Using an Integrated Consistent Fuzzy Preference Relations and Interval Type-2 Fuzzy Topsis Methodology for Personnel Selection and Promotion

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Abstract: - Promotion is an organizational procedure. Education, experience, and personal qualities are crucial requirements for individuals to be promoted. Their characteristics determine the promotion-eligible employee's approach to the job and compatibility with coworkers. This research employs an integrated Consistent Fuzzy Preference Relations (CFPR) - Interval Type-2 (IT2) Fuzzy TOPSIS methodology to identify the most competent individuals for promotion. Using this methodology, the ranking of individuals for a case study in Turkey is calculated. The CFPR technique calculates the weight of the criteria stated by experts in our most recent research [1]. Then, the IT2 Fuzzy TOPSIS method is used to determine the order of options using IT2 trapezoidal fuzzy numbers. Thus, the best competent candidate for promotion is selected. Thus, managers and human resources departments may assess and promote employees rapidly.

Key-Words: - Personnel Selection, Personnel Promotion, Fuzzy Logic, Multi Criteria Decision Making (MCDM), Consistent Fuzzy Preference Relations (CFPR), Interval Type-2 Fuzzy TOPSIS.

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1 Introduction and Literature Review

Personnel selection is one of the most significant factors in the business process. For an enterprise to carry out its business and eliminate the lack of personnel in places where it is disrupted, personnel selection tries to fill that gap by choosing the most experienced, talented, and qualified people who are most suitable for that job or position.

Multi-criteria decision-making (MCDM) [2] refers to selecting or ranking options from a collection of accessible alternatives according to numerous criteria. The MCDM methodology is utilized for staff selection procedures. This research tries to determine the best candidate for advancement inside a company. The criteria for staff selection are derived from our most current study [1]. Consequently, the problem of people selection is improved for this investigation. Then, the IT2 Fuzzy Topsis methodology is utilized to choose the most qualified employees. Numerous research on staff selection is available in the literature [3-11].

Zadeh [12] presented Type-2 fuzzy sets (T2 FSs). T2 FSs are an expansion of a standard fuzzy set known as a Type-1 fuzzy set (T1 FS). The T2 FS method represents uncertainty with greater flexibility than T1 FS. In addition, uncertainty may be adequately modeled with a T2 FS [13]. MCDM methods are very important for decision making problems. Many selection problems are solved by MCDM methods. There are many studies in the literature using MCDM methods [14-21].

The CFPR discovered by [22] simplifies pairwise comparison. Numerous research on the CFPR approach has been published. Patel et al. [23] assessed risks using the CFPR approach. Lu et al. [24] utilized CFPR for the Korean LNG Bunkering Port site selection. Ozdemir et al. [25] analyzed campus components using CFPR and FANP techniques by inclusive design principles. Ozdemir and Nalbant [9] combined the CFPR and FAHP selection procedures.

Numerous research on the Fuzzy TOPSIS approach using IT2 FSs may be found in the literature. Chen and Lee [26] introduced an IT2 Fuzzy TOPSIS technique for dealing with fuzzy multiple-attribute group decision-making issues based on IT2 FSs. Dymova et al. [27] created an IT2-fuzzy modification of the TOPSIS approach using -cuts to express IT2-fuzzy values. Liao [28] suggested two novel TOPSIS material selection techniques based on IT2 FSs. Buyukozkan et al. [29] established a group decision framework for assessing and selecting an appropriate knowledge management solution based on the IT2 fuzzy TOPSIS technique. Yildiz [30] used IT2 fuzzy TOPSIS to choose the best vendor. Toklu [31] created a model that uses the IT2 Fuzzy TOPSIS approach to find the best suitable calibration source. Alaoui et al. [32] suggested an IT2-fuzzy TOPSIS-based solution for agriculture MCDM issues. Zhang et al. [33] created an IT2 Fuzzy TOPSIS method with a utility function and employed it to assess the operational risk of a subway station. Bera et al. [34] established a framework for selecting potential suppliers using the IT2 Fuzzy TOPSIS approach. Ozdemir et al. [35] present a novel hybrid model based on IT2 Fuzzy Analytic Network Process (FANP) and IT2 Fuzzy TOPSIS for evaluating store layout options generated using a ruled-based design technique.

In the Section 2, the integrated CFPR-IT2 Fuzzy TOPSIS methodology is explained. In Section 3, personnel selection problem is defined and the integrated technique is applied to personnel selection problem. The evaluation of the results is given in Section 4.

2 Integrated CFPR - Interval Type-2 Fuzzy Topsis Methodology

Lee and Chen [36] introduced an approach known as IT2 Fuzzy TOPSIS. Lee and Chen [36] defined ranking values of trapezoidal IT2 FSs.

$\tilde{\tilde{A}}_i$ is the IT2 FS that can be seen in Figure 1 and is shown as:

$$\tilde{\tilde{A}}_i = \left(\tilde{A}_i^U; \tilde{A}_i^L\right) = \begin{pmatrix} \left(a_{i1}^U, a_{i2}^U, a_{i3}^U, a_{i4}^U; H_1\left(\tilde{A}_i^U\right), H_2\left(\tilde{A}_i^U\right)\right), \\ \left(a_{i1}^L, a_{i2}^L, a_{i3}^L, a_{i4}^L; H_1\left(\tilde{A}_i^L\right), H_2\left(\tilde{A}_i^L\right)\right) \end{pmatrix}.$$

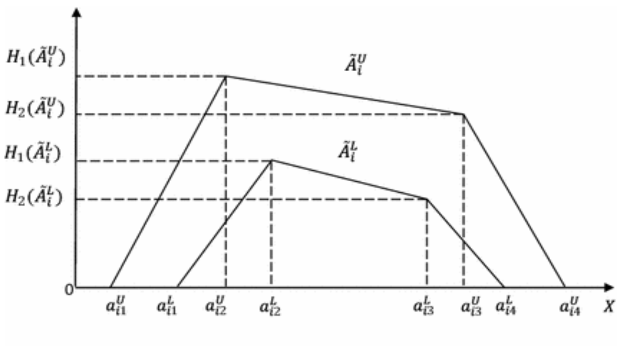

Figure 1. The membership functions of the IT2 FS $\tilde{\tilde{A}}$ [37].

The ranking value $\mathrm{Rank}\left(\tilde{\tilde{A}}_i\right)$ of the IT2 FS $\tilde{\tilde{A}}_i$ is shown below [26, 31, 36].

$$\begin{aligned} Rank\left(\tilde{\tilde{A}}_i\right) = {} & M_1\left(\tilde{A}_i^U\right) + M_1\left(\tilde{A}_i^L\right) + M_2\left(\tilde{A}_i^U\right) \\ & + M_2\left(\tilde{A}_i^L\right) + M_3\left(\tilde{A}_i^U\right) + M_3\left(\tilde{A}_i^L\right) \\ & - \frac{1}{4}\Big(s_1\left(\tilde{A}_i^U\right) + s_1\left(\tilde{A}_i^L\right) \\ & + s_2\left(\tilde{A}_i^U\right) + s_2\left(\tilde{A}_i^L\right) + s_3\left(\tilde{A}_i^U\right) \\ & + s_3\left(\tilde{A}_i^L\right) + s_4\left(\tilde{A}_i^U\right) + s_4\left(\tilde{A}_i^L\right)\Big) \\ & + H_1\left(\tilde{A}_i^U\right) + H_1\left(\tilde{A}_i^L\right) + H_2\left(\tilde{A}_i^U\right) \\ & + H_2\left(\tilde{A}_i^L\right) \end{aligned} \quad (1)$$

$M_p\left(\tilde{A}_i^j\right)$ is the average of the elements a_{ip}^j and $a_{i(p+1)}^j$, $M_p\left(\tilde{A}_i^j\right) = \left(a_{ip}^j + a_{i(p+1)}^j\right)/2$, $1 \le p \le 3$,

$S_q\left(\tilde{A}_i^j\right)$ is the standard deviation of the elements a_{iq}^j and $a_{i(q+1)}^j$,

$S_q\left(\tilde{A}_i^j\right) = \sqrt{\frac{1}{2}\sum_{k=q}^{q+1}\left(a_{ik}^j - \frac{1}{2}\sum_{k=q}^{q+1} a_{ik}^j\right)^2}$, $1 \le q \le 3$,

$S_4\left(\tilde{A}_i^j\right)$ is the standard deviation of the elements a_{i1}^j, a_{i2}^j, a_{i3}^j, a_{i4}^j,

$S_4\left(\tilde{A}_i^j\right) = \sqrt{\frac{1}{4}\sum_{k=1}^{4}\left(a_{ik}^j - \frac{1}{4}\sum_{k=1}^{4} a_{ik}^j\right)^2}$,

$H_p\left(\tilde{A}_i^j\right)$ is the membership value of the element $a_{i(p+1)}^j$ in the trapezoidal membership function $\tilde{A}_i^j$, $1 \le p \le 2$, $j \in \{U, L\}$, and $1 \le i \le n$.

In (1), the summation of $M_1\left(\tilde{A}_i^U\right), M_1\left(\tilde{A}_i^L\right), M_2\left(\tilde{A}_i^U\right), M_2\left(\tilde{A}_i^L\right), M_3\left(\tilde{A}_i^U\right)$, $M_3\left(\tilde{A}_i^L\right), H_1\left(\tilde{A}_i^U\right), H_1\left(\tilde{A}_i^L\right), H_2\left(\tilde{A}_i^U\right)$ and $H_2\left(\tilde{A}_i^L\right)$ is called the basic ranking score, where deducting the average of $s_1\left(\tilde{A}_i^U\right), s_1\left(\tilde{A}_i^L\right), s_2\left(\tilde{A}_i^U\right), s_2\left(\tilde{A}_i^L\right), s_3\left(\tilde{A}_i^U\right), s_3\left(\tilde{A}_i^L\right)$, $s_4\left(\tilde{A}_i^U\right)$ and $s_4\left(\tilde{A}_i^L\right)$ from the basic ranking score gives the dispersive IT2 Fuzzy set a penalty, where $1 \le \mathrm{i} \le \mathrm{n}$.

Alternatives $X = \{x_1, x_2, \ldots, x_n\}$, n denotes the number of alternatives.
Attributes $F = \{f_1, f_2, \ldots, f_m\}$, m denotes the number of attributes.

$F1$ (for benefit) and $F2$ (for cost)

$F1 \cap F2 = \Phi$ and $F1 \cup F2 = F$.

Decision-makers $D_1, D_2, \ldots, D_k$, k denotes the number of decision-makers.

The linguistic variables and their trapezoidal IT2 fuzzy scales of importance are listed in Table 1 [38].

Table 1. Linguistic terms [38].

Linguistic Terms	Trapezoidal IT2 fuzzy scales
Low (L)	(0,0.1,0.1,0.3;1,1) (0.05,0.1,0.1,0.2;0.9,0.9)
High (H)	(0.7,0.9,0.9,1;1,1) (0.8,0.9,0.9,0.95;0.9,0.9)
Medium (M)	(0.3,0.5,0.5,0.7;1,1) (0.4,0.5,0.5,0.6;0.9,0.9)
Medium High (MH)	(0.5,0.7,0.7,0.9;1,1) (0.6,0.7,0.7,0.8;0.9,0.9)
Medium Low (ML)	(0.1,0.3,0.3,0.5;1,1) (0.2,0.3,0.3,0.4;0.9,0.9)
Very High (VH)	(0.9,1,1,1;1,1) (0.95,1,1,1;0.9,0.9)
Very Low (VL)	(0,0,0,0.1;1,1) (0,0,0,0.05;0.9,0.9)

The methodological flow of the integrated CFPR-IT2 Fuzzy TOPSIS is explained below [9, 31, 39]:

Step 1. Define the problem and decide its purpose in light of that definition. Identify the model's primary criteria, subcriteria, and alternatives.

Step 2. Comparison. Develop pairwise comparison matrices based on the criteria. The decision-makers give pairwise comparisons for n-1 preference values.

Step 3. Transformation. Transform the preference value $a_{ij} \in \left[\frac{1}{9}, 9\right]$ into $p_{ij} \in [0,1]$ through (2).

$$p_{ij} = \frac{1}{2} \times (1 + log_9\, a_{ij}) \qquad (2)$$

Then, calculate the remaining p_{ij}^k by using (3), (4) and (5).

$$p_{ij} + p_{ji} = 1 \qquad (3)$$

$$p_{ji} = \frac{j-i+1}{2} - p_{i(i+1)} - p_{i+1(i+2)} - \cdots - p_{j-1(j)} \qquad (4)$$

$$p_{ij} + p_{jk} + p_{ki} = \frac{3}{2} \qquad (5)$$

This preference matrix may include values from the interval [-a, 1+a] instead of the interval [0, 1]. To maintain reciprocity in this circumstance, a transformation function is employed. Finding the transformation by (6).

$$f(p_{ij}) = \frac{p_{ij} + a}{1 + 2a} \qquad (6)$$

Here, a represents the absolute lowest value in this preference matrix. Similarly, fuzzy preference relation matrices are created for all decision-makers.

Step 4. Aggregation. Aggregate the fuzzy preference relation matrices to get the selection criteria's important weights. Let p_{ij}^k denote the transformed fuzzy preference value of the k -th decision maker for criteria i and criteria$j$. To incorporate the opinions of m decision-makers, the average value approach (7) is utilized. m represents the total amount of decision-makers.

$$p_{ij} = \frac{1}{m}(p_{ij}^1 + p_{ij}^2 + \cdots + p_{ij}^m), \quad k = 1,2,\ldots,m \quad (7)$$

Step 5. Normalization. Normalize the aggregated fuzzy related preference matrices. h_{ij} represents each criterion's normalized fuzzy preference value in (8), and the normalized fuzzy preference relation matrix is determined.

$$h_{ij} = \frac{p_{ij}}{\sum_{i=1}^{n} p_{ij}} \quad i,j = 1,2,\ldots,n \qquad (8)$$

Calculate the importance weight of each criteria (9).

$$w = \frac{1}{n}\sum_{j=1}^{n} h_{ij} \qquad (9)$$

Step 6. Build the decision matrix Y_p of the pth decision-maker and obtain the average decision matrix ($\bar{Y}$);

$$Y_p = \tilde{\tilde{f}}_{ij\,mxn}^{p} = \begin{bmatrix} \tilde{\tilde{f}}_{11}^p & \tilde{\tilde{f}}_{12}^p & \cdots & \tilde{\tilde{f}}_{1n}^p \\ \tilde{\tilde{f}}_{21}^p & \tilde{\tilde{f}}_{22}^p & \cdots & \tilde{\tilde{f}}_{2n}^p \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{\tilde{f}}_{m1}^p & \tilde{\tilde{f}}_{m2}^p & \cdots & \tilde{\tilde{f}}_{mn}^p \end{bmatrix}$$

$$\bar{Y} = \left(\tilde{\tilde{f}}_{ij}\right)_{mxn}$$

where $\tilde{\tilde{f}}_{ij} = \left(\frac{\tilde{\tilde{f}}_{ij}^1 \oplus \tilde{\tilde{f}}_{ij}^2 \oplus \ldots \oplus \tilde{\tilde{f}}_{ij}^k}{k}\right)$, $\tilde{\tilde{f}}_{ij}$ is an IT2 FS,

$1 \le p \le k, 1 \le i \le m, 1 \le j \le n.$

Step 7. Retrieve the average weighting matrix from the CFPR technique in Step 7.

Step 8. Find the weighted decision matrix as:

$$\bar{Y}_w = \left(\tilde{\tilde{v}}_{ij}\right)_{m\times n} = \begin{bmatrix} \tilde{\tilde{v}}_{11} & \tilde{\tilde{v}}_{12} & \cdots & \tilde{\tilde{v}}_{1n} \\ \tilde{\tilde{v}}_{21} & \tilde{\tilde{v}}_{22} & \cdots & \tilde{\tilde{v}}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{\tilde{v}}_{m1} & \tilde{\tilde{v}}_{m2} & \cdots & \tilde{\tilde{v}}_{mm} \end{bmatrix} \tilde{\tilde{V}}_{ij},$$

$1 \le i \le m$ and $1 \le j \le n$.

Step 9. The ranking value $\mathrm{Rank}(\tilde{\tilde{v}}_{ij})$ of the IT2 FS $\tilde{\tilde{v}}_{ij}$ is computed where $1 \le j \le n$ by using (1), $\bar{Y}_w^* = \left(Rank(\tilde{\tilde{v}}_{ij})\right)_{m \times n}, 1 \le j \le n, 1 \le i \le m.$

Step 10. The positive ideal solution (PIS) $x^+ = (v_1^+, v_2^+, \dots, v_m^+)$ and the negative ideal solution (NIS) $x^- = (v_1^-, v_2^-, \dots, v_m^-)$ are calculated as:

$$v_1^+ = \begin{cases} \max\limits_{1 \le j \le n} \{Rank(\tilde{\tilde{v}}_{ij})\}, & f_i \in F_1 \\ \min\limits_{1 \le j \le n} \{Rank(\tilde{\tilde{v}}_{ij})\}, & f_i \in F_2 \end{cases}$$

$$v_1^- = \begin{cases} \min\limits_{1 \le j \le n} \{Rank(\tilde{\tilde{v}}_{ij})\}, & f_i \in F_1 \\ \max\limits_{1 \le j \le n} \{Rank(\tilde{\tilde{v}}_{ij})\}, & f_i \in F_2 \end{cases}$$

Step 11. Compute the distance $d^+(x_j)$ among each alternative x_j and the PIS x^+ and the distance $d^-(x_j)$ among each alternative x_j and the NIS x^- as:

$$d^+(x_j) = \sqrt{\sum_{i=1}^{m} \left(Rank(\tilde{\tilde{v}}_{ij}) - v_i^+\right)^2}$$

$$d^-(x_j) = \sqrt{\sum_{i=1}^{m} \left(Rank(\tilde{\tilde{v}}_{ij}) - v_i^-\right)^2}$$

for $1 \le j \le n$.

Step 12. Calculate the closeness coefficient $CC(x_j)$:

$$CC(x_j) = \frac{d^-(x_j)}{d^+(x_j) + d^-(x_j)}$$

Select the best alternative.

The methodological flow diagram is shown in Figure 2 [30, 39].

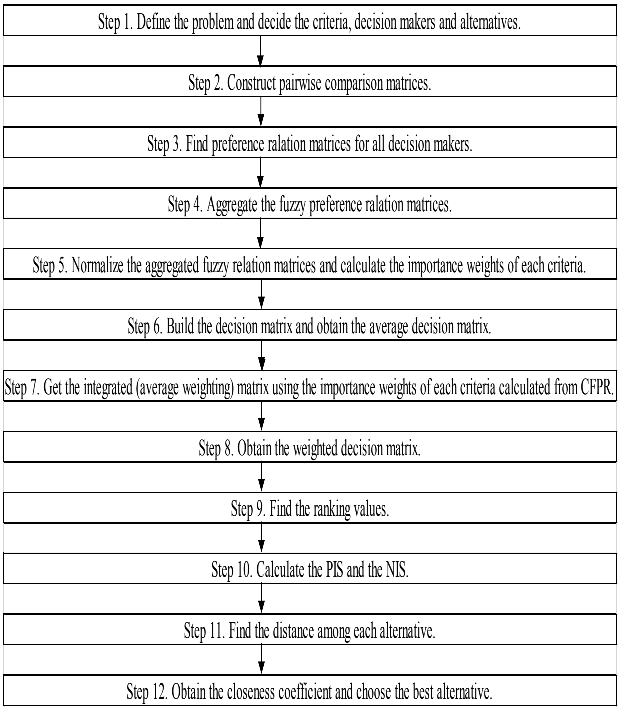

Figure 2. The flow diagram of the application of hybrid CFPR-IT2 Fuzzy TOPSIS methodology.

3 Problem Definition and Application

In this section, we studied for selecting the personnel applying integrated CFPR-IT2 Fuzzy TOPSIS methodology. The problem of personnel selection for a company in Istanbul, Turkey, was selected for this study. The company intends to promote one of the engineers to chief engineer. We questioned three decision-makers from the institution and the company. Five main criteria and 22 sub-criteria were determined based on the opinions of academicians and business managers, as indicated in Table 2 [1]. In this new problem, 5 personnel were determined according to the managers. One of them will be promoted.

Table 2. Personnel selection criteria[1].

Main Criteria		Subcriteria	
MC1	ACTIVITY	SC11	Productive Activity
		SC12	Auxiliary Activity
		SC13	Inefficient Activity
MC2	FEE	SC21	Fee Paid
		SC22	Payable Fee
		SC23	Requested Fee
MC3	EDUCATION	SC31	Education Status
		SC32	Foreign Languages
		SC33	Certificates
		SC34	Job Experience
		SC35	Technology Usage
		SC36	Lifelong Learning
MC4	INTERNAL FACTORS	SC41	Self-Confidence
		SC42	Take Initiative
		SC43	Analytic Thinking
		SC44	Leadership
		SC45	Productivity
		SC46	Decision Making / Problem Solving
MC5	BUSINESS FACTORS	SC51	Compatible with the Team / Communication
		SC52	Teamwork Skills
		SC53	Finishing Work on Time
		SC54	Business Discipline

The average weighting matrix was taken from our previous study in Table 3 [1].

Table 3. Importance weights of subcriteria.

Main-criteria	Weight	Subcriteria	Weight
MC1	0.292	SC11	0.388
		SC12	0.337
		SC13	0.275
MC2	0.153	SC21	0.288
		SC22	0.346
		SC23	0.366
MC3	0.180	SC31	0.197
		SC32	0.208
		SC33	0.116
		SC34	0.183
		SC35	0.138
		SC36	0.158
MC4	0.256	SC41	0.096
		SC42	0.167

Main-criteria	Weight	Subcriteria	Weight
		SC43	0.234
		SC44	0.155
		SC45	0.167
		SC46	0.181
MC5	0.119	SC51	0.287
		SC52	0.289
		SC53	0.148
		SC54	0.276

To determine the ranking of options using the IT2 Fuzzy TOPSIS approach, the weighted decision matrix shown in Table 4 is first computed. v11, v12, v13, v14 and v15 denote the weights of Alternatives A1, A2, A3, A4, A5 according to the subcriteria SC11; v21, v22, v23, v24 and v25 denote the weights of Alternatives A1, A2, A3, A4 and A5 according to the subcriteria SC12, and so on. Since the table is very large, only the sub-criteria values of 2 main criteria are given in the Table 4.

Table 4. Weighted decision matrix.

	U						L					
v11	0.004	0.015	0.015	0.034	1	1	0.009	0.015	0.015	0.025	0.9	0.9
v12	0.015	0.034	0.034	0.057	1	1	0.025	0.034	0.034	0.045	0.9	0.9
v13	0.079	0.098	0.098	0.110	1	1	0.089	0.098	0.098	0.104	0.9	0.9
v14	0.057	0.079	0.079	0.098	1	1	0.068	0.079	0.079	0.089	0.9	0.9
v15	0.079	0.098	0.098	0.110	1	1	0.089	0.098	0.098	0.104	0.9	0.9
v21	0.036	0.056	0.056	0.075	1	1	0.046	0.056	0.056	0.066	0.9	0.9
v22	0.016	0.036	0.036	0.056	1	1	0.026	0.036	0.036	0.046	0.9	0.9
v23	0.043	0.062	0.062	0.079	1	1	0.052	0.062	0.062	0.070	0.9	0.9
v24	0.062	0.082	0.082	0.095	1	1	0.072	0.082	0.082	0.089	0.9	0.9
v25	0.062	0.082	0.082	0.095	1	1	0.072	0.082	0.082	0.089	0.9	0.9
v31	0.005	0.019	0.019	0.035	1	1	0.012	0.019	0.019	0.027	0.9	0.9
v32	0.024	0.040	0.040	0.056	1	1	0.032	0.040	0.040	0.048	0.9	0.9
v33	0.051	0.067	0.067	0.078	1	1	0.059	0.067	0.067	0.072	0.9	0.9
v34	0.024	0.040	0.040	0.056	1	1	0.032	0.040	0.040	0.048	0.9	0.9
v35	0.040	0.056	0.056	0.070	1	1	0.048	0.056	0.056	0.063	0.9	0.9
v41	0.006	0.013	0.013	0.022	1	1	0.010	0.013	0.013	0.018	0.9	0.9
v42	0.019	0.028	0.028	0.037	1	1	0.023	0.028	0.028	0.032	0.9	0.9
v43	0.034	0.041	0.041	0.044	1	1	0.037	0.041	0.041	0.043	0.9	0.9
v44	0.031	0.038	0.038	0.043	1	1	0.034	0.038	0.038	0.040	0.9	0.9
v45	0.022	0.031	0.031	0.038	1	1	0.026	0.031	0.031	0.034	0.9	0.9
v51	0.007	0.016	0.016	0.026	1	1	0.011	0.016	0.016	0.021	0.9	0.9
v52	0.016	0.026	0.026	0.037	1	1	0.021	0.026	0.026	0.032	0.9	0.9
v53	0.041	0.049	0.049	0.053	1	1	0.045	0.049	0.049	0.051	0.9	0.9
v54	0.023	0.034	0.034	0.044	1	1	0.028	0.034	0.034	0.039	0.9	0.9
v55	0.037	0.046	0.046	0.051	1	1	0.041	0.046	0.046	0.049	0.9	0.9
v61	0.028	0.039	0.039	0.048	1	1	0.034	0.039	0.039	0.044	0.9	0.9
v62	0.017	0.028	0.028	0.039	1	1	0.022	0.028	0.028	0.034	0.9	0.9
v63	0.024	0.035	0.035	0.045	1	1	0.030	0.035	0.035	0.040	0.9	0.9
v64	0.013	0.024	0.024	0.035	1	1	0.019	0.024	0.024	0.030	0.9	0.9
v65	0.035	0.047	0.047	0.054	1	1	0.041	0.047	0.047	0.050	0.9	0.9

Then, the ranking weighted decision matrix is shown in Table 5.

Table 5. Ranking weighted decision matrix.

	A1	A2	A3	A4	A5
SC11	3.887	3.994	4.374	4.260	4.374
SC12	4.122	4.004	4.160	4.276	4.276
SC13	3.905	4.031	4.189	4.031	4.126
SC21	3.875	3.962	4.040	4.023	3.979
SC22	3.890	3.952	4.088	3.994	4.068
SC23	4.027	3.961	4.005	3.938	4.071
SC31	3.875	3.860	3.993	3.860	4.001
SC32	3.808	3.908	4.004	3.908	4.013
SC33	3.808	3.843	3.901	3.852	3.901
SC34	3.895	3.881	3.979	3.868	3.979
SC35	3.810	3.871	3.935	3.842	3.941
SC36	3.882	3.837	3.955	3.859	3.955
SC41	3.871	3.832	3.934	3.851	3.934
SC42	3.873	4.043	3.890	4.007	4.043
SC43	3.996	4.127	3.948	4.067	4.140
SC44	3.868	3.882	4.034	3.945	4.008
SC45	3.940	4.034	3.906	3.957	3.975
SC46	3.844	3.970	4.025	3.915	4.063
SC51	3.845	3.938	3.986	3.832	3.925
SC52	3.871	3.832	3.994	3.925	3.994
SC53	3.858	3.896	3.872	3.851	3.892
SC54	3.907	3.946	3.920	3.978	3.986

The positive ideal solution (PIS) $x^+ = (v_1^+, v_2^+, \dots, v_m^+)$ and the negative ideal solution (NIS) $x^- = (v_1^-, v_2^-, \dots, v_m^-)$ are calculated as seen in Table 6.

Table 6. Positive and negative ideal solution.

Positive ideal solution	Negative ideal solution
4.374	3.887
4.276	4.004
4.189	3.905
4.040	3.875
4.088	3.890
4.071	3.961
4.001	3.860
4.013	3.808
3.901	3.808
3.979	3.868
3.941	3.810
3.955	3.837
3.934	3.832
4.043	3.873
4.140	3.948
4.034	3.868
4.034	3.906
4.063	3.844
3.986	3.832
3.994	3.832
3.896	3.851
3.986	3.907

The distance $d^+(x_j)$ among each alternative x_j and the PIS x^+ and the distance $d^-(x_j)$ among each alternative x_j and the NIS x^- are as seen in Table 7.

Table 7. The distance $d^+(x_j)$ and the distance $d^-(x_j)$.

d+				
A1	A2	A3	A4	A5
0.829	0.645	0.317	0.457	0.127
d-				
A1	A2	A3	A4	A5
0.167	0.402	0.799	0.580	0.848

The closeness coefficient $CC(x_j)$ is determined as seen on Table 8.

Table 8. The weights and the normalized values.

	Weights	Normalized Values
CC(A1)	0.168	6.22%
CC(A2)	0.384	14.24%
CC(A3)	0.716	26.54%
CC(A4)	0.559	20.74%
CC(A5)	0.870	32.26%
Total	2.696	100.00%

According to Table 8, the alternative weights determined using a hybrid CFPR–IT2 Fuzzy TOPSIS approach are 0.168, 0.384, 0.716, 0.559, and 0.888. This indicates that the sequence is A5, A3, A4, A2, and A1 from most significant to worst.

4 Conclusion

One of the most significant aspects of organizations is the choice of their workforce. Businesses should be able to select the right personnel for an open position, taking into account the criteria for personnel selection. The quality, quantity and suitability of the personnel, which is the most important element of a business, plays an active role in the success of that business. Personnel selection problem is a very important MCDM problem for businesses. In this study, the problem of choosing a person to be promoted from 5 alternatives for a company is discussed.

This study aims to pick the most qualified employees utilizing an integrated CFPR-IT2 Fuzzy TOPSIS technique. As determined by the evaluation procedure, the employees are ranked as follows: A5>A3>A4>A2>A1, followed by the rest. Consequently, selecting Alternative A5 for the promotion is the most reasonable option.

When it comes to resolving issues with employee selection, MCDM procedures provide a great deal of convenience. In terms of work that will be done in the future, the problem may be solved using several MCDM approaches.

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Contribution of individual authors to the creation of a scientific article (ghostwriting policy)

Kemal Gokhan Nalbant conceived the presented idea. Then, he developed the theory and designed the model and the computational framework. After that, he performed the computations and supervised the findings of this work. Finally, he discussed the results and contributed to the final manuscript.

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