



## Two-Dimensional Model Designing to Evaluate Employees' Performance Using Fuzzy Approach

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ARTICLE INFO	ABSTRACT
<p>Article History:            Received 18 February 2022            Received in revised form            26 April 2022            Accepted 29 May 2022            Available online 6 June 2022</p>	<p>Performance management is a critical topic in contemporary management studies due to its impact on employee performance. Performance evaluation is a process that assesses employees based on predetermined criteria and methods. This research examines the criteria for general and specific evaluations of employee performance, based on related research. The employees under consideration work in the software development section. The main active sections in software development companies, including IT, software engineering, finance, sales and marketing, and project control, were explored to identify primary criteria. These criteria were derived from related studies and job descriptions and are used to evaluate the special criteria of each section. The experts were given the primary criteria and subsequently interviewed. No changes in content were made, as per the instructions. The secondary general and specific criteria related to the four active sections were examined. The number of appropriate samples was calculated for each section, and questionnaires related to general and specific performance evaluation were created and distributed. The language used is clear, concise, and objective, adhering to formal register and avoiding biased or ornamental language. The text is grammatically correct and follows conventional structure, with a logical flow of information and causal connections between statements. Technical terms are explained when first used, and precise word choice is employed where necessary. The text adheres to formatting guidelines and citation style, with quotes clearly marked and filler words avoided. After collecting and analyzing the data from the questionnaires, the employees were evaluated using regular and fuzzy Topsis. The study compared two approaches and found that Fuzzy Topsis was the superior method. The employees underwent two evaluations: one based on general criteria for all employees and another based on specific criteria for employees in their own section. The study revealed that the best or worst employees in their own section were not necessarily the best or worst in the entire organization.</p>
<p>Keywords:            Employees' Performance Evaluation, Performance Management, Performance Evaluation Criteria, Fuzzy TOPSIS, Regular TOPSIS, Decision Making, Rating</p>	

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## 1. INTRODUCTION

Performance evaluation is a crucial issue for organizations and a key aspect of modern management's study of performance management. Baharan Co. conducts employee performance evaluations based on two groups of criteria: general and special. General criteria apply to all employees, while special criteria are specific to employees in certain sections. The evaluation criteria are objective, clearly defined, and ensure fairness and accuracy in the evaluation process. Each employee is rated twice based on two groups of criteria: once with respect to all employees and once with respect to all employees in their own section. This two-dimensional rating process allows for a better evaluation of their performance. One study [1] investigated the impact of customer-perceived control on restaurant employee performance evaluations. The study found that greater perceived control led to a better understanding of the evaluation process by employees. Employee performance evaluation is an important area of research with a significant body of literature. A study by [1] examined the effect of customer-perceived control on evaluations of restaurant employee performance. The study found that employees had a better understanding of the evaluation process when they perceived greater control. The study was conducted twice [1].

Another study [2] examined self-evaluation and performance evaluation, exploring various factors that influence self-evaluation. In their work, [3], a model was presented that incorporates Fuzzy Topsis and Fuzzy AHP to evaluate employees' performance. [4] This study focuses on the influence of employing talented managers and performance evaluation systems on employees' commitment. The authors present a framework to study this issue. [5] At Tehran Oil Refinery Co., researchers investigated the relationship between organizational justice and employees' performance evaluation. [6] Using expert systems, they studied employees' performance evaluation and classified individuals into three groups: good, average, and bad. The paper investigates the relationship between performance evaluation and employee performance improvement. It reviews several studies, including [7], [8], [9], and [10]. The study in [8] evaluates the performance of employees at the National Iranian Oil Refining and Distribution Company in Ahvaz using the Hierarchical Analytic Process. [9] proposes a fuzzy Tree model for evaluating employee performance. [10] examines the impact of employee performance evaluations on performance improvement at Imam Sadeq University. The paper also evaluates the validity of the research.

In their study, [12] examined the relationship between comprehensive quality management and employee empowerment, as well as performance evaluation. Meanwhile, [13] investigated the correlation between employee performance evaluation and satisfaction at Lorestan University of Medical Science using the classic 360-degree feedback method. Furthermore, [14] presented a model for assessing employees who work in hazardous jobs, while [15] conducted a performance evaluation of employees within a particular organization. Lastly, [16] developed an evaluation model based on patterns of organizational performance management.

The main questions of current paper are as follows:

- What Are the General Criteria to Evaluate Employees' Performance?
- What Are the Criteria to Evaluate Employees' Performance in Each Section Alone?
- How Are the Results of Rating Employees Based on General Criteria in The Whole Organization?
- How Are the Results of Rating Employees Based on Special Criteria and With Respect To Other Employees In Their Own Section?

## 2. METHOD

The research is based on survey methodology and is descriptive due to the current time of research and the research topic. The objective of this research is practical usage. The data gathering method is based on previous related research and job descriptions, as well as expert interviews. The data is collected through questionnaires. The method used is fuzzy multi-criteria decision making. The Fuzzy Topsis method was utilized for multi-criteria decision making. This method rates options based on the distance between them and the desired outcome. The data necessary for the research was obtained through field studies, related research, job descriptions, and interviews. Figure 1 displays the research framework.

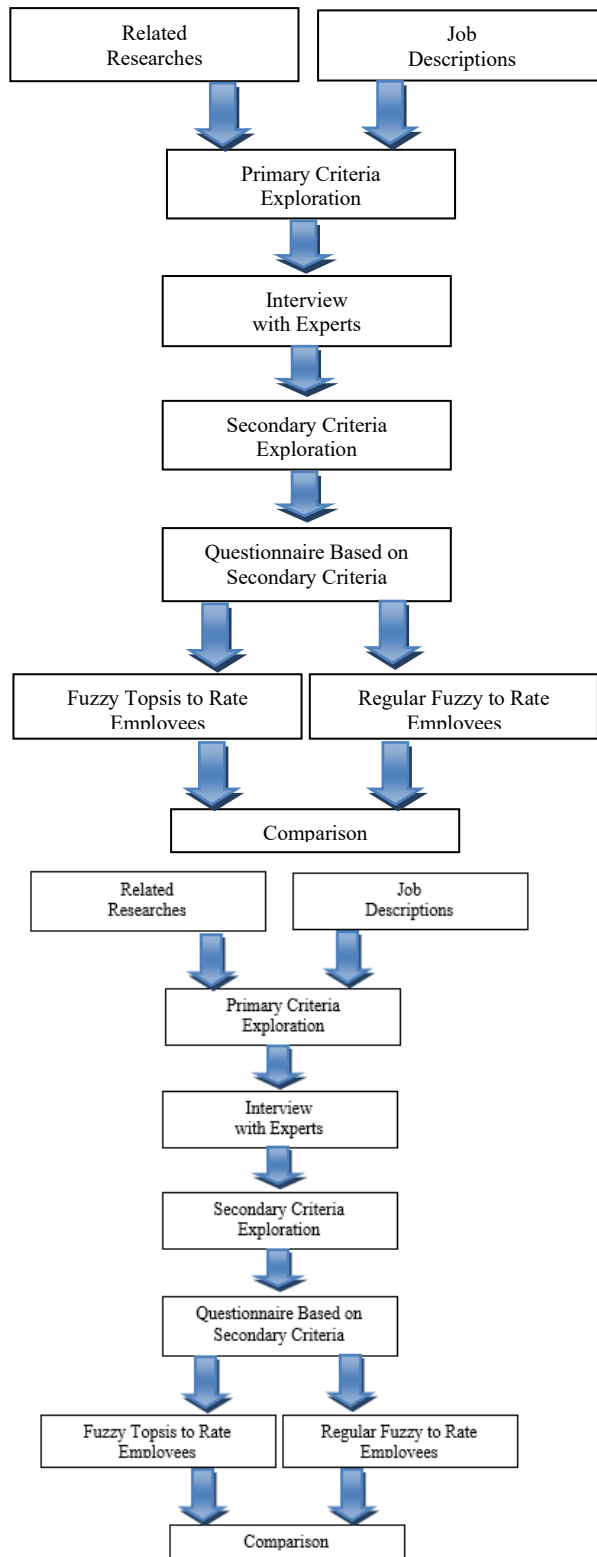


Fig. 1. Research framework

## 2.1. Fuzzy TOPSIS

To solve the fuzzy TOPSIS models It is possible to use the different kinds of fuzzy numbers. The fuzzy TOPSIS method employed in this paper can be arranged as follows:

- Step1. The criteria weighting
- Step2. Decision matrix
- Step3. Fuzzy decision matrix normalization
- Step4. Weighted normalized fuzzy matrix making
- Step5. Computing the distance from optimal point
- Step6. Computing closeness coefficient and rating

## 2.2. Sample

The study community comprises employees of the software development industry in Tehran Science and Technology parks, who work in four different sections. Table 1 provides a summary of the number of samples computed for each section.

**Table 1.** The study community

Number of Members	Section
80	IT and Software
15	Finance
12	Sales and Marketing
12	Project Control
119	Total

## 3. RESULTS

### 2.3. Secondary Criteria

#### 2.3.1. General Secondary Criteria

These criteria are utilized to assess the overall performance of employees in all areas. The criteria were developed based on relevant research, and job descriptions were not necessary for exploring the general criteria due to the variety of research in this area. The collected criteria were then evaluated by experts. After the expert interviews, we analyzed secondary criteria. Table 2 presents the general secondary criteria and their corresponding references.

**Table 2.** General secondary criteria

Criteria
Creativity and Innovation
Job Knowledge
Experimental and Job Skills
Working Quality
Work Discipline
Team Work and Cooperation

2.3.2. Secondary criteria explored for Finance section

These criteria are used to evaluate the performance of employees in the Finance section. These criteria are used to evaluate the performance of employees in the Finance section. The evaluation is based solely on criteria related to this section. Since there is a lack of research on criteria specific to the Finance section, we established primary criteria by using job descriptions, which were then reviewed by experts. Eventually, we identified secondary criteria for this section. It is important to note that these criteria are specific to our company and may not be applicable to others.

**Table 3.** Criteria for finance section

Criteria	Source of Exploration	Resources	Job Description	Interview with Experts
	Familiarity with Computer Programs and Financial Software's	✗	✓	✓
	Providing Financial Reports	✗	✓	✓
	Finding Educational and Specialties Requirements and Notifying Employers	✗	✓	✓
	Actions Related to Loan, Salary Payments, employees' Absence, Presence and Vacations	✗	✓	✓
	Execution of Regulations	✗	✓	✓

2.3.3. Secondary criteria for Sales and Marketing section

These criteria are used to evaluate the performance of employees in the Sales and Marketing section. The evaluation is based solely on the criteria related to this section. The criteria were explored using [17] and job descriptions, and secondary criteria were developed through expert interviews. It is important to note that these criteria may not be suitable for other companies.

**Table 4.** Criteria for Sales and Marketing section

Criteria	Source of Exploration	Resources	Job Description	Interview with Experts
	Communication and Public Relations	✓	✓	✓
	Quality and Speed of Responses	✗	✓	✓
	The Skill of Negotiation and Contract Establishment	✗	✓	✓
	Familiarity and Use of Marketing Systems	✗	✓	✓
	Familiarity with Selling Regulations and Market	✓	✓	✓
	The Activity and Selling Level	✓	✗	✓

2.3.4. Secondary criteria for Control Project section

These criteria are utilized to assess the performance of employees in the Control Project department. The evaluation is solely based on the criteria related to this department. The criteria were examined in [10], and additional criteria were obtained through job descriptions. Secondary criteria were developed through expert interviews. It is important to note that these criteria may not be relevant to other companies.

**Table 5.** Secondary criteria for Control Project Section [10]

Criteria	Source of Exploration	Resources	Job Description	Interview with Experts
Ability of Execution of Project Plan		✗	✓	✓
Ability of Conducting Project and Technical Supervision		✗	✗	✓
Ability to Define the Workspace of Project		✓	✓	✓
Ability to Provide an Accurate Schedule		✓	✓	✓
Ability to Provide A Suitable Cost Allocation Plan		✓	✓	✓
Ability to planning for Activities and Productions		✓	✓	✓
Capability of Analysis of Differences between Performance and Plans		✗	✓	✓

2.3.5. Secondary criteria for IT and Software development section

These criteria are related to the evaluation of employee performance in the IT and Software Development section. Only criteria related to this section are used to evaluate employees active in this section. The criteria were explored using [4] and [8], and additional criteria were obtained through job descriptions. Finally, secondary criteria were developed through expert interviews. It should be noted that these criteria may not be suitable for other companies due to localization.

**Table 6.** Secondary criteria for IT and Software development section [4],[8]

Criteria	Source of Exploration	Resources	Job Description	Interview with Experts
Level of Familiarity with Programming Languages		✓	✓	✓
Familiarity with Computer Networks		✗	✓	✓
Familiarity with ICT		✗	✓	✓
Level of Using New Technologies		✗	✓	✓
Software Debugging		✗	✓	✓
Complex Problem Solving		✓	✗	✓
Data Clustering		✓	✗	✓

2.4. Validity and Reliability of Questionnaires

After examining secondary criteria, we developed questionnaires. To validate them, we distributed the questionnaires to four experts. To confirm their reliability, we used Cronbach's alpha. Table 7 displays the results of Cronbach's alpha for the questionnaires. All of the results were above 0.7, indicating that the questionnaires passed the Cronbach's alpha test and are at a good level of reliability.

**Table 7.** Cronbach’s Alpha tests for questionnaires

Questionnaire	Cronbach’s Alpha
General Criteria	0.821
Finance	0.812
Sales and Marketing	0.784
IT and Software Development	0.795
Project Control	0.774

### 2.5. The results of employees rating

The table below shows the symbols for employees.

**Table 8.** Symbols for each section

Symbol	Number of Employees	Section
$A_i \ i = 1, 2, \dots, 80$	80	IT and Software Development
$B_i \ i = 1, 2, \dots, 15$	15	Finance
$C_i \ i = 1, 2, \dots, 12$	12	Sales and Marketing
$D_i \ i = 1, 2, \dots, 12$	12	Project Control

### 2.6. Rating employees based on Regular and TOPSIS fuzzy

The employees in different sections were evaluated based on specific criteria within their own section, as well as general criteria across the entire organization.

### 2.7. Closeness coefficient computation

This paper presents a new method for investigating the closeness coefficient between employee ratings and expert judgments. The method involves interviewing five employees from different sections, and their features are presented in Table 9.

**Table 9.** Expert’s features chosen to dedicate the weights

Employee	Education Level	Number of Years at Job	Section
E <sub>1</sub>	MS	9	IT and Software
E <sub>2</sub>	BS	15	IT and Software
E <sub>3</sub>	PhD	12	Sales and Marketing
E <sub>4</sub>	PhD	11	Project Control
E <sub>5</sub>	MS	14	Finance

Weights dedicated to general and special criteria by these employees were shown in table 10.

**Table 10.** Weights dedicated by experts

	Employee	E <sub>1</sub>	E <sub>2</sub>	E <sub>3</sub>	E <sub>4</sub>	E <sub>5</sub>
	Finance	0.9	0.95	0.7	0.8	0.75
	IT and Software	0.6	0.9	0.85	0.95	0.75
	Sales and Marketing	0.8	0.65	0.6	0.85	0.95
	Control Project	0.8	0.75	0.75	0.9	0.5
	General	0.85	0.7	0.8	0.9	0.7
	Finance	0.8	0.9	0.75	0.75	0.7
	IT and Software	0.7	0.7	0.8	0.9	0.7
	Sales and Marketing	0.75	0.65	0.65	0.7	0.8
	Control Project	0.7	0.75	0.75	0.7	0.6
	General	0.8	0.65	0.75	0.7	0.7

This paper presents a new method for investigating the closeness coefficient between employee ratings and expert judgments. The final weight for each rating is shown by  $\alpha_j$ , which is the average of the five employees' dedicated weights.

**Table 11.** Final weights computed to rate using fuzzy TOPSIS

Final Weight	Symbol	Value
General final weights	$\alpha_1$	0.79
Final weights for IT & Software	$\alpha_2$	0.81
Final weights for Sales & Marketing	$\alpha_3$	0.77
Final weights for Finance	$\alpha_4$	0.82
Final weights for Control Project	$\alpha_5$	0.74

Table 11 shows that the ratings achieved using fuzzy TOPSIS were closest to the expected results for employees in the Finance section, according to five experts. However, the results for employees in the Control project section were farthest from the expected results.

**Table 12.** Final weights computed to rate using Regular TOPSIS

Final Weight	Symbol	Value
General final weights	$\alpha_1$	0.72
Final weights for IT & Software	$\alpha_2$	0.76
Final weights for Sales & Marketing	$\alpha_3$	0.71
Final weights for Finance	$\alpha_4$	0.78
Final weights for Control Project	$\alpha_5$	0.7

Based on the experts' expectations, the results for the Finance section are the most reliable, while the results for the Control Project section are the least reliable. The Fuzzy TOPSIS method produced the same results as the experts'. To compare the regular fuzzy and TOPSIS methods, a parameter A was defined as follows:

$$A = \sum_{i=1}^5 \alpha_i \tag{1}$$

The more the A the more reliable the method used is. table shows the parameter value for regular fuzzy and Topsis based on tables 11 and 12.

**Table 13.** Validation of Regular and Fuzzy Topsis

Method	Regular Topsis	Fuzzy Topsis
A	3.67	3.97

The results from Topsis are more reliable and can be used to rate employees in the software development industry.

#### 4. CONCLUSION

This paper examines the evaluation of employees using general and specific criteria. The results indicate that an individual's rank based on general criteria may not correspond with their rank based on specific criteria within their own section. As a result, an individual may have a higher rank based on general criteria but a lower rank within their own section. Therefore, the employees have been divided into four groups: those who have received high ratings both generally and specifically, those who have not received high ratings, those who have received high ratings generally but not in their own sections, and those who have received high ratings specifically but not in the overall organization.

#### CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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