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Blue Collar Personnel Selection for A Manufacturing Company with Fuzzy COPRAS Method Based on Fuzzy PIPRECIA

Bulanık PIPRECIA tabanlı bulanık COPRAS yöntemi ile bir üretim işletmesi için mavi yaka personel seçimi

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Today, the rapid increase in the competitive environment has made it a complex and strategic decision for companies to select the most suitable candidate for personnel recruitment. For this reason, using Multi-Criteria Decision Making (MCDM) methods in this decision problem will provide a quick result. Due to the uncertainty of the criteria, fuzzy PIPRECIA and fuzzy COPRAS methods, which are fuzzy MCDM methods, were used together in the study in order to achieve more effective results. For the evaluation of the criteria and alternatives, three decision makers consisting of HR manager, production manager and shift supervisor were identified. The weights of the six criteria created by utilizing the three decision makers and the literature were calculated with the fuzzy PIPRECIA method and five alternatives were ranked with the fuzzy COPRAS method. Candidates were interviewed through online interviews, which is a common practice today. The most important criterion was K_5 (professional competence) and the best alternative was A_3. The methods used are unique to the study as they are rarely used together in the literature and have never been used in personnel selection.

Keywords: *Blue Collar Personnel, Online Job Interview, Fuzzy PIPRECIA, Fuzzy COPRAS*

Günümüzde rekabet ortamının hızlı bir şekilde artması şirketlerin personel alımlarınında da stratejik bir karar olmasını sağlamıştır. Alınan personelin iş tecrübesi, yetkinlikleri gibi özellikleri işletmelerin başarısında oldukça önemli rol oynamaktadır. Personel seçiminde en uygun adayı seçmek için birçok kriter altında değerlendirmek karmaşıklık oluşturmaktadır. Bu nedenle bu karar probleminde de Çok Kriterli Karar Verme (ÇKKV) yöntemlerini kullanmak hızlı bir şekilde sonuca ulaşmayı sağlayacaktır. Kriterlerin belirsiz olmasından dolayı daha etkin sonuçlara ulaşmak amacıyla çalışmada bulanık ÇKKV yöntemlerinden bulanık PIPRECIA ve bulanık COPRAS yöntemleri birlikte kullanılmıştır. Kriterlerin ve alternatiflerin değerlendirilmesi için İK sorumlusu, üretim müdürü ve vardiya amirinden oluşan üç karar verici belirlenmiştir. Üç karar vericiden ve literatürden yararlanılarak oluşturulan altı kriterin bulanık PIPRECIA yöntemi ile ağırlıkları hesaplanmış ve bulanık COPRAS yöntemi ile beş alternatif sıralanmıştır. Adayların görüşmesi günümüzde yaygın olarak yapılan online görüşme şeklinde olmuştur. Yapılan işlemler sonucunda en önemli kriter K_5 (mesleki yetkinlik) olurken en iyi alternatif A_3 olmuştur. Kullanılan yöntemler literatürde birlikte kullanımı az olan ve personel seçiminde hiç kullanılmamış olduğundan çalışmaya özgünlük sağlamıştır.

Anahtar Kelimeler: *Mavi Yaka Personel Alımı, Online İş Görüşmesi, Bulanık PIPRECIA, Bulanık COPRAS*

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1. INTRODUCTION

In today's world where global competition is increasing, the most important factor that plays a role in the productivity of businesses is the human factor. Recruitment of qualified personnel is an important process for businesses to achieve their goals (Eroğlu et al., 2014: 2). Qualified personnel's characteristics such as work experience and professional competence are effective in the success of businesses. The aim of personnel recruitment is to determine the most suitable candidate for the position by evaluating the candidates applying for the position under the criteria (Ulutaş, 2019: 1554). Online job interviews, which are common today, are also very effective in finding suitable positions.

As in many decision-making problems, MCDM methods can be used to reach the most appropriate solution in personnel selection. MCDM is used to select, rank, or classify one or more alternatives from alternatives with different characteristics according to criteria with different weights by determining numerous quantitative and qualitative criteria in a decision-making process (Yenilmezel & Ertuğrul, 2022: 252). Fuzzy MCDM methods have emerged due to the inadequacy of MCDM methods in cases of uncertainty. The use of fuzzy MCDM methods in complex real-life problems where information is not certain provides more effective solutions.

In this study, it is aimed to select the most appropriate alternative with the integrated use of Fuzzy PIPRECIA method when selecting blue collar personnel in a manufacturing company. For this purpose, the criteria weighting process was performed with the fuzzy PIPRECIA method, which has recently been introduced to the literature and allows the evaluation of the opinions of different decision makers in an integrated manner with non-complex process steps, and the fuzzy COPRAS method was used to evaluate the alternatives using verbal variables. An important feature of the fuzzy COPRAS method is that the calculated performance index facilitates the comparison between alternatives by expressing the values of the alternatives in percentages (Katrancı & Kundakcı, 2020: 64). The unique aspect of the study is that fuzzy PIPRECIA and fuzzy COPRAS methods are used together for the personnel selection problem.

In the second part of the study, the methods to be used in the study and the literature research on personnel selection, which is the subject to which the methods will be applied, are included. In the third section, information about the fuzzy PIPRECIA and fuzzy COPRAS methods and the process steps of the methods are discussed. In the fourth section, the criteria and alternatives are evaluated with fuzzy PIPRECIA and fuzzy COPRAS methods and the optimal solution is reached. The last section, the conclusion, presents the findings and recommendations of the study.

2. LITERATURE REVIEW

When the literature is examined, there are studies on personnel selection with different MCDM methods. Özkan (2007), personnel selection with AHP, ELECTRE and TOPSIS methods in his master's thesis, Eroğlu et al. (2014), personnel selection with ORESTA method, Erokutan (2016), blue collar personnel selection with Fuzzy TODIM and Fuzzy TOPSIS methods in his master's thesis, Akın (2016), personnel selection with Fuzzy TOPSIS method, Kenger & Organ (2017), bank personnel selection with Entropy-based ARAS method, Akdeniz

(2018), selection of the best employee for a business with AHP method, Ulutaş et al. (2018), personnel selection with Fuzzy AHP and Fuzzy GIA methods, Ulutaş (2019), personnel selection with Entropy and MABAC methods, Ayçin (2020), personnel selection with CRITIC and MAIRCA methods, Vural et al. (2020), personnel selection with AHP and VIKOR methods, İnan & Yüncü (2021), determination of the competencies prioritized in the selection of senior managers in city hotels with AHP method and Ada & Çakır (2022), personnel selection with AHP and TOPSIS methods.

The literature review on Fuzzy PIPRECIA and Fuzzy COPRAS methods used in the study is given in Table 1.

Table 1. Fuzzy PIPRECIA and Fuzzy COPRAS Method literature review

Studies with Fuzzy PIPRECIA Method
• Stanujkic et al. (2017) evaluated SWOT elements for the implementation of barcode technology.
• Đalić et al. (2020) used the Fuzzy PIPRECIA method for green supplier selection.
• Vesković et al. (2020) integrated Fuzzy PIPRECIA and Fuzzy EDAS method in their study to select the best solution for business balance of passenger rail operator.
• Stanković et al. (2020) used Fuzzy PIPRECIA, Fuzzy MARCOS, Fuzzy SAW and Fuzzy TOPSIS methods for risk analysis of road traffic.
• Tomašević et al. (2020) used the Fuzzy PIPRECIA method to evaluate the criteria for information processing systems.
• Blagosević et al. (2020) used Fuzzy PIPRECIA, Entropy and DEA methods in the safety assessment of railway traffic.
• Memiş et al. (2020) provided the prioritization of road transportation risks with the Fuzzy PIPRECIA method.
• Blagosević et al. (2021) integrated Fuzzy PIPRECIA and Fuzzy MARCOS methods to assess the degree of safety at railway crossings to achieve sustainable traffic management.
• Nedeljković et al. (2021) used Fuzzy PIPRECIA and Fuzzy MABAC methods in the evaluation of rapeseed varieties.
• Taş (2021) used Fuzzy PIPRECIA method to determine the site selection criteria for medical waste.
• Arman & Kundakcı (2022) used the Fuzzy PIPRECIA method to evaluate the critical factors affecting the adoption of blockchain technology in the banking industry.
Studies with Fuzzy COPRAS Method
• Çakır & Özdemir (2016) used Fuzzy AHP, Fuzzy VIKOR, Fuzzy TOPSIS and Fuzzy COPRAS methods to select six sigma projects.
• Dhiman & Deb (2020) used Fuzzy TOPSIS and Fuzzy COPRAS methods for wind farms.
• Alkan & Albayrak (2020), Fuzzy Entropy-based Fuzzy COPRAS and Fuzzy MULTIMOORA methods were used to rank renewable energy resources for regions in Turkey.
• Katrancı & Kundakcı (2020) performed cold storage selection with SWARA-based Fuzzy COPRAS method.
• Baki (2021) used the Fuzzy COPRAS method in the site selection of a private hospital.
• Potur & Toptancı (2021) used Fuzzy AHP and Fuzzy COPRAS methods in the evaluation of pain medication.
• Türkmen et al. (2022), SWARA and Fuzzy COPRAS methods were used in supplier selection.

3. METHODOLOGY

Fuzzy PIPRECIA and Fuzzy COPRAS methods were used in an integrated manner in the evaluation of the criteria and alternatives determined for the selection of blue collar personnel in an enterprise. Information about the methods is given in the rest of the study.

3.1. Fuzzy PIPRECIA Method

The PIPRECIA (PIvot Pairwise RElative Criteria Importance Assessment) method developed by Stanujkic et al. (2017) as an extension of the SWARA method proposed by Kersuliene et al. is a MCDM method that allows subjective evaluation of criteria weights. The main advantage of the method over the SWARA method is that it allows the evaluation of criteria without ranking them in order of importance in the case of many criteria and decision makers (Dalic et al., 2020: 127). Instead of preliminary ranking, it considers the step of relative importance being less than, equal to or greater than the importance value of the previous criterion (Özdağoğlu et al., 2021: 272). Nowadays, MCDM problems are usually solved by applying group decision-making method (Stevic et al., 2018: 7). In this case, the PIPRECIA method makes it possible to obtain more accurate and less complex solutions.

Stevic et al. (2018) developed the Fuzzy PIPRECIA method and enabled decision makers to digitize linguistic evaluations in real life problems (Arman & Kundakcı, 2022: 86).

The process steps of the fuzzy PIPRECIA method, which was developed by adding fuzzy sets to the classical PIPRECIA method, consist of 10 steps and are as follows (Stevic et al., 2018: 7-9).

- Step 1. Criteria are determined by the decision-making team. The criteria are ranked regardless of their importance.
- Step 2. Each decision maker evaluates the ranked criteria starting from the second criterion using Equation (1) to determine the relative importance of the criteria.
- $$\begin{Bmatrix} > \bar{l}\; if\; C_j > C_{j-1} \\ = \bar{l}\; if\; C_j = C_{j-1} \\ < \bar{l}\; if\; C_j < C_{j-1} \end{Bmatrix} \quad (1)$$
- $\overline{s_j^r}$, refers to the evaluation of the criteria by decision maker r. Using the arithmetic or geometric mean, the mean of the $\overline{s_j^r}$ matrix is found and the $\overline{s_j^r}$ matrix is obtained. Table 2 and Table 3 are used to evaluate the criteria. Table 2 is used when the criterion is more important than the previous criterion, while Table 3 is used when the criterion is less important than the previous criterion. In order to facilitate the evaluation of the decision makers, each comparison has been subjected to a process of clarification and is shown in Table 2 and Table 3.
- l: lower bound value of triangular fuzzy number
- m: triangular fuzzy number most promising value
- u: triangular fuzzy number upper bound value

Table 2. The linguistic variables for the evaluation of the criteria (Scale 1-2)

Linguistic Variables	**Fuzzy Number**			
	l	**m**	**u**	**Stabilized Value**
Almost Equal Value	1,000	1,000	1,050	1,008
Slightly More Significant	1,100	1,150	1,200	1,150
Moderately More Significant	1,200	1,300	1,350	1,292
More Significant	1,300	1,450	1,500	1,433
Much More Significant	1,400	1,600	1,650	1,575
Dominantly More Significant	1,500	1,750	1,800	1,717
Absolutely More Significant	1,600	1,900	1,950	1,858

Table 3. The linguistic variables for the evaluation of the criteria (Scale 0-1)

Linguistic Variables	**Fuzzy Number**			
	l	**m**	**u**	**Stabilized Value**
Weakly Less Significant	0,667	1,000	1,000	0,944
Moderately Less Significant	0,500	0,667	1,000	0,694
Less Significant	0,400	0,500	0,667	0,511
Really Less Significant	0,333	0,400	0,500	0,406
Much Less Significant	0,286	0,333	0,400	0,337
Dominantly Less Significant	0,250	0,286	0,333	0,288
Absolutely Less Significant	0,222	0,250	0,286	0,251

Step 3. The coefficient $\overline{k_j}$ is determined by Equation (2).

$$\overline{k_j} = \begin{cases} \bar{l} \; if \; j = 1 \\ 2 - \overline{s_j} \; if \; j > 1 \end{cases} \tag{2}$$

Step 4. Equation (3) is used to find the fuzzy weight $\overline{q_j}$.

$$\overline{q_j} = \begin{cases} \bar{l} \; if \; j = 1 \\ \frac{\overline{q_{j-1}}}{\overline{k_j}} \; if \; j > 1 \end{cases} \tag{3}$$

Step 5. The relative weight of $\overline{w_j}$ is obtained with the help of Equation (4).

$$\overline{w_j} = \frac{\overline{q_j}}{\sum_{j=1}^{n} \overline{q_j}} \tag{4}$$

The following steps belong to the inverse fuzzy PIPRECIA method.

Step 6. Starting from the penultimate kiter, the criteria are evaluated according to Tables 2 and 3.

$$\overline{s_j^{r}}' = \begin{cases} > \bar{l} \; if \; C_j > C_{j+1} \\ = \bar{l} \; if \; C_j = C_{j+1} \\ < \bar{l} \; if \; C_j < C_{j+1} \end{cases} \tag{5}$$

$\overline{s_j^{r}}'$, denotes the evaluation of the criteria by decision maker r.

Step 7. Equation (6) shows the coefficient $\overline{k_j'}$.

$$\bar{k}_j' = \begin{cases} \bar{l} \; if \; j = n \\ 2 - \bar{s}_j' if \; j > n \end{cases} \tag{6}$$

n is the total number of criteria.

Step 8. The fuzzy weight $\bar{q}_j'$ is obtained by Equation (7).

$$\bar{q}_j' = \begin{cases} \bar{l} \; if \; j = n \\ \frac{\overline{q_{j+1}}'}{\overline{k_j}'} \; if \; j > n \end{cases} \tag{7}$$

Step 9. The relative weight of criterion $\bar{w}_j'$ is calculated by Equation (8).

$$\bar{w}_j' = \frac{\bar{q}_j'}{\sum_{j=1}^{n} \bar{q}_j'} \tag{8}$$

Step 10. $\bar{w}_j$ and $\bar{w}_j'$ values obtained for determining the final weights of the criteria are analyzed with Equation (9).

$$\bar{w}_j'' = \frac{1}{2}\left(\bar{w}_j + \bar{w}_j'\right) \tag{9}$$

3.2. Fuzzy COPRAS Method

COPRAS (COmplex PRoportional ASsessment) method is a MCDM method introduced to the literature by Zavadskas & Kaklauskas (1996) to rank and evaluate alternatives (Potur & Toptancı, 2021: 227). This method enables the decision maker to select the most appropriate alternative among the alternatives (Fouladgar et al., 2012: 171). In the method, the most appropriate alternative is determined by comparing the ideal solution ratio with the ideal worst solution ratio (Baki, 2021: 1508).

The evaluation of alternative and criterion values as net values may be insufficient to make decisions in real life problems. In order to overcome this inadequacy, the fuzzy COPRAS method was developed.

The process steps of the fuzzy COPRAS method, which consists of nine steps, are given below (Fouladgar et al., 2012: 172-173).

Step 1. The identified alternatives are evaluated by decision makers using the verbal variables given in Table 4.

Table 4. Verbal Variables for Alternatives

Verbal Variables	Fuzzy Numbers
Very Low (VL)	(0, 0, 2.5)
Low (L)	(0, 2.5, 5)
Medium (M)	(2.5, 5, 7.5)
High (H)	(5, 7.5, 10)
Very High (VH)	(7.5, 10, 10)

Step 2. The generated decision matrices are transformed into combined decision matrices using Equation (10).

$$x_{ij} = (x_{ij1}, x_{ij2}, x_{ij3})$$

$$x_{ij1} = \min\{x_{ijk1}\},\; x_{ij2} = \frac{1}{K}\sum_{k=1}^{K} x_{ijk2},\; x_{ij3} = \max\{x_{ijk3}\} \tag{10}$$

Step 3. The values in the combined fuzzy decision matrix are converted into definite values by using Equation (11) and BNP (Best Nonfuzzy Performance Value) values are obtained.

$$\text{BNP} = \frac{(u-l)+(m-l)}{3} + l \quad (11)$$

Step 4. The normalized decision matrix is created by Equation (12).

$$\overline{x_{ij}} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}};\ \text{i=1, 2, …, m ve j= 1,…, n.} \quad (12)$$

Step 5. A weighted normalized decision matrix is obtained using Equation (13).

$$x_{ij} = \overline{x_{ij}}.w_j;\ \text{i= 1, …, m ve j= 1, …, n.} \quad (13)$$

Step 6. Equation (14) is used for the sum of the values in the weighted normalized decision matrix for the beneficial criteria where higher values indicate a better situation in achieving the objective, while Equation (15) is used for the sum of the values in the weighted normalized decision matrix for the non-beneficial criteria where lower values indicate a better situation.

$$P_i = \sum_{j=1}^{q} x_{ij} \qquad \text{j= 1, 2, …, q benefit criteria} \quad (14)$$

$$R_i = \sum_{j=q+1}^{n} x_{ij}\ \text{j= q+1, q+2, …, n non-benefit criteria} \quad (15)$$

Step 7. Equation (16) is used to obtain the relative importance of the alternatives.

$$Q_i = P_i + \frac{\sum_{i=1}^{m} R_i}{R_i \sum_{i=1}^{m} \frac{1}{R_i}} \quad (16)$$

Step 8. The highest relative importance value is determined by Equation (17).

$$K = \max Q_i\ ;\ i = 1, \dots, m \quad (17)$$

Step 9. Equation (18) is used for the performance index values of the alternatives.

$$N_i = \frac{Q_i}{Q_{max}}.100\%\ ;\ i = 1, \dots, m \quad (18)$$

4. APPLICATION

The issue addressed in the study is the selection of blue collar personnel for an enterprise. The criteria determined in the study were determined by utilizing both the opinions of decision makers and the literature (Erokutan, 2016: 69). The 6 criteria and 5 alternatives were evaluated by three people, namely HR officer, production manager and shift supervisor. While the fuzzy PIPRECIA method was used to weight the criteria, the evaluation of the alternatives was made with the fuzzy COPRAS method. Table 5 shows the criteria to be used in the study.

Table 5. Criteria, objectives and codes to be used in the study

Criteria	Objective	Code
Education Status	Maximum	K_1
Desire for Self-Improvement	Maximum	K_2
Shift Resilience	Maximum	K_3
Wage Expectation	Minimum	K_4
Professional Competence	Maximum	K_5
Work Experience	Maximum	K_6

4.1. Determination of Criteria Weights with Fuzzy PIPRECIA Method

In determining the criteria weights, six criteria were determined and evaluated in consultation with three decision makers, namely HR officer, production manager and shift supervisor. Fuzzy PIPRECIA method was used to determine the weights of the criteria. The evaluations of the decision makers and the process steps of the Fuzzy PIPRECIA method are given below.

As a first step, Equation (1) was applied for the normal Fuzzy PIPRECIA evaluations of the decision makers with the help of Tables 2 and 3 and the results were obtained and given in Table 6.

Table 6. Three decision makers' evaluations of six criteria for the Normal Fuzzy PIPRECIA Method

	KV_1			KV_2			KV_3		
	l	m	u	l	m	u	l	m	u
K_1									
K_2	1,500	1,750	1,800	1,400	1,600	1,650	1,600	1,900	1,950
K_3	1,300	1,450	1,500	1,500	0,175	1,800	1,600	1,900	1,950
K_4	0,333	0,400	0,500	0,400	0,500	0,667	0,500	0,667	1,000
K_5	1,500	1,750	1,800	1,600	1,900	1,950	1,400	1,600	1,650
K_6	0,400	0,500	0,667	0,286	0,333	0,400	0,333	0,400	0,500

$\overline{k_j}$ coefficient is determined by Equation (2), $\overline{q_j}$ fuzzy weight is determined by Equation (3) and $\overline{w_j}$ relative weight is determined by Equation (4) and given in Table 7.

Table 7. Results of Normal Fuzzy PIPRECIA Application

	$\overline{s_j}$			$\overline{k_j}$			$\overline{q_j}$			$\overline{w_j}$			
	l	m	u	l	m	u	l	m	u	l	m	u	SV
K_1				1,000	1,000	1,000	1,000	1,000	1,000	0,006	0,041	0,061	0,0387
K_2	1,498	1,746	1,796	0,204	0,254	0,502	1,991	3,932	4,898	0,013	0,162	0,299	0,1601
K_3	1,461	0,784	1,740	0,260	1,216	0,539	3,696	3,234	18,813	0,024	0,133	1,148	0,2842
K_4	0,405	0,511	0,693	1,307	1,489	1,595	2,318	2,172	14,400	0,015	0,090	0,878	0,2086
K_5	1,498	1,746	1,796	0,204	0,254	0,502	4,615	8,541	70,525	0,029	0,352	4,302	0,9569
K_6	0,336	0,405	0,511	1,489	1,595	1,664	2,774	5,356	47,363	0,018	0,221	2,889	0,6318

In the rest of the method, inverse fuzzy PIPRECIA process steps were applied. As a first step, using Equation (5) and Tables 2 and 3, the criteria were evaluated by the decision makers and shown in Table 8.

Table 8. Four decision makers' evaluations of seven criteria for the Inverse Fuzzy PIPRECIA Method

	KV_1			KV_2			KV_3		
	l	m	u	l	m	u	l	m	u
K_6									
K_5	1,300	1,450	1,500	1,500	1,750	1,800	1,400	1,600	1,650
K_4	0,333	0,400	0,500	0,286	0,333	0,400	0,286	0,333	0,400
K_3	1,300	1,450	1,500	1,500	1,750	1,800	1,400	1,600	1,650
K_2	0,500	0,667	1,000	0,400	0,500	0,667	0,400	0,500	0,667
K_1	0,286	0,333	0,400	0,286	0,333	0,400	0,333	0,400	0,500

In the next step, the coefficient $\overline{k_j}'$ is obtained with Equation (6), fuzzy weight values with $\overline{q_j}'$ with Equation (7) and relative weight values with $\overline{w_j}'$ with Equation (8) and the results are shown in Table 9.

Table 9. Results of Inverse Fuzzy PIPRECIA Application

	$\overline{s_j}'$			$\overline{k_j}'$			$\overline{q_j}'$			$\overline{w_j}'$			
	l	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	$\overline{DF}$
K6				1,000	1,000	1,000	1,000	1,000	1,000	0,057	0,078	0,145	0,0858
K5	1,398	1,595	1,645	0,355	0,405	0,602	1,660	2,471	2,820	0,095	0,193	0,409	0,2128
K4	0,301	0,354	0,431	1,569	1,646	1,699	0,977	1,501	1,797	0,056	0,117	0,260	0,1310
K3	1,398	1,595	1,645	0,355	0,405	0,602	1,622	3,709	5,070	0,093	0,290	0,735	0,3312
K2	0,431	0,550	0,763	1,237	1,450	1,569	1,034	2,559	4,100	0,059	0,200	0,594	0,2422
K1	0,301	0,354	0,431	1,569	1,646	1,699	0,608	1,555	2,613	0,035	0,122	0,379	0,1499

As a final step, Equation (9) was used to obtain the final weights of the criteria. The obtained values are shown in Table 10.

Table 10. Subjective weights of criteria

Criteria	**DF**	$\overline{DF}$	$\overline{w_j}''$
K1	0,038736	0,149927	0,0943
K2	0,160078	0,242239	0,2012
K3	0,284162	0,331242	0,3077
K4	0,208606	0,130986	0,1698
K5	0,956871	0,212764	0,5848
K6	0,631813	0,085834	0,3588

4.2. Evaluation of Alternatives with Fuzzy COPRAS Method

According to Table 4, the alternatives evaluated by the decision makers are given below.

Table 11. Fuzzy decision matrix created by the first decision maker

	K1			K2			K3			K4			K5			K6		
	l	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**
A1	2,5	5	7,5	5	7,5	10	0	2,5	5	2,5	5	7,5	2,5	5	7,5	0	2,5	5
A2	0	2,5	5	2,5	5	7,5	5	7,5	10	5	7,5	10	5	7,5	10	5	7,5	10
A3	7,5	10	10	5	7,5	10	2,5	5	7,5	5	7,5	10	5	7,5	10	5	7,5	10
A4	2,5	5	7,5	2,5	5	7,5	5	7,5	10	2,5	5	7,5	2,5	5	7,5	2,5	5	7,5
A5	5	7,5	10	5	7,5	10	2,5	5	7,5	2,5	5	7,5	2,5	5	7,5	2,5	5	7,5

Table 12. Fuzzy decision matrix created by the second decision maker

	K1			K2			K3			K4			K5			K6		
	l	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**
A1	0	2,5	5	2,5	5	7,5	2,5	5	7,5	2,5	5	7,5	0	2,5	5	0	2,5	5
A2	2,5	5	7,5	0	2,5	5	5	7,5	10	2,5	5	7,5	2,5	5	7,5	2,5	5	7,5
A3	5	7,5	10	5	7,5	10	5	7,5	10	5	7,5	10	5	7,5	10	5	7,5	10
A4	2,5	5	7,5	2,5	5	7,5	0	2,5	5	2,5	5	7,5	0	2,5	5	5	7,5	10
A5	5	7,5	10	7,5	10	10	2,5	5	7,5	5	7,5	10	5	7,5	10	5	7,5	10

Table 13. Fuzzy decision matrix created by the third decision maker

	K_1			K_2			K_3			K_4			K_5			K_6		
	l	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**
A_1	2,5	5	7,5	2,5	5	7,5	0	2,5	5	2,5	5	7,5	0	2,5	5	0	2,5	5
A_2	0	2,5	5	0	2,5	5	2,5	5	7,5	2,5	5	7,5	2,5	5	7,5	2,5	5	7,5
A_3	5	7,5	10	5	7,5	10	2,5	5	7,5	2,5	5	7,5	7,5	10	10	5	7,5	10
A_4	2,5	5	7,5	0	2,5	5	0	2,5	5	2,5	5	7,5	2,5	5	7,5	2,5	5	7,5
A_5	5	7,5	10	5	7,5	10	5	7,5	10	2,5	5	7,5	5	7,5	10	5	7,5	10

The created decision matrices are combined with the help of Equation (10) and shown in Table 14.

Table 14. Combined fuzzy decision matrix

	K_1			K_2			K_3			K_4			K_5			K_6		
	l	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**	**l**	**m**	**u**
A_1	0,00	4,17	7,50	2,50	5,83	10,00	0,00	3,33	7,50	2,50	5,00	7,50	0,00	3,33	7,50	0,00	2,50	5,00
A_2	0,00	3,33	7,50	0,00	3,33	7,50	2,50	6,67	10,00	2,50	5,83	10,00	2,50	5,83	10,00	2,50	5,83	10,00
A_3	5,00	8,33	10,00	5,00	7,50	10,00	2,50	5,83	10,00	2,50	6,67	10,00	5,00	8,33	10,00	5,00	7,50	10,00
A_4	2,50	5,00	7,50	0,00	4,17	7,50	0,00	4,17	10,00	2,50	5,00	7,50	0,00	4,17	7,50	2,50	5,83	10,00
A_5	5,00	7,50	10,00	5,00	8,33	10,00	2,50	5,83	10,00	2,50	5,83	10,00	2,50	6,67	10,00	2,50	6,67	10,00

Using Equation (11), the combined fuzzy decision matrix has been stabilized and the values are shown in Table 15.

Table 15. Clarified decision matrix

	K_1	K_2	K_3	K_4	K_5	K_6
A_1	3,89	6,11	3,61	5,00	3,61	2,50
A_2	3,61	3,61	6,39	6,11	6,11	6,11
A_3	7,78	7,50	6,11	6,39	7,78	7,50
A_4	5,00	3,89	4,72	5,00	3,89	6,11
A_5	7,50	7,78	6,11	6,11	6,39	6,39

The normalized values are normalized using Equation (12). The normalized decision matrix is shown in Table 16.

Table 16. Normalized decision matrix

	K_1	K_2	K_3	K_4	K_5	K_6
A_1	0,14	0,21	0,13	0,17	0,13	0,09
A_2	0,13	0,13	0,24	0,21	0,22	0,21
A_3	0,28	0,26	0,23	0,22	0,28	0,26
A_4	0,18	0,13	0,18	0,17	0,14	0,21
A_5	0,27	0,27	0,23	0,21	0,23	0,22

Using the criteria weights obtained by the fuzzy PIPRECIA method, a weighted normalized decision matrix was obtained using Equation (13) and shown in Table 17.

Table 17. Weighted normalized decision matrix

	K_1	K_2	K_3	K_4	K_5	K_6
Weights	**0,0943**	**0,2012**	**0,3077**	**0,1698**	**0,5848**	**0,3588**
A_1	0,013	0,043	0,041	0,030	0,076	0,031
A_2	0,012	0,025	0,073	0,036	0,129	0,077
A_3	0,026	0,052	0,070	0,038	0,164	0,094
A_4	0,017	0,027	0,054	0,030	0,082	0,077
A_5	0,025	0,054	0,070	0,036	0,135	0,080

P_i values were obtained using Equation (14) and R_i values were obtained using Equation (15) and shown in Table 18.

Table 18. P_i and R_i values

Alternatives	P_i	R_i
A_1	0,204	0,030
A_2	0,316	0,036
A_3	0,406	0,038
A_4	0,256	0,030
A_5	0,364	0,036

Table 19. Relative importance values of alternatives

Alternatives	Q_i
A_1	0,2428
A_2	0,3471
A_3	0,4363
A_4	0,2949
A_5	0,3955

Equation (17) was used to obtain the highest relative importance value (Qmax) and the alternative with the highest relative importance was found to be alternative A3 with a value of 0.4363.

The performance index values of the alternatives were calculated using Equation (18) to show the performance index value of the best alternative as 100 and the obtained values are shown in Table 20.

Table 20. Performance index values of alternatives

Alternatives	Q_i	Sıralama
A_1	55,65	5
A_2	79,56	3
A_3	100,00	1
A_4	67,60	4
A_5	90,65	2

The table shows the preference rankings of the alternatives. As a result of the solution of the fuzzy COPRAS method, it is seen that the best alternative is A_3 while the worst alternative is A_1.

5. CONCLUSION

In today's world of increasing competition, the knowledge and competencies of the personnel have a major role in the performance of the businesses they work for. Therefore, personnel selection is a strategic decision for businesses. The number of criteria required for the personnel to be selected may increase with the nature of the job. In order to solve the complexity in the most effective way, it is possible to utilize MCDM methods in the personnel selection decision problem. In case there are uncertainties when determining the criteria and alternatives, the use of fuzzy MCDM methods in decision making will provide more appropriate solutions for the business.

In this study, three decision makers, namely HR manager, production manager and shift supervisor, were formed for the selection of blue collar personnel. Six criteria were determined by utilizing the decision makers and the literature. After the weights of the criteria were calculated with the fuzzy PIPRECIA method, the five alternatives were ranked with the fuzzy COPRAS method. In the weights obtained with the fuzzy PIPRECIA method, the criterion with the highest weight is K_5, which expresses professional competence, while the criterion with the lowest weight is K_1, which expresses educational status. After the determined criteria weights, the fuzzy COPRAS method was used to evaluate the alternatives and the best alternative was A_3 while the worst alternative was A_1. According to the results of the study, it was recommended to the company to select the personnel expressing the A_3 alternative. The combination of Fuzzy PIPRECIA and Fuzzy COPRAS methods for personnel selection makes the study different from other studies.

In future studies, different fuzzy MCDM methods can be used for personnel selection for different enterprises and the results can be compared. In addition, adding different criteria to the criteria will be useful in future studies. For example, since success is achieved with the selection of qualified personnel in e-commerce enterprises, these methods can be compared using different methods and criteria.

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