

A FUZZY AHP BASED PERFORMANCE ASSESSMENT SYSTEM FOR THE STRATEGIC PLAN OF TURKISH MUNICIPALITIES

Hüseyin Selçuk Kılıç

Marmara University, Industrial Engineering Department

34722/ Kadıköy Istanbul, Turkey

E-mail: huseyin.kilic@marmara.edu.tr

—Abstract —

Since performance assessment is vital for the management, it is important to develop a stable system for this process. That being the case, performance assessment system has been used for a long time in the private sector in Turkey. However, within the legal compulsories, it became an obligation for most of the municipalities satisfying the conditions. Performance program in the municipalities is regarded with the strategic plan which is the long term plan of a company. Performance program related with a strategic plan is the application program of the strategic plan throughout the years. In this paper, a fuzzy AHP based performance assessment system is developed for the municipalities in Turkey. First, the current performance assessment system in some of the municipalities in Istanbul is analyzed. Then, different from the current system, a new methodology including unit weighted performance score based on fuzzy AHP is developed for municipality performance score calculation. An example based on real life applications is utilized so as to validate the model.

Keywords: Decision making, fuzzy AHP, municipality strategic plan, performance assessment system.

JEL Classification: H11, D81

1. INTRODUCTION

Different from most of the countries in OECD, performance measurement system is a new concept for the municipalities in Turkey. After the regulation of law (Financial Management and Control Law numbered 5018) which made municipalities (populations greater than 50 000) compulsory for preparing the strategic plan, a radical change in the government processes has happened.

Adapting to this change, all of the municipalities tried to prepare their strategic plans with the performance program related to it.

After the regulation in 2005, municipalities in Turkey started to prepare their strategic plans for five year period. Every year, their strategic plan and performance programs are revised.

Due to the probable affect of the performance measurement to the organizational performance, performance measurement in public sector has great importance (Mimba et. al., 2007). When the performance assessment systems in Turkish municipalities are analyzed, as it is also explained in the following sections, it is seen that a stable performance assessment system does not exist. A new methodology based on fuzzy AHP is proposed to address this research gap. Different from the current methodology, an importance weighting system is proposed. The importance weights are calculated by fuzzy AHP because of the vague structure of the judgments made by the managers of the municipality.

The rest of the paper is organized as follows: Literature review about performance assessment systems in the municipalities is given in Section 2. Section 3 includes the current and proposed performance assessment systems and their comparison. Section 4 includes a numerical example and finally, conclusions are provided in section 5.

2. LITERATURE REVIEW

There are a lot of studies taking into consideration the performance assessment in the public sector but few contain a quantitative systematic approach for calculating the performance scores. Some of the studies are briefly explained as follows:

Ghobadian (1994) explained the reasons why performance measurement was important in local government. The writer also stated the properties of an effective performance measurement system. Black et. al. (2001) analyzed the performance measurement systems both in public and private sectors on a comparative basis. Beside other subjects, they mainly explained the similarities and differences of performance measurement systems between the sectors.

Pollanen (2005), in his study, got in contact with 334 senior administrators in Canadian municipalities by examining the real and aimed use of performance measures for the purposes of management and external reporting. It is extracted that although the starting date of obligation of performance measurement and reporting requirements for municipalities in Canada is after some countries like

UK, USA and Australia, an important level of usage happened voluntary in the municipalities of Canada. Greiling (2005) analyzed the performance measurement system of public sector in Germany and according to the analysis' results; recommendations were made for a better measurement system. Sotirakou and Zeppou (2006) tried to find the factors which make the performance measurement systems more effective in the Greek public sector. A qualitative approach is carried out in the Greek Public administration and factor which lead to success are found. Rantanen et. al. (2007) tried to determine the problems occurred in the design and implementation of performance measurement systems in the public sector of Finland. To achieve this goal, three case studies are taken into consideration. The results of the study could be used for a better design and implementation of performance measurement systems. Greatbanks and Tapp (2007) aimed to determine the impact of balanced scorecards on the performance of the public sector. For this aim, a case study is analyzed and the effect of the balanced score cards is tried to be found at three levels such as "strategic planning", "team management" and "individual staff performance".

3. PERFORMANCE ASSESSMENT METHODOLOGY

One of the well known and mostly applied decision making methods is AHP proposed by Saaty (1980). In the classical AHP, vague thoughts of the decision makers aren't taken into consideration. For including the vague thoughts, fuzzy AHP based on fuzzy set theory introduced by Zadeh (1965) will be valid in this study. In the performance evaluation framework, while determining the weights of the criteria, the fuzzy AHP methodology proposed by Chang (1992) will be used.

The methodology presented here is developed for the municipalities as a result of the practical experiences, but it can be extended to use in other public sector. As it was explained before, Turkish municipalities satisfying the conditions are compulsory for preparing their strategic plan and performance program related to the strategic plan. Depending on the observations in some of the municipalities in Turkey, the current methodology used for performance assessment is explained. After the explanation of the current system, the proposed methodology and the comparison of the systems are presented.

3.1 Current Methodology

In the current performance assessment system, municipality performance score is basically the average performance scores of the units that it has. Similarly, the performance of the units is the performance scores of the activities/projects defined according to the strategic plan, so the performance score of the strategic

plan is the performance score of the municipality. Each unit in the municipality determines the activities/projects to be done in one year period as monthly basis. For each activity/project, performance indicators are defined and measured on the required date. All the activities/projects are regarded as equal and no weight showing the importance of each activity/project is defined. Once the performance score of the units are calculated, then the average performance score of the units makes the municipality performance score. The equations used for calculating the municipality performance score are given below.

Unit Performance Score

Unit performance score is the average performance score of the activities/projects for the related month. The related indexes and formulations are shown as below.

UP_{ij}: The performance score of the unit “i” for the month “j”

$$UP_{ij} = \frac{\sum_k AP_{ijk}}{K} \tag{1}$$

AP_{ijk}: Realized score of the ith unit’s kth activity/project for the jth month.

i: Unit no; j: Month no; k: Activity/project no; K: total number of activities/projects;

After the calculation of performance in each unit, then the municipality performance is calculated as the average of the unit performance values.

Municipality Performance Score

MP_j: Municipality performance score for the month j; U: Total number of units in the municipality.

$$MP_j = \frac{\sum_i UP_{ij}}{U} \tag{2}$$

3.2 Proposed Methodology

In the proposed methodology, the main feature which makes the proposed methodology different from the current methodology is to take into consideration the importance of activities/projects and units. While calculating both the unit performance and municipality performance, there should be a stable system for determining the importance weights. To achieve this goal, fuzzy AHP in which vague thoughts of the decision makers can be taken into consideration is used.

Determining unit weighted performance score

Different from the current methodology, while calculating the performance of the units, weight of each activity/project is found by using Fuzzy AHP. However, due to the fact that to make a pair-wise comparison between all the activities/projects of a unit is difficult, factors for evaluating the activities/projects are first determined. These factors are weighted according to the Fuzzy AHP process. Each activity/project is then given scores according to each factor. Then, the weights are obtained for each activity/project as an average weighted value of the factors for that activity/project.

After obtaining the weights of each A/P, the weighted performance score of each unit is calculated. While calculating unit weighted performance score, each unit is not regarded as equal. The weight of each unit is calculated as the sum of its A/P's weights. Then, the weighted average performance score is calculated as unit weighted performance score.

The general indexes and formulas in addition to the ones given before are as follows:

f: Factor no; WF_f : The importance weight of the factor "f".

PF_{ijkf} : The effect of activity/project "k" of the unit "i" on the factor "f" in the month "j".

W_{ijk} : The importance weight of the activity/project "k" in the unit "i" for the month "j".

$$W_{ijk} = \sum_f (WF_f * PF_{ijkf}) \tag{3}$$

WUP_{ij} : The weighted unit performance of the unit "i" for the month "j"

$$WUP_{ij} = \frac{\sum_k (AP_{ijk} * W_{ijk})}{\sum_k W_{ijk}} \tag{4}$$

W_{ij} : The weights of all the activities/projects of the unit "i" in the month "j".

$$W_{ij} = \sum_k W_{ijk} \tag{5}$$

WPS_j : The weighted performance score of all the units for the month "j"

$$WPS_j = \frac{\sum_i (UP_{ij} * W_{ij})}{\sum_i W_{ij}} \tag{6}$$

4. NUMERICAL EXAMPLE BASED ON REAL APPLICATIONS

For the application of the proposed methodology, a numerical example is developed in accordance with the real applications in the municipalities of Istanbul in Turkey.

The current and proposed systems are explained in details with the numerical example. The numerical example consists of three units for the easiness of operations. The three units and their performance scores for each activity/project are as in the Table 1.

Table 1: Performance scores of each activity/project in each unit.

UNIT 1				UNIT 2		UNIT 3			
No	A/P	No	A/P	No	A/P	No	A/P	No	A/P
1	90	6	80	1	80	1	50	6	75
2	80	7	90	2	85	2	75	7	95
3	60	8	70	3	75	3	90	8	45
4	50	9	85	4	60	4	80		
5	75	10	60	5	45	5	60		

Current methodology

In the current methodology, as it is mentioned before, all the activities/projects are assessed on an equal basis and also every unit like the activities/projects is assessed on the same basis. That is, their importance degrees are accepted as equal. The performance of the units and the municipality is simply the average of the performance values as calculated below.

Performance of Unit 1: $(90 + \dots + 60) / 10 = 74\%$; Performance of Unit 2: $(80 + \dots + 45) / 5 = 69\%$; Performance of Unit 3: $(50 + \dots + 45) / 8 = 71,25\%$;

Municipality Performance = $(74\% + 69\% + 71,25\%) / 3 = 71,41\%$

Proposed methodology

The new performance scores of the units and municipality are calculated according to the proposed methodology. When the proposed methodology is applied, the municipality performances score changes. The applications of the steps are as follows:

1. Determining the factors for activities/projects and calculating the weights of them by using fuzzy AHP.

Since each activity/project has a different importance, first, factors are determined to obtain the weights. The factors listed below are determined in general and can

be changed according to the municipality's special circumstances. The factors determined are as follows:

F1. The effect to customer satisfaction; **F2.** The monetary requirement; **F3.** The effect to environmental development; **F4.** The effect to internal processes

Each activity/project is assessed according to these factors. There are three scales for the evaluation: "High", "Medium" and "Low". The mathematical corresponding of these linguistic expressions are 1, 0.50 and 0.25 respectively.

Before giving scores to each activity/project, firstly the importance weights of these factors are obtained by using fuzzy AHP. Pair wise comparison matrices are constructed and fuzzy triangular numbers are used. The comparisons are represented by five degrees. These linguistic comparison variables and their triangular lower, medium and upper bounds are as follows:

Equal (1,1,1); *Weakly strong* (0.5, 1, 1.5); *Strong* (1, 1.5, 2); *Very strong* (1.5, 2, 2.5); *Absolute* (2, 2.5, 3)

The determined factors are compared as shown in the Table 2 and the weights are found.

The compromise pair wise comparisons of the factors in terms of importance are as follows:

Table 2: Pair wise comparison of the factors

	F1	F2	F3	F4
F1	(1,1,1)	(0.5,1,1.5)	(1,1.5,2)	(1.5,2,2.5)
F2	(0.67,1,2)	(1,1,1)	(0.5,1,1.5)	(1,1.5,2)
F3	(0.5,0.67,1)	(0.67,1,2)	(1,1,1)	(0.5,1,1.5)
F4	(0.4,0.5,0.67)	(0.5,0.67,1)	(0.67,1,2)	(1,1,1)

All of the steps of the fuzzy AHP proposed by Chang (1992) are performed and weights of the factors are found as follows:

$$W_{F1} = 1 / (3,16) = 0,32; W_{F2} = 0,85 / (3,16) = 0,27; W_{F3} = 0,71 / (3,16) = 0,22; W_{F4} = 0,60 / (3,16) = 0,19$$

2. *Evaluating each activity/project according to each factor by using the scale ("High", "Medium", "Low") and determining the weights of each activity/project.*

Each activity/project is scored according to the factors with respect to the scale ("High", "Medium", "Low") as shown in the Table 3.

$$X = 0,32(\text{High}=1) + 0,27(\text{High}=1) + 0,22 (\text{Medium}=0,5) + 0,19(\text{Low}=0,25) = 0,7475$$

$$Y = 0,32(\text{High}=1) + 0,27(\text{Medium}=0,5) + 0,22 (\text{Low}=0,25) + 0,19(\text{Low}=0,25) = 0,5575$$

...

$$Z = (0,32) \dots$$

Table 3: Scores of activity/project according to factors in a unit

Activity/Project	F1 (0,32)	F2 (0,27)	F3 (0,22)	F4 (0,19)	Weight (W _{ijk})
AP1	High	High	Medium	Low	X
AP2	High	Medium	Low	Low	Y
...
AP _n	Z

3. Determining the weights of each unit and calculating the strategic plan weighted performance score.

The importance weight of each unit for a specific month is the total of its activity/project's weights. So for calculating a unit's importance weight, all the weights of activity/projects are added.

By using the values in Step 2 and assuming some other values.

The weight of a unit: $X + Y + \dots + Z$

As it is seen in table 4, the municipality weighted performance score is % 78,11 and it differs from the performance score without weights which was found as % 71,41.

Table 4: Performance score and importance weight of activity/project

UNIT 1			UNIT 2			UNIT 3								
No	A/P	W.	No	A/P	W.	No	A/P	W.	No	A/P	W.	No	A/P	W.
1	90	0,75	6	80	0,85	1	80	0,9	1	50	0,25	6	75	0,4
2	80	0,55	7	90	0,95	2	85	0,95	2	75	0,85	7	95	0,9
3	60	0,35	8	70	0,4	3	75	0,35	3	90	0,85	8	45	0,25
4	50	0,25	9	85	0,85	4	60	0,3	4	80	0,9			
5	75	0,8	10	60	0,3	5	45	0,25	5	60	0,3			
Total Weight		6,05			Total Weight		2,75		Total Weight		4,7			

Weighted Unit Performance	78,80	Weighted Unit Performance	75,73	Weighted Unit Performance	78,62
Municipality Weighted Performance Score: $(6,05 * \%78,8 + 2,75 * \%75,73 + 4,7 * \%78,62) / (6,05 + 2,75 + 4,7) = \%78,11$					

5. CONCLUSION

The importance of performance based management in government is increasing especially with the last legal regulations. The accurate performance score of both the whole municipality and the units is crucial while making decisions especially in performance based awarding or wage systems and also in determining the improvement areas etc. While calculating the performance score of a municipality, all of the factors do not have the same importance. With this study, firstly, the current methodology used in some of the Turkish Municipalities is presented. Then, different from the current applications in Turkish municipalities; a fuzzy AHP based performance assessment system is presented for determining the importance weights of factors in different levels. A numerical example based on the real applications is presented for a detailed explanation of the proposed methodology. As it can be seen from the numerical example, the performance scores of the current methodology and the proposed methodology differ from each other. For further studies, fuzzy AHP methodology can be extended for performance assessment of other service sectors. Some other decision making techniques such as TOPSIS, ELECTRE etc. can also be used for performance assessment systems. Comparative studies can be made between multi-criteria decision making methods.

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