

A PROPOSED MODEL FOR CANDIDATE SELECTION PROCESS IN POLITICAL PARTIES BASED ON FUZZY LOGIC METHODOLOGY

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Abstract- Classical logic and classical set theorems are not sufficient enough when it is necessary to deal with complex decision making problems which also involve human experiences. Some researches suggest that senior management usually makes intuitive decisions in the process of selecting the candidates in political parties which brings out the need to derive a new efficient, robust and applicable method.

In this study, the qualitative characteristics and their significance level which could be used for the candidate selection process in political parties are determined. The candidate selection process consisting vague inputs is analyzed by fuzzy logic methodology and a quantitative final score has been determined for the candidate. It has been shown that the model provided some realistic and promising results which could enable further studies to derive more optimized and enhanced models for similar purposes.

Key Words- Fuzzy logic, Candidate selection process, Political parties, Centroid method

1. INTRODUCTION

In the recent years, a vast amount of growing interest has been observed in specific technologies which mostly focus on human factors such as artificial intelligence, neural networks, genetic algorithms and evolutionary programming. Representing knowledge in such a manner that enables processing information not only in human style but also in a format amenable to computer manipulation is the common requirement for all these so-called “intelligent technologies” [1].

It is shown that analyses of human behavior using pure quantitative methodologies are not likely to have much relevance to social, political and economical real world problems which involve human beings [2]. Such cases refer to the concept of uncertainty or vagueness which is caused by the human factor. People mostly have a tendency to use common linguistic terms to express both themselves and the world that they live in, such as; *old, young, very old, hot, cold, slightly cold, etc.* Thinking in the frame of the theory of classical logic; if a proposition is evaluated, eventually it will have two exact results, such as “true” and “false”. But if a term such as “old” is used to describe something, this descriptor will be a subjective parameter [3].

The impact and popularity of competition concept has been increasing in the last decades and this concept has escalated the importance of giving right decision for organizations. Decision makers have encountered the fact of using proper scientific

methods instead of using intuitive and emotional choices in decision making process. Due to the relevant costs and possible economical, political and social impacts, it is crucial for the decision makers to analyze and use effective methods in their decision making process. Fuzzy models and fuzzy applications are expected to fulfill such crucial requirements [4] [5] [6].

Some researches suggest that senior management usually makes intuitive decisions in the process of determining the candidates in political parties which brings out the need to derive a new efficient, robust and applicable method.

In the beginning of this study some meetings with the delegates of the Turkish political party (AK Party) were held and also necessary information was collected from questionnaire forms and literature surveys [7]. It was found out that the candidate selection process among political parties in Turkey is generally conducted without using quantitative methods. Thus, bringing out a feasible and applicable new alternative model with a quantitative methodology was the main motive in this study. A specific fuzzy logic model is proposed such that it could be used in the candidate selection process of political parties. The model is applied to AK Party's candidate selection process with real data. After implementing the model and making the necessary calculations, some promising and feasible results were obtained.

2. CANDIDATE SELECTION PROCESS IN POLITICAL PARTIES

In today's political systems, the participation of citizens to the governmental administration is established by the aid of electing and monitoring the rulers and the government where these two elements are generally accepted as the most crucial ones in democracy. In democratic regimes, all citizens in a country exercise equal control over the matters which affect their rights and interests by some governmental mechanisms (i.e., general / local elections), constitutions, rules and laws [8]. Turkey is one of the countries governed with representative democracy and parliamentary system. In Turkey, candidate selection for the members of parliament is legislated in the section under the title of "The Law of Political Parties, 7th section: The attendance of the political parties to the election process and the assignment of the candidates" [9]. Also, the principles of assignment of the candidates for both the local administration and for the membership in "T.B.M.M." take place individually in the rules and regulations of political parties (i.e., see AK Party rules [10]). However, almost in every political party in Turkey, the candidate selection process is usually carried out by intuitive and subjective decision mechanisms which could cause problems and arguments.

In order to improve this process, AK Party's administrative board developed a new strategy, established an evaluation form within this strategy and distributed it to their members and organizations before the 2009 local elections in Turkey. The criteria for selecting and evaluating the candidates and the essential characteristics of the candidates were described in this form. Also, these strategies were analyzed in a previous study (see Gökşen, Doğan and Yaralıoğlu [7] for details of this study). The questionnaire form which is used in this study was developed according to the preliminary framework in the previous studies [7].

3. SOME BASIC TERMINOLOGIES IN FUZZY LOGIC

Real world problems involve uncertainties. These uncertainties might come out due to the lack of knowledge or they might exist due to the fact of ambiguity. Fuzzy logic models are shown to be an alternative approach when knowledge is incomplete or linguistic terms have multiple and indefinite values. In 1965, Lotfi A. Zadeh introduced the concept of fuzziness [11] as opposed to crispiness in data sets. Zadeh's fuzzy logic model combines the concepts of crisp logic and the Lukasiewicz sets by defining graded membership [1] [12].

A fuzzy set extends the notion of standard set by enabling degrees of membership of an element in the standard set where this extension is measured by real numbers in the interval $[0, 1]$. A fuzzy set A over a universal set X defined by its membership function

$$\mu_A : X \rightarrow [0, 1] \quad (1)$$

such that, for any $x \in X$, the value of $\mu_A : X$ is obtained as a degree of the individual x which belongs to the set A .

In fuzzy set theory, operators are defined in a similar way to the ones described in classical set theory. The original definitions proposed by Zadeh can be denoted simply as follows:

$$\begin{aligned} \forall x \in X \\ \mu_{A^c}(x) &= 1 - \mu_A(x) \\ \mu_{A \cap B}(x) &= \min\{\mu_A(x), \mu_B(x)\} \\ \mu_{A \cup B}(x) &= \max\{\mu_A(x), \mu_B(x)\} \end{aligned} \quad (2)$$

A fuzzy system accepts numbers as input and then translates the input numbers into linguistic terms such as “Slow”, “Medium”, and “Fast”. This process is named as “fuzzification”. Rules map the input linguistic terms onto similar linguistic terms describing the output. Finally, the output linguistic terms are translated into an output number which is known as “defuzzification” [13].

4. PROPOSED MODEL AND IMPLEMENTATION

In the first part of this study, criteria and sub-criteria have been defined and their significance levels (weights) have been determined. Then, two matrices are derived from these weights and from the evaluation criteria of the political party committee including relevant survey results. The “min-max” operation is applied to these matrices and the relevant fuzzy values are evaluated. Finally, these values are defuzzified by the aid of Centroid method and the crisp score for each candidate is obtained. The model in this study is based on the fact that the operations used in classical set theory also could be used in fuzzy set theory. Hence, in this proposed model, intersection and union operations are used to evaluate a final fuzzy score. The union operation in fuzzy sets could be represented as follows;

$$\text{For } R \subseteq AxB \text{ and } S \subseteq AxB \text{ and } \forall (x, y) \in AxB \text{ then,} \quad (3)$$

$$\mu_{R \cup S}(x, y) = \max[\mu_R(x, y), \mu_S(x, y)] = \mu_R(x, y) \vee \mu_S(x, y)$$

In general, “ \vee ” sign is used for the maximum operator. Similarly, intersection operation could be defined as follows;

$$\text{For } R \subseteq AxB \text{ and } S \subseteq AxB \text{ and } \forall (x, y) \in AxB \text{ then,} \quad (4)$$

$$\mu_{R \cap S}(x, y) = \min[\mu_R(x, y), \mu_S(x, y)] = \mu_R(x, y) \wedge \mu_S(x, y)$$

It should be noted that “ \wedge ” sign is used for the minimum operator [14].

Union and intersection operations could be arranged with “min-max” operators. These kinds of operations called as min-max method [15]. In the final phase of our model, Centroid method is used for defuzzification which can be formulated as;

$$Z_0 = \frac{\sum_{j=1}^n \mu_c(Z_j) Z_j}{\sum_{j=1}^n \mu_c(Z_j)} \quad (5)$$

Using this operator, fuzzy data and fuzzy values could be transformed into crisp values [14]. In this study, the similar methodology is applied to the model. It should also be mentioned that, the generic method for fuzzy means is used to calculate the weighted averages (mean scores); however, some alternative methodologies might be applied to calculate the fuzzy arithmetic means, such as *GUMAR* [16].

4.1. Implementation and evaluation of qualitative weights

In this section; data generation and transformation, establishment of qualitative weights and scores are given. In the beginning of this study, a questionnaire form which was prepared according to the constraints and requirements that were specified by some experts in the political party and the authors of this paper. All the questions used in this form are denoted in Table 1 under “Criteria” and “Sub-criteria” titles. Then, this form is used to conduct a survey among a population of 40 people that were members of the political party. In the survey, each survey respondent gave a score between 0 and 100 for each of the criteria which should make up a total of 100. Similarly, they gave a score between 0 and 100 for all the sub-criteria so that it should give a sum of 100 for each sub-criteria group belonging to that specific criterion. After collecting all the results from all of the forty survey respondents, mean scores (significance levels) are determined for each of the criteria and their corresponding sub-criteria. The criteria and their corresponding sub-criteria items and their respective mean scores are denoted in Table 1.

Table 1. Score table used in defining the qualitative weights and their corresponding criteria for party candidates

CRITERIA	MEAN SCORE	Sub-criteria	Sub-criteria Mean Score
Human Skills and Qualifications	22	Communication skills	28
		Positive influence on people	22
		Leadership and persuasion skills	27
		Motivation capability and durability	23
		TOTAL	100
General Skills	23	Knowledge level about local and global affairs and issues	23
		Having a powerful and sufficient technical team	24
		Possessing municipality mission and vision	19
		Ability to work in harmony and coordination with NGOs	16
		Educational background and training history about local administration	18
		TOTAL	100
Urban Strategies	18	Taking part as sponsor / owner in urban projects	26
		Adding value to urban developments and being successful in representation of the city	23
		Positive relationship with the notables of the city	18
		Knowledge about urban problems and issues	33
		TOTAL	100
Personal Characteristics	21	Being able to use resources efficiently and economically	34
		Courage, intelligence and extroversion	23
		Not being involved in notorious acts such as fraud, bribe, embezzlement	32
		Sub-identity notion	11
		TOTAL	100
Interaction between Candidate and Political Party	16	Adopt in political party's own mission and vision	25
		Being in harmony with the political party organization	24
		Previous achievements in party tasks	31
		Experience in grassroots projects	20
TOTAL	100	TOTAL	100

For each of the sub-criteria “Human Skills and Qualifications”, “General Skills”, “Urban Strategies”, “Personal Characteristics”, “Interaction between Candidate and Political Party”; their respective weight matrices A_1 , A_2 , A_3 , A_4 and A_5 could be

derived by using the sub-criteria mean scores in Table 1. These weight matrices are denoted in (6).

$$\begin{aligned}
 A_1 &= (0,28 \ 0,22 \ 0,27 \ 0,23) \\
 A_2 &= (0,23 \ 0,24 \ 0,19 \ 0,16 \ 0,18) \\
 A_3 &= (0,26 \ 0,23 \ 0,18 \ 0,33) \\
 A_4 &= (0,34 \ 0,23 \ 0,32 \ 0,11) \\
 A_5 &= (0,25 \ 0,24 \ 0,31 \ 0,20)
 \end{aligned} \tag{6}$$

Similarly, the generalized weight matrix A is obtained from the criteria mean scores as follows:

$$A = (0,22 \ 0,23 \ 0,18 \ 0,21 \ 0,16) \tag{7}$$

In order to obtain the results for the implementation phase, it was assumed that there is a party committee with five members. It was supposed that the members would give scores to candidates' features among a scale of 1 to 5 (Very High=5, High=4, Medium=3, Low=2, Very Low=1). By this way, the matrices are derived from these party members' assessment and the results are evaluated by calculating the union of these matrices. It should be noted that the member set size used in this implementation is not a mandatory value or limit. This is a discretionary value chosen for this study and it can be changed to different alternative values in similar studies in the future.

Table 2. Scores given by the party committee members for each of the candidate selection criteria

CRITERIA	Sub-criteria	Scores given by the party committee members				
		M1	M2	M3	M4	M5
Human Skills and Qualifications	Communication skills	5	4	4	4	5
	Positive influence on people	3	5	4	2	1
	Leadership and persuasion skills	5	4	2	3	2
	Motivation capability and durability	5	4	5	3	2
General Skills	Knowledge level about local and global affairs and issues	1	2	3	5	4
	Having a powerful and sufficient technical team	3	4	4	4	5
	Possessing municipality mission and vision	5	5	4	3	4
	Ability to work in harmony and coordination with NGOs	3	3	4	4	5
	Educational background and training history about local administration	3	3	3	2	2
Urban Strategies	Taking part as sponsor / owner in urban projects	3	4	5	4	5
	Adding value to urban developments and being successful in representation of the city	4	4	3	5	5
	Positive relationship with the notables of the city	2	3	3	4	4
	Knowledge about urban problems and issues	5	2	2	4	4

Personal Characteristics	Being able to use resources efficiently and economically	1	4	3	3	3
	Courage, intelligence and extroversion	2	4	2	3	4
	Not being involved in notorious acts such as fraud, bribe, embezzlement	3	4	5	5	1
	Sub-identity	3	2	2	3	2
Interaction between Candidate and Political Party	Adopt in political party's own mission and vision	5	4	5	4	3
	Being in harmony with the political party organization	4	5	5	4	3
	Previous achievements in party tasks	4	5	3	4	3
	Experience in grassroots projects	3	3	2	4	4

4.2 Fuzzy methodology and results

In this section, fuzzification and defuzzification process which provide the quantitative modeling and derivation of the respective results are explained. The sample scores of a candidate given by the party committee members are shown in Table 2. With respect to these scores, the final cumulative score for that candidate has to be found out by implementing fuzzy logic methodology. To establish this, first, the scores for each of the criteria and its relevant sub-criteria should be transformed into an appropriate format so as to be used in the fuzzy process.

Table 3. Sample scores for human skills and qualifications

Human Skills and Qualifications	Communication skills	5	4	4	4	5
	Positive influence on people	3	5	4	2	1
	Leadership and persuasion skills	5	4	2	3	2
	Motivation capability and durability	5	4	5	3	2

For instance, as it could be seen in Table 3; “Communication skills” sub-criteria of the candidate gets 5 points from two members and 4 points from the other three members. The other sub-criteria are also analyzed in the same way. Using these points, a matrix composed from fuzzy numbers can be obtained, which is denoted in Table 4.

Table 4. Fuzzification of human skills and qualifications

	Very High	High	Average	Low	Very Low
Communication skills	2 (0,4)	3 (0,6)	0 (0,0)	0 (0,0)	0 (0,0)
Positive influence on people	1 (0,2)	1 (0,2)	1 (0,2)	1 (0,2)	1 (0,2)
Leadership and persuasion skills	1 (0,2)	1 (0,2)	1 (0,2)	2 (0,4)	0 (0,0)
Motivation capability and durability	2 (0,4)	1 (0,2)	1 (0,2)	1 (0,2)	0 (0,0)

Thus, the matrix for “Human Skills and Qualifications” could be written as;

$$B_1 = \begin{bmatrix} 0,4 & 0,6 & 0,0 & 0,0 & 0,0 \\ 0,2 & 0,2 & 0,2 & 0,2 & 0,2 \\ 0,2 & 0,2 & 0,2 & 0,4 & 0,0 \\ 0,4 & 0,2 & 0,2 & 0,2 & 0,0 \end{bmatrix} \quad (8)$$

Using the same methodology, the other four matrices are developed and they are denoted one by one as follows;

“General Skills” matrix:

$$B_2 = \begin{bmatrix} 0,2 & 0,2 & 0,2 & 0,2 & 0,2 \\ 0,2 & 0,6 & 0,2 & 0,0 & 0,0 \\ 0,4 & 0,4 & 0,2 & 0,0 & 0,0 \\ 0,2 & 0,4 & 0,4 & 0,0 & 0,0 \\ 0,0 & 0,0 & 0,6 & 0,4 & 0,0 \end{bmatrix} \quad (9)$$

“Urban Strategies” matrix:

$$B_3 = \begin{bmatrix} 0,4 & 0,4 & 0,2 & 0,0 & 0,0 \\ 0,4 & 0,4 & 0,2 & 0,0 & 0,0 \\ 0,0 & 0,4 & 0,4 & 0,2 & 0,0 \\ 0,2 & 0,4 & 0,0 & 0,4 & 0,0 \end{bmatrix} \quad (10)$$

“Personal Characteristics” matrix:

$$B_4 = \begin{bmatrix} 0,0 & 0,2 & 0,6 & 0,2 & 0,0 \\ 0,0 & 0,4 & 0,2 & 0,4 & 0,0 \\ 0,4 & 0,2 & 0,2 & 0,0 & 0,2 \\ 0,0 & 0,0 & 0,4 & 0,6 & 0,0 \end{bmatrix} \quad (11)$$

“Interaction between Candidate and Political Party” matrix:

$$B_5 = \begin{bmatrix} 0,4 & 0,4 & 0,2 & 0,0 & 0,0 \\ 0,4 & 0,4 & 0,2 & 0,0 & 0,0 \\ 0,2 & 0,4 & 0,4 & 0,0 & 0,0 \\ 0,0 & 0,4 & 0,4 & 0,2 & 0,0 \end{bmatrix} \quad (12)$$

After this step, each of these matrices is to be processed using the union operation and the weight matrices that were defined in section 4.1, (6). Recall that the union operation is defined as below;

$$C_i = A_i \cdot B_i \quad (13)$$

Thus, using this definition, the necessary quantitative evaluations could be established. For instance, the fuzzy union operation for “Human Skills and Qualifications” criteria could be implemented as follows;

$$C_1 = A_1.B_1$$

$$C_1 = [0,28 \quad 0,22 \quad 0,27 \quad 0,23] \otimes \begin{bmatrix} 0,4 & 0,6 & 0,0 & 0,0 & 0,0 \\ 0,2 & 0,2 & 0,2 & 0,2 & 0,2 \\ 0,2 & 0,2 & 0,2 & 0,4 & 0,0 \\ 0,4 & 0,2 & 0,2 & 0,2 & 0,0 \end{bmatrix} \quad (14)$$

$$\begin{aligned} C_1 &= ((0,28 \wedge 0,4) \vee (0,22 \wedge 0,2) \vee (0,27 \wedge 0,2) \vee (0,23 \wedge 0,4) \\ & (0,28 \wedge 0,6) \vee (0,22 \wedge 0,2) \vee (0,27 \wedge 0,2) \vee (0,23 \wedge 0,2) \\ & (0,28 \wedge 0,0) \vee (0,22 \wedge 0,2) \vee (0,27 \wedge 0,2) \vee (0,23 \wedge 0,2) \\ & (0,28 \wedge 0,0) \vee (0,22 \wedge 0,2) \vee (0,27 \wedge 0,4) \vee (0,23 \wedge 0,2) \\ & (0,28 \wedge 0,0) \vee (0,22 \wedge 0,2) \vee (0,27 \wedge 0,0) \vee (0,23 \wedge 0,0)) \end{aligned} \quad (15)$$

$$\begin{aligned} C_1 &= ((0,28 \vee 0,2 \vee 0,2 \vee 0,23) \\ & (0,28 \vee 0,2 \vee 0,2 \vee 0,2) \\ & (0,0 \vee 0,2 \vee 0,2 \vee 0,2) \\ & (0,0 \vee 0,2 \vee 0,27 \vee 0,2) \\ & (0,0 \vee 0,2 \vee 0,0 \vee 0,0)) \end{aligned} \quad (16)$$

For “Human Skills and Qualifications”, the membership degrees C_1 are obtained as $C_1 = (0,28 \quad 0,28 \quad 0,2 \quad 0,27 \quad 0,2)$. All the other criteria are evaluated in the same manner as below;

$$\text{General Skills:} \quad C_2 = (0,2 \quad 0,24 \quad 0,2 \quad 0,2 \quad 0,2)$$

$$\text{Urban Strategies:} \quad C_3 = (0,26 \quad 0,33 \quad 0,2 \quad 0,33 \quad 0,0)$$

$$\text{Personal Characteristics:} \quad C_4 = (0,22 \quad 0,23 \quad 0,34 \quad 0,23 \quad 0,2)$$

$$\text{Interaction between Candidate and Political Party:} \quad C_5 = (0,25 \quad 0,31 \quad 0,31 \quad 0,2 \quad 0,0)$$

Hence, the matrix obtained from these criteria can be denoted as follows;

$$C = \begin{bmatrix} 0,28 & 0,28 & 0,2 & 0,27 & 0,2 \\ 0,2 & 0,24 & 0,2 & 0,2 & 0,2 \\ 0,26 & 0,33 & 0,2 & 0,33 & 0,0 \\ 0,22 & 0,23 & 0,34 & 0,23 & 0,2 \\ 0,25 & 0,31 & 0,31 & 0,2 & 0,0 \end{bmatrix} \quad (17)$$

In order to obtain a final fuzzy score for the candidate, union operation will be applied on general weight matrix A and matrix C . After this operation, Final Fuzzy Score (FFS) is determined.

$$FFS = A \cdot C$$

$$= [0,22 \ 0,23 \ 0,18 \ 0,21 \ 0,16] \otimes \begin{bmatrix} 0,28 & 0,28 & 0,2 & 0,27 & 0,2 \\ 0,2 & 0,24 & 0,2 & 0,2 & 0,2 \\ 0,26 & 0,33 & 0,2 & 0,33 & 0,0 \\ 0,22 & 0,23 & 0,34 & 0,23 & 0,2 \\ 0,25 & 0,31 & 0,31 & 0,2 & 0,0 \end{bmatrix} \quad (18)$$

$$= [0,22 \ 0,23 \ 0,21 \ 0,22 \ 0,2]$$

The values in the matrix show the weights corresponding to the previous qualitative scale for this candidate and they are denoted as below;

Very High	High	Medium	Low	Very Low
0,22	0,23	0,21	0,22	0,20

In the final step, this final fuzzy score matrix will be operated through defuzzification process. Thus, a final score will be determined for the candidate. It should be noted that, after defuzzification, the final score for any candidate can be any quantitative value ranging between 0 and 100. The formula and the calculations are denoted in (19).

$$P = \frac{\sum_{i=1}^5 (FFS_i) \cdot \bar{z}}{\sum_{i=1}^5 (FFS_i)}$$

$$P = \frac{(0,22) \cdot 20 + (0,23) \cdot 40 + (0,21) \cdot 60 + (0,22) \cdot 80 + (0,2) \cdot 100}{0,22 + 0,23 + 0,21 + 0,22 + 0,2} \quad (19)$$

$$P = \frac{4,4 + 9,2 + 12,6 + 17,6 + 20}{1,08} = 59,07$$

After these calculations, the final score of the candidate is found out as 59.07 and this score will be compared with other candidates' scores. Retrieving the scores by filling in the entries denoted in Table 2 and executing the same subsequent steps, the final score for each candidate was obtained.

5. CONCLUSION

The results show that the model in this study could be a promising alternative for the traditional candidate selection methods in political parties so that the subjectivity, vagueness and qualitative weaknesses could be significantly decreased. It is shown that fuzzification and defuzzification methods can be applied to candidate selection process conveniently. Since, a quantitative, non-ambiguous numerical value can be obtained and assessed for any candidate's political image; clear, objective and efficient comparisons and evaluations could be made for all the candidates in political parties. Hence, this could enable the presidents and the decision makers in the political parties to make correct, non-trivial and reliable strategic decisions. In addition, this would increase the trustworthiness and positive impression of that political party among its members and the citizens.

This model also brings forward some promising and interesting topics for further studies. We are planning to implement this model within a web based automated

software that calculates the results simultaneously. By this way, the reliability, usability and efficiency of the model could be increased.

The number of party committee members was chosen as five in this study, however this could be set to some other values and the model could be re-implemented and new results could be observed for these different values.

The criteria and sub-criteria in score tables and surveys were developed for a specific political party in Turkey. Similar methods and models could be developed in other countries holding democratic elections as well, where such criteria might be re-defined considering the diversity of regulations, laws and culture among these countries. In the same manner, other political parties in Turkey could implement this model according to their own strategies and policies.

Also, the significance level of the criteria could be determined not only by the party's committee members but also by the supporters of the party and / or any voting citizen. This might increase the eligibility of the candidate who would be selected by that political party as a nominee for elections.

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