ISSN (e): 2250 – 3005 || Volume, 09 || Issue, 2 || February– 2019 ||
International Journal of Computational Engineering Research (IJCER)

Personnel Selection by Multi-Criteria Decision Making and a Case Study

Pınar MİÇ[1]

[1]Research Assistant, Department of Industrial Engineering, Çukurova University, Engineering Faculty, 01330, Saricam, Balcali, Adana, Turkey.

Corresponding Author: Pınar MİÇ

ABSTRACT

Personnel selection is one of the most significant and complex processes of human resources management. It depends choosing the best candidate for a job. But this process contains multiple factors affecting the results and contains uncertainty. Thus, personnel selection is handled as a multi-criteria decision making (MCDM) problem in this study. Between various MCDM methods, due to their effective results, Analytic Hierarchy Process (AHP) and Fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods are utilized. Fuzzy logic is incorporated to TOPSIS to gain better results. A case study is performed to select best alternative and both two methods resulted with same alternative.

KEYWORDS: *Personnel selection, multi-criteria decision making, analytic hierarchy process, fuzzy logic*

Date of Submission: 20-02-2019 Date of acceptance: 08-03-2019

I. INTRODUCTION

Personnel selection is between the key functions of human resources management. This selection process has a strategic importance since it affects the productivity and future of the company. Furthermore, this process needs to be planned and performed in many processes. The goal of personnel selection is to recruit the right personnel with certain features and competencies required for that position. It can be observed that this problem contains multiple criteria and thus it can be handled as a multi-criteria decision making (MCDM) problem.

In literature, many researchers have adopted MCDM methods to personnel selection problem [1-14]. These studies include Elimination and Choice Translating Reality English (ELECTRE) method [1], Technique for Order Preference by Similarity to Ideal Solution [2], fuzzy logic [3,4,8,12,13], hybrid approaches [5,11], fuzzy MULTIMOORA [6], The Decision Making Trial and Evaluation Laboratory (DEMATEL), Analytic Hierarchy Process (AHP) [7], fuzzy Multi-attribute decision making (MADM) [10], Step-Wise Weight Assessment Ratio Analysis (SWARA) and MULTIMOORA [12]. In this study, for personnel selection in a manufacturing company, seven criteria and five alternative personnel are specified; based on three human resources staff in the company. AHP and fuzzy TOPSIS methods are adopted for personnel selection problem and the results are compared. The remainder of this paper is organized as follows: In Section II; we provide the material and method. Section III includes the results of two methods. Finally, in Section IV, we present conclusions and suggestions for further studies.

II. MATERIAL-METHOD

The problem handled in this study is performed for personnel selection in an anonymous manufacturing company in Adana, Turkey. In order to conduct the study with right and real data, we interviewed with 3 staff of human resources (this corresponds to three decision maker and indicated by DM1, DM2 and DM3 in case study) department and according to their opinions and approvals, as a result; we determined 5 alternative personnel and 7 criteria to select them.

Alternative personnel set are specified as: A1, A2, A3, A4 and A5. The specified criteria are as follows:

- Computer knowledge (C1):
  - Basic programs,
  - Basic and complex programs,
- Foreign language (C2):
  - Reading,
  - Speaking,

- Writing.

- Experience (C3):
- No experience,
- Less than a year,
- 1-3 years,
- More than 3 years.

- Wage claim (C4):
- Acceptable,
- More than acceptable range.

- Analytical thinking (C5):
- Low,
- Middle,
- Decent.

- Ability of self-expression (C6):
- Low,
- Middle,
- Decent.

- Overtime work/shift (C7):
- Capable,
- Not capable.

We need many qualitative and quantitative factors to be able to adapt changing environmental conditions and to make effective decisions in parallel with changes. In these processes, Multi-Criteria Decision Making (MCDM) methods are very suitable. Thus, in this study, we utilized two effective MCDM methods which are Analytic Hierarchy Process and Fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods for personnel selection.

AHP

AHP is suggested by Myers and Alpert in 1968 and developed by Thomas L. Saaty in 1977 as a model to be used in decision problems [15]. The importance values and their meanings for pairwise comparisons [16] are demonstrated with Table 1 below. For detailed information about this method, readers should refer to [16].

Table: 1 Importance values and their meanings for pairwise comparisons [adopted from 16]

Importance Values	Value Meanings
1	Equally important
3	Slightly favor one element over another
5	Strongly favor one element over another
7	Very strongly over another
9	Absolutely more important over another
2,4,6,8	Compromise is needed

Fuzzy TOPSIS

TOPSIS is suggested by Hwang and Yoon [17] in 1981 and is one of the most utilized methods in MCDM problems. Since nowadays many problems contain uncertainty, fuzzy numbers are started to be used in TOPSIS method. In this study, to reach more consistent results, we handled the problem in fuzzy logic framework, which is developed by Zadeh in 1965 [18]. The linguistic expressions to be used in determining decision criteria weights and in evaluating alternatives are presented by Table 2 and Table 3, respectively [19]. For detailed information about this method, readers should refer to [20].

Table: 2 Linguistic expressions to determine decision criteria weights [adopted from 19]

Very High (VH)	(0.8,1,1)
High (H)	(0.7,0.8,0.9)
Medium High (MH)	(0.5,0.65,0.8)
Medium (M)	(0.4,0.5,0.6)
Medium Low (ML)	(0.2,0.35,0.5)
Low (L)	(0.1,0.2,0.3)
Very Low (VL)	(0,0,0.2

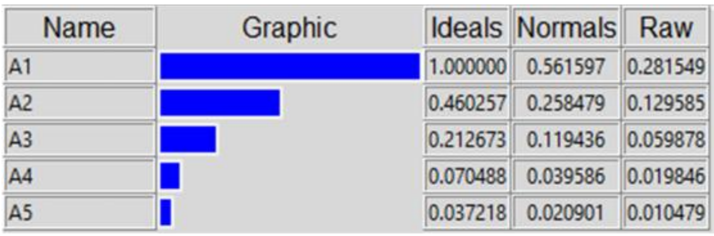
Table: 3 Linguistic expressions to evaluate the alternatives [adopted from 19]

Very Good (VG)	(8,10,10)
Good (G)	(7,8,9)
Medium Good(MG)	(5,6.5,8)
Medium (M)	(4,5,6)
Medium Poor (MP)	(2,3.5,5)
Poor (P)	(1,2,3)
Very Poor (VP)	(0,0,2)

III. RESULTS

3.1. AHP Results

For AHP, we utilized Super Decisions Software Version 2.8. After determining criteria and sub-criteria, connections between criteria are established by Super Decisions. Pairwise comparison matrices are constituted and comparisons are performed according to Table 1. Consistency analyses of pairwise comparisons are performed and consistency ratio is calculated. As a result, we obtained a consistency ratio with a value lower than 0.1 which means that comparisons are consistent. Lastly, these are synthetized via software and the result screen is presented with Figure 1. Alternatives can be ordered from the biggest ideal value to lowest and the alternative with biggest ideal value is the best result. As seen from Figure 1, the best alternative is A1.



Name	Graphic	Ideals	Normals	Raw
A1		1.000000	0.561597	0.281549
A2		0.460257	0.258479	0.129585
A3		0.212673	0.119436	0.059878
A4		0.070488	0.039586	0.019846
A5		0.037218	0.020901	0.010479

Figure: 1 The result screen of Super Decisions software

3.2. Fuzzy TOPSIS Results

In this method, after determining criteria to be utilized in the study, decision makers are evaluated decision criteria according to Table 2. Also, the alternatives are evaluated for each criteria and these evaluations are given by Table 4 and Table 5 respectively.

Table: 4 Determining of criteria weights by decision makers

Criteria	Decision Makers		
	DM1	DM2	DM3
C1	VH	H	H
C2	H	VH	H
C3	VH	H	VH
C4	MH	MH	H
C5	H	H	MH
C6	MH	H	MH
C7	VH	VH	H

Table: 5 Determining of criteria weights by decision makers

Criteria	Alternatives	Decision Makers			Criteria	Alternatives	Decision Makers		
		DM1	DM2	DM3			DM1	DM2	DM3
C1	A1	VG	G	VG	C5	A1	G	G	G
	A2	G	G	G		A2	MG	MG	MI
	A3	MG	MG	MI		A3	MI	MI	MP
	A4	MP	MI	MP		A4	MI	MP	MP
	A5	P	VP	MP		A5	P	VP	MP
C2	A1	VG	G	G	C6	A1	VG	VG	VG
	A2	G	MG	G		A2	G	G	MG
	A3	MG	MI	MP		A3	MP	MP	MI
	A4	MI	MI	MP		A4	MI	MP	MP

	A5	P	P	VP
C3	A1	G	G	G
	A2	MG	MI	MP
	A3	MI	MI	MP
	A4	MP	MP	MI
	A5	P	P	MP
C4	A1	VG	G	G
	A2	G	MG	MG
	A3	MP	MP	MI
	A4	MI	MI	MP
	A5	P	P	VP
	A5	P	VP	P
C7	A1	VG	G	G
	A2	G	MG	MG
	A3	MI	MI	MI
	A4	MP	P	P
	A5	P	P	P

These linguistic evaluations are transformed into fuzzy numbers via Table 2 and Table 3; thus criteria weights (Table 6) and fuzzy decision matrix are obtained (Table 7).

Table: 6 Criteria weights

Criteria	Weights
C1	(0.73,0.87,0.93)
C2	(0.73,0.87,0.93)
C3	(0.77,0.93,0.97)
C4	(0.57,0.70,0.83)
C5	(0.63,0.75,0.87)
C6	(0.57,0.70,0.83)
C7	(0.77,0.93,0.97)

Table: 7 Fuzzy decision matrix

	Criteria						
Alternatives	C1	C2	C3	C4	C5	C6	C7
A1	(5.75,7.0,7.25)	(5.5,6.5,7.0)	(5.25,6.0,6.75)	(5.5,6.5,7.0)	(5.25,6.75,6.75)	(6,7.5.0,7.5)	(5.5,6.5,7.0)
A2	(5.25,6.0,6.75)	(4.75,5.63,4.25)	(2.75,3.75,4.75)	(4.25,5.25,6.25)	(43.5,4.5,5.5)	(4.75,5.63,6.5)	(4.25,5.25,6.25)
A3	(3.5,4.35,5.5)	(2.75,3.75,4.75)	(2.5,3.38,4.25)	(2.0,3.0,4.0)	(2.5,3.38,4.25)	(2.0,3.0,4.0)	(3,3.75,4.5)
A4	(2.0,3.0,4.0)	(2.5,3.38,4.25)	(2.0,3.0,4.0)	(2.5,3.38,4.25)	(2.0,3.0,4.0)	(2.0,3.0,4.0)	(1,1.88,2.75)
A5	(0.75,1.38,2.5)	(0.5,1.0,2.0)	(1.0,1.88.2.75)	(0.5,1.0,2.0)	(0.75,1.38,2.5)	(0.5,1.0,2.0)	(0.75,1.5,2.25)

Table: 8 Normalized fuzzy decision matrix

	Criteria						
Alternatives	C1	C2	C3	C4	C5	C6	C7
A1	(0.79,0.97,1.0)	(0.79,0.93,1.0)	(0.78,0.89,1.0)	(0.79,0.93,1.0)	(0.78,1.0,1.0)	(0.80,1.0,1.0)	(0.79,0.93,1.0)
A2	(0.72,0.83,0.93)	(0.68,0.80,0.61)	(0.41,0.56,0.70)	(0.61,0.75,0.89)	(0.52,0.67,0.81)	(0.63,0.75,0.87)	(0.61,0.75,0.89)
A3	(0.48,0.62,0.76)	(0.39,0.54,0.68)	(0.37,0.50,0.63)	(0.29,0.43,0.57)	(0.37,0.50,0.63)	(0.27,0.40,0.53)	(0.43,0.54,0.64)
A4	(0.28,0.41,0.55)	(0.36,0.48,0.61)	(0.30,0.44,59)	(0.36,0.48,0.61)	(0.30,0.44,0.59)	(0.27,0.40,0.53)	(0.14,0.27,0.39)
A5	(0.10,0.19,0.34)	(0.07,0.14,0.29)	(0.15,0.28,0.41)	(0.07,0.14,0.29)	(0.11,0.20,0.37)	(0.07,0.13,0.27)	(0.11,0.21,0.32)

Table: 9 Weighted normalized fuzzy decision matrix

	Criteria						
Alternatives	C1	C2	C3	C4	C5	C6	C7
A1	(0.58,0.84,0.93)	(0.58,0.80,0.93)	(0.60,0.83,0.97)	(045.,0.65,0.83)	(0.49,0.75,0.87)	(0.45,0.70,0.83)	(0.60,0.87,0.97)
A2	(0.53,0.72,0.87)	(0.50,0.70,0.57)	(0.31,0.52,0.68)	(0.34,0.53,0.74)	(0.33,0.50,0.71)	(0.36,0.53,0.72)	(0.47,0.70,0.86)
A3	(0.35,0.54,0.71)	(0.29,0.46,0.63)	(0.28,0.47,0.61)	(0.16,0.30,0.48)	(0.23,0.38,0.55)	(0.15,0.28,0.44)	(0.33,0.50,0.62)
A4	(0.20,0.36,0.51)	(0.26,0.42,0.57)	(0.23,0.41,57)	(0.20,0.34,0.51)	(0.19,0.33,0.51)	(0.15,0.28,0.44)	(0.11,0.25,0.38)
A5	(0.08,0.16,0.32)	(0.05,0.12,0.27)	(0.11,0.26,0.39)	(0.04,0.10,0.24)	(0.07,0.15,0.32)	(0.04,0.09,0.22)	(0.08,0.20,0.31)

The normalized fuzzy decision matrix and then weighted normalized fuzzy decision matrix is constructed and these are demonstrated with Table 8 and Table 9, respectively.

Finally, for each alternative, fuzzy positive-ideal solution (FPIS-A^*) and fuzzy negative-ideal solution (FNIS-A^-) are calculated. After this determination, the distance of each alternative personnel from these solutions (d_i^*andd_i^-) are computed and closeness coefficient of each alternative (C_i) is determined. These values are given by Table 10.

Table: 10 Distances from FPIS and FNIS and closeness coefficient values

Alternatives	c_i^*	c_i	$c_i^* + c_i$	C_i
A1	2.13	7.80	9.93	0.786
A2	3.12	6.04	9.16	0.660
A3	4.18	4.96	9.15	0.543
A4	4.67	4.70	9.38	0.501
A5	5.83	3.04	8.87	0.343

The alternative with biggest C_i value will be the best alternative. As seen from the Table 10, A1 is the best alternative.

IV. CONCLUSION

Selecting right personnel and their working of productively is one of the most significant responsibilities of administrators. This process is the most important process for the company's future and future successes. Thus, in this study, we focused on selecting personnel between a set of alternatives using two effective multi-criteria decision making techniques: AHP and Fuzzy-TOPSIS. For AHP, we utilized a recognized software which is Super Decisions and for other method, we included fuzziness into problem and adopted fuzzy-TOPSIS method. As a result of case study, we obtained same alternative (A1) for two approaches.

In future studies, the problem can be addressed by other MCDM methods, case study area can be extended, and sensitivity analyses can be executed to observe the impacts of changes in criteria weights and evaluations to the results.

REFERENCES

[1]. A.R. Afshari, M. Hojahed, R.M. Yusuff and T.S. Hong, Personnel selection using ELECTRE, Journal of Applied Sciences, Vol. 10 (2010), pp. 3068-3075.

[2]. A. Kelemenis and Askounis, D., A new TOPSIS based multi-criteria approach to personnel selection, Expert Systems with Applications Vol. 37 (2010), No. 7, pp. 4999-5008.

[3]. A. Rashidi, F. Jazebi and I. Brilakis, Neurofuzzy genetic system for selection of construction project managers, Journal of Construction Engineering and Management Vol. 107 (2011), No. 1, pp. 17-29.

[4]. F.E. Boran, S. Genç and D. Akay, Personnel selection based on intuitionistic fuzzy sets, Human Factors and Ergonomics in Manufacturing & Service Industries Vol. 21 (2011), No. 5, pp. 493-503.

[5]. Kabak, M., S. Burmaoğlu and Y. Kazançoğlu, A fuzzy hybrid MCDM approach for professional selection, Expert Systems with Applications Vol. 39 (2012), No. 3, pp. 3516-3525.

[6]. A. Balezentis, T. Balezentis and W. K. Brauers, Personnel selection based on computing with words and fuzzy MULTIMOORA, Expert Systems with Applications Vol. 39 (2012), No. 9, pp. 7961-7967.

[7]. B. Roy and S.K. Misra, An integrated DEMATEL and AHP approach for personnel estimation, International Journal of Computer Science and Information Technology & Security Vol. 2 (2012), pp. 1206-1212.

[8]. D. Yu, W. Zhang and Y. Xu, Group decision making under hesitant fuzzy environment with application to personnel evaluation, Knowledge Based Systems Vol. 16 (2013), No. 2, pp. 1-10.

[9]. R. Md. Saad, M.Z. Ahmad, M.S. Abu and M.S. Jusoh, Hamming distance method with subjective and objective weights for personnel selection, The Scientific World Journal ID 865495 (2014), pp. 1-9.

[10]. R. Aggarwal, Identifying and prioritizing human capital measurement indicators for personnel selection using fuzzy MADM, in M. Pant, K. Deep, A. Nagar, J. Bansal, editors. Proceedings of Third International Conference on Soft Computing for Problem Solving, Advances in Intelligent Systems and Computing, Springer, New Delhi (2014), 258, pp. 427-439.

[11]. K. Violeta and Z. Turskis, A hybrid linguistic fuzzy multiple criteria group selection of a chief accounting officer, Journal of Business Economics and Management Vol. 15 (2014), No. 2, pp. 232-252.

[12]. D. Karabasevic, D. Stanujkic, S. Urosevic and M. Maksimovic, Selection of candidates in the mining industry based on the application of the SWARA and the MULTIMOORA methods, ActaMontanisticaSlovaca Vol. 20 (2015), No. 2, pp. 116-124.

[13]. S.F. Zhang and S.Y. Liu, A GRA-based intuitionistic fuzzy multi-criteria group decision making method for personnel selection, Expert Systems with Applications Vol. 38 (2011), No. 9, pp. 11401-11405.

[14]. H.T. Lin, Personnel selection using analytic network process and fuzzy data envelopment analysis approaches, Computers and Industrial Engineering Vol. 59 (2010), No. 4, pp. 937-944.

[15]. T. Tanino, T. Tanaka and M. Inuiguchi, Multi-objective programming and goal programming theory and applications, first edition, Springer-Verlag (2003), Berlin, Heidelberg.

[16]. T.L. Saaty, How to make a decision: The analytic hierarch process, Interfaces Vol. 24 (1990), No. 6, pp 19-43.

[17]. C.L., Hwang and K. Yoon, Multiple attributes decision making methods and applications, Springer, BerlinHeidelberg, 1981.

[18]. L.A. Zadeh, Fuzzy sets, Information and Control Vol. 8 (1965), No. 3, pp. 338-353.

[19]. C.T. Chen, Extensions of the TOPSIS for group decision making under fuzzy environment, Fuzzy Sets and Systems Vol. 114 (2000), No. 1, pp. 1-9.

[20]. C.T. Chen and C.T. Lin, A fuzzy approach for supplier evaluation and selection in supply chain management, International Journal of Production Economics Vol. 102 (2006), No. 2, pp. 289-301.