and more than 94% organizations know BSC [22].

The Process of Topsis Approach for Making Decision: In this research we have used TOPSIS method for ranking of the organizations. This method considers the distance of an alternative from the ideal point and also its distance from the negative ideal point. The selected alternative should have minimum distance from the ideal choice and maximum distance from the negative choice [23].

TOPSIS Algorithm Is as Follows:
Step 1: Conversion of current decision making matrix to weightless matrix.

$$n_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^{m} r_{ij}^2}}$$

Step 2: Creation of weightless matrix with using of W vector as an entrance item to algorithm:

$W = \{w_1, w_2, ..., w_n\} \approx (\text{Given of DM})$

Overweight matrix: $= V = N_D W_{n \times n} = \begin{vmatrix} V_{11}, ..., V_{1j}, ..., V_{1n} \\ \vdots \quad \vdots \quad \vdots \\ V_{m1}, \ V_{mj}, \ V_{mn} \end{vmatrix}$

Criterions of ND are weightless and comparable.

Step 3: Determining positive and negative ideal:

Positive ideal: $= A^+ = \left\{ (\underset{i}{\max} \ V_{ij} \Big| j \in J), (\underset{i}{\min} \ V_{ij} \Big| j \in J') \Big| i = 1, 2, ... m \right\} = \left\{ V_1^+, V_2^+, ..., V_j^+, ..., V_n^+ \right\}$

Negative idea: $A^- = \left\{ (\underset{i}{\min} \ V_{ij} \Big| j \in J), (\underset{i}{\max} \ V_{ij} \Big| j \in J') \Big| i = 1, 2, ... m \right\} = \left\{ V_1^-, V_2^-, ..., V_j^-, ..., V_n^- \right\}$

Step 4: Calculating distance

$d_{i+} = \text{Distance of positive ideal} = \left\{ \sum_{j=1}^{n} (V_{ij} - V_j^+)^2 \right\}^{0/5} ; \quad i = 1, 2, ..., m$

$d_{i-} = \text{Distance of negative ideal} = \left\{ \sum_{j=1}^{n} (V_{ij} - V_j^-)^2 \right\}^{0/5} ; \quad i = 1, 2, ..., m$

Step 5: Calculating proportional nearness to positive ideal:

$$ cl_{i+} = \frac{d_{i-}}{(d_i + d_{i-})} ; \quad \circ \leq cl_i \leq 1 \quad i = 1, 2, ..., m $$

If $A_i = A^+$ then $d_{i+} = \circ$ and $cl_{i+} = 1$. If $A_i = A^-$ then $d_{i-} = \circ$ and $d_{i+} = \circ$.

Step 6: Ranking of the alternatives

Research Hypotheses:
Main Hypothesis: There is a significant difference between performance of organizations dependent on Mashhad municipality.

The First Hypothesis: There is a significant difference (in financial aspect) between performance of organizations dependent on Mashhad municipality.

The Second Hypothesis: There is a significant difference (in customer aspect) between performance of organizations dependent on Mashhad municipality.

The Third Hypothesis: There is a significant difference (in internal process aspect) between performance of organizations dependent on Mashhad municipality.

The Forth Hypothesis: There is a significant difference (in growth and learning aspect) between performance of organizations dependent on Mashhad municipality.

Methodology: Four organizations dependent on Mashhad municipality (in transportation area) have been investigated in the present research. We have customized BSC for these organizations. For the purpose of calculating score of each aspect, we have distributed variables in structures and then structures in aspects.

In the present study, we assess 29 variables. To determine variables, previous researches and experts opinions have been studied. To evaluate amounts of BSC variables, financial statement, personnel information and questionnaire have been used. In the present study, there are two types of questionnaire: questionnaire of employees and questionnaire of customers (citizens). We have distributed questionnaire of employees among employees of four organizations and questionnaire of

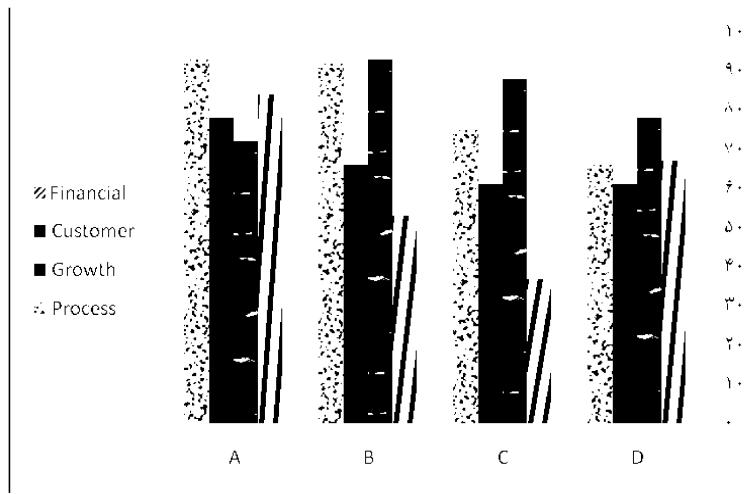**Chart 1 .** Conceptual Model of the Research

Fig. 1: Comparison of organizations scores in BSC aspects

Table 1: Dual comparisons matrix

Aspects	Customer	Growth	Financial	Process	Weight
Customer	1	5	2	4	0.5115
Growth	0.2	1	0.5	0.5	0.0986
Financial	0.5	2	1	2	0.2433
Process	0.25	2	0.5	1	0.1466

Table 2: Results of organizations scores in BSC aspects

Aspects	A	B	C	D	Weight
Financial	84	53	37	67	0.2433
Customer	72	93	88	78	0.5115
Growth	78	66	61	61	0.0986
Process	93	92	75	66	0.1466

Table 3: Normalized matrix of TOPSIS

Aspects	Financial /0.2433	Customer /0.5115	Growth /0.0986	Process /0.1466
Organization A	0.0163	0.2199	0.5772	0.0821
Organization B	0.1046	0.2864	0.0483	0.0806
Organization C	0.0705	0.2711	0.0453	0.0659
Organization D	0.1314	0.2404	0.0453	0.0586
Positive Ideal	0.163	0.2864	0.0572	0.0821
Negative Ideal	0.0705	0.2199	0.0453	0.0586

Table 4: Results of TOPSIS

Organization	Positive Ideal	Negative Ideal	Score	Rank
A	0.0663	0.0958	0.5909	1
B	0.0589	0.0774	0.5676	2
C	0.0955	0.0515	0.3503	4
D	0.0614	0.0641	0.5107	3

Table 5: Results of organizations ranking

Organization	Financial	Customer	Growth	Process	General
A	1	4	1	1	1
B	3	1	2	2	2
C	4	2	3	3	4
D	2	3	4	4	3

customers among citizens and calculated reliability of questionnaire by software of SPSS. Kronbakh alpha of employees and citizens questionnaire is 0.853 and 0.804 (both of them more than 0.7). Therefore reliability of both of them has been confirmed and to increase the questionnaire validity, we have used standard questions.

In the present study, we have chosen one of Mashhad municipality regions (region 8 with 101139 persons population) because of high volume of citizens community. classificatory accidental method has been applied for selection of examples. To determine the size and volume of the examples, Morgan table has been utilized. For filling the questionnaire of each organization, we have asked 385 people (totally 1540 people). We have distributed the questionnaires of each organization in the waiting stations of that organization. For selecting example of employees community, we have used classificatory accidental method. And for determination of example size, we have used Morgan table. We have asked 85,75,83 and 41 people from the organizations with the community volume of 104,93,103 and 46 people respectively.

Considering the difference between variables, we have normalized them After gathering data. The average amount of every variable has been made its Score which is related to a different BSC aspect. to rank the organizations based on TOPSIS and calculate the importance degree of aspects, we have used AHP (analytic hierarchy process) weight determination technique . the importance degree of all aspects is shown in table2. The Harmony rate of this matrix is 0.019 which indicates that dual comparisons have harmony.

CONCLUSION

The results of BSC aspects scores are shown in table 3. In this table, scores of BSC aspects have been calculated from structures average. And scores of structures have been calculated from variables average. To determine the importance degree of BSC aspects, experts' opinions and AHP weight determination technique have been applied.

This step has revealed the scores of organizations from different BSC aspects and ranked them separately from various viewpoints. The present study shows that from financial view point, organization A has the best performance and organization c has the worst performance. In customer aspect, organization B has the best performance and organization A has the worst performance. From growth and learning perspective, organization A has the best performance and organization D has the worst. In internal process, organization A has the best performance and organization D has the worst.

After rating the organizations based on BSC aspects, we have finally ranked them in general point of view. In this step, we have used TOPSIS technique .At first, we have calculated weight of BSC aspects using AHP technique. We have normalized data and applied TOPSIS technique to determine positive and negative ideals. Weighted and normalized matrix have been shown in Table 4 .

The results of TOPSIS shows that organization A has had the best general performance and organization C had the worst one.

The results of organizations ranking have been shown in Table 6.

Considering that in this research, SPSS software has been applied to test the hypotheses and according to the fact that SPSS shows a significant level after assessing, it can be concluded that whenever, there is a significance level lower than 5% in the results of analyses, there is a significant different between the organizations' performance dependent on municipality (from different BSC viewpoints). If the level of difference (alfa) becomes more than 5%, zero hypothesis will be accepted and it indicates the non-existence of any significant difference between the performance of organizations dependant on municipality. In the present study, according to SPSS result, alfa for main hypothesis is 0.008 and for hypothesis 1 to 4 is respectively 0.042, 0.037, 0.006, 0.012 (all of them are lower than 0.05). Therefore the entire hypotheses are confirmed. It means that, there is significant difference between the organizations' performance (from BSC aspects).

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