International Journal of Pure and Applied Mathematics
Volume 117 No. 15 2017, 779-793
ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version)
url: http://www.ijpam.eu
Special Issue

ijpam.eu

Comparative Analysis ofFuzzy Multi Attribute Decision Making Employees Selection and Recruitment

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Abstract :

Acceptance of employees must be in accordance with predetermined criteria, to assist in selecting a person eligible to be accepted as an employee or not required method in making a decision that is using Fuzzy Multi Attribute Decision Making (Fuzzy MADM). This study aims to compare the results of calculations with the method of fuzzy SAW with TOPSIS fuzzy method. The criteria used are interview, appearance, psychotest I, Psychotest II, Psychotest III, Ms. Word Test and Ms. Excel Test. Based on multi criteria analysis using fuzzy SAW and fuzzy TOPSIS method, it shows that the first rank is X with fuzzy SAW 92,93, fuzzy TOPSIS 0.75, second rank is Y with fuzzy value 92.45, fuzzy TOPSIS 0.74. Viewed from the ranking that the results of both methods are the same although the value is different.For future research can be done with other Fuzzy MADM method so that can know the best method in doing ranking.

Passwords : Fuzzy MADM, Fuzzy SAW, Fuzzy TOPSIS, Employee.

1.Introduction

One of the most significant developments in the field of organizations in recent times is the increasing importance given to human resources. People are vital to organizations as they offer perspectives, values and attributes to organizational life; and when managed effectively, these human traits can be of considerable benefits to the organization. As revealed in (Djabatey, 2012) this scenario lends credence to the increasing attention being paid to the people aspect of organizational wealth. This is so because the development of people, their competencies, and the process development of the total organization are the fulcrum of human resource management (Mullins, 1999; Djabatey, 2012).
Recruitment and selection are vital functions of human resource management for any type of business organization. These are terms that refer to the process of attracting and choosing candidates for employment. The quality of the human resource which the firm has heavily depended on the effectiveness of these two functions (Gamage, 2014). Recruiting and selecting the wrong candidates who are not capable come with a huge negative cost which businesses cannot afford. Thus, the overall aim of recruitment and selection within the organization is to obtain the number and quality of employees that are required to satisfy the strategic objectives of the organization, at minimal cost(Ofori&Aryeetey, 2011).

As explained by Opatha (2010)recruitment is the process of finding and attracting suitably qualified people to apply for job vacancies in the organization. It is a set of activities an organization uses to attract job candidates who have the needed abilities and attitudes. Recruitment is the process of generating a pool of qualified applicants for organizational job vacancies. For Ofori and Aryeetey (2011), recruitment is the process of generating a pool of competent individuals to apply for employment within an organization. Evidence has shown that larger corporations are more likely than smaller organizations in implementing sophisticated recruitment processes (Bacon &Hoque,

2005) with majority of smaller organizations relying on referrals and advertising as their recruitment practices of choice(Barber, Wesson, Roberso& Taylor, 1999).

The mechanism that runs on the University of Main Potential in employee recruitment has no weight value in each criteria. Therefore we need a model that can take into account the weight value of each criteria. In selecting new employee selection decisions using the Technique for Order Preference method by Similarity to Ideal Solution (TOPSIS), a method is chosen because the method (TOPSIS) is based on the best chosen alternative concept not only having the shortest distance from the ideal solution but also the distance of the longest of the ideal solution (Hwang, 1981). Research is done by finding the weight value for each criteria, then through the ranking process that will determine the optimal alternative of the best employee candidates to be considered by decision makers to become employees.

2. Theoritical Setting

2.1 The Employee

The employee is a physical and mental worker of physical and spiritual being (mental and mind) that is always needed and therefore become one of the principal capital in the business of cooperation to achieve certain goals (organization) (A.W. Widjaja, 2006). The next definition of the Employee is the person employed in a corporation, both in government institutions and in business corporations. "From the above definition we can draw a conclusion that employees are laborers or who organize work that need to be motivated so they can obtain skills and abilities in their work so that they will ultimately be able to produce results that are useful for the achievement of the organizational goals.

2.2 Decision Support System

Decision Support System (DSS) is a specific information system which is intended to assist management in making a decision with regard to the question of which semi structured,and it does not replace the function of the decision makers in making informed decisions. Decision support system combines the intellectual resource of individuals with computer capabilities to improve the quality of the decisions.
Some components in the DSS include (M. Kusrini,2007) :
1. Subsystem data management
2. Subsystem model management
3. Subsystem user interface
4. Subsystem knowledge-based management

2.3 Fuzzy Sets and Fuzzy Numbers

Definitions 1 :
A fuzzy set in X is defined by : $A = \{x, \mu A (x)\}, x \in X$ .....**Equation 1**
in which $\mu A (x) : X \rightarrow [0, 1]$ is the membership function of A and $\mu A (x)$ is the degree of membership of x in A. If $\mu A (x)$ equals 1, x completely belongs to fuzzy set A. Unlike in classical set theory, $\mu A (x)$ may be a value between zero and one, capturing partial membership of x in the fuzzy set A (L. Zadeh,1965).
Definition 2:
A fuzzy number M is a convex normal fuzzy set M of the real line R such that (H.-J. Zimmermann, 1992). There exists exactly one $x 0 \in R$ with $\mu M (x 0) = 1$ ($x 0$ is called mean value of M) and $\mu M (x)$ is continuous.The triangular fuzzy number (TFN) is most widely used in decision making because of its intuitive membership functions and computational simplicity (Erturul and Karakaolu,2007) (Lima Junior, Osiro, and Carpinetti, 2014). In this study, TFNs are adopted in both of the fuzzy TOPSIS methods. Triangular fuzzy number can be defined as a triplet (l, m, u). The parameters l, m and u, respectively, specify the smallest possible value, the peak value and the largest possible value of the membership function.

2.4 Fuzzy Attribute Decision Making (FMADM)
Fuzzy Fuzzy Multi-Attribute Decision Making is a method used to find the optimal alternative from a number of alternatives for certain criteria. FMADM is the core from determining the value of the weights for each attribute, followed by a ranking process that will select the alternative that has been given. Basically, there are three approaches to find the weights of attributes, namely the approaches of subjective and objective and the approach of integration between the subjective and objective. Each approach has advantages and disadvantages. In the subjective approach, the weights are determined based on the subjectivity of decision makers, so that some of the factors in the alternative ranking can be determined independently. While the objective approach, the weights are mathematically calculated that ignore the subjectivity of the decision makers. There are several methods that can be used to solve the problems of FMADM namely (Kusumadewi, Hartati, Harjoko, and Wardoyo, 2006).

1. Simple Additive Weighting (SAW)
2. Weighted Product (WP)
3. ELECTRE
4. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)
5. Analytic Hierarchy Process (AHP)

2.5 Simple Additive Weighting (SAW)
The basic concept of the SAW method is to find the weighted sum of performance ratings on each alternative on all attributes weighted from performance on each alternative to all attributes (Fishburn, 1967) (MacCrimmon, 1968). The SAW method requires the process of normalizing the decision matrix (X) to a scale comparable to all existing alternative ratings.

Equation 2
To calculate the attribute of cost, it is used the formulation as in equation…

Equation 3
with
: The normalized performance rating of alternative Ai on attributeCj
: 1,2,3, …
: 1,2,3, … n
: maximum value of each row and column
: minimum value of each row and column
: rows and columns of a matrix

To calculate the value of the preference for each alternative, it is used the formulas in Equation….

= **Equation 4**

with :

: end value of the alternative
: the specified weights
: matrix normalization

This research uses Fuzzy SAW method.The steps are :

Step 1 : Determining the criteria that will used as a reference in decision making, namely Ci.

Step 2 : Determining the suitability rating of each alternative on each criterion.

Step 3 : Making decisions based on criteria matrix (Ci).

Step 4 : Normalizing matrix based on the adapted equation with the type of benefit attribute (attribute or cost attribute) so that it is obtained normalized matrix R.

Step 5 : The final results are obtain from the ranking process ,namely, the sum of normalized matrix R with the weight vector in order to obtain the greatest value which is selected as the best alternative (Ai) as the solution.

2.5 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

TOPSIS based on the concept that the best alternative was selected not only does it have the shortest distance from the positive ideal solution, but it also has the longest negative ideal solution from the distance. (Kusumadewi, Hartati, Harjoko, and Wardoyo, 2006). In general, TOPSIS procedure is following the steps as follows:

1. Make a decision matrix that is normalized;
2. Make a decision matrix that is normalized weighted;
3. Determine the ideal solution matrix of positive and negative ideal solution matrix;
4. Determine the distance between the value of each alternative with the ideal solution matrix positive and negative ideal solution matrix.
5. Determining the value of preference for each alternative.

TOPSIS require the rating of performance for each alternative Ai, on each criterion Cj that are normalized as:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$ i=1,2,…,m; j=1,2,...n. **Equation 5**

A- positive ideal solution and negative ideal solution A + rating weights can be determined based on the normalized (y_{ij}):

$y_{ij} = w_i \quad r_{ij}$ i=1,2,…,m; j=1,2, …, n. **Equation 6**

$A^+ = (y_1^+ + y_2^+, \ldots, y_n^+);$ **Equation 7**

$A^- = (\ y_1^-\ ,\ y_2^-\ ,\ldots,\ y_n^-\ );$ **Equation 8**

With :

$$y_j^+ = \begin{cases} \max\limits_i y_{ij}; & \text{If j is profit attribute} \\ \min\limits_i y_{ij}; & \text{If j is fee attribute} \end{cases}$$ **Equation 9**

$$y_j^- = \begin{cases} \min\limits_i y_{ij}; & \text{If j is fee attribute} \\ \max\limits_i y_{ij}; & \text{If j is fee attribute} \end{cases}$$ **Equation 10**

j=1,2, ...n.

The distance between the alternative Ai with a positive ideal solution is formulated as:

$$D_i^+ = \sqrt{\sum_{j=1}^{n}(y_i^+ - y_{ij})^2}; i = 1, 2, \ldots, m \quad \textbf{Equation 11}$$

The distance between the alternative Ai with negative ideal solution is formulated as:

$$D_i^- = \sqrt{\sum_{j=1}^{n}(y_{ij} - y_i^-)^2}; i = 1, 2, \ldots, m. \quad \textbf{Equation 12}$$

Preference value for each alternative (Vi) is as follows:

$$V_i = \frac{D_i^-}{D_i^- + D_i^+}; i = 1, 2, \ldots, m \quad \textbf{Equation 13}$$

Vi larger value indicates that the preferred alternative is Ai.

3. Data and methodology

3.1 Data

The data used in this study are employee data from the UniversitasPotensiUtama, for weighted values obtained from the Human Resources Department (HRD) of UniversitasPotensiUtama (Verina, Wiwi.,Andrian, Yudhi. &Rahmad, Fitrianto, 2015) with the criteria as follows :
Interview, Appearance, Psychotest 1 (Correlation & Analytic Ability Test), Psikotes 2 (Test of Figures and Arithmetic), Psikotes 3 (Passive English Test), Microsoft Word Test, Microsoft Excel Test.

3.2 Methodology

SAW Method: the first stage, it was the study of the literature related to the research. The second stage, it determined the criteria that would be used as reference in employee selection. The criteria included the value of interview, the value of Appearance, the value of Psychotest I, the value of the Psychotest II, the value of the Psychotest III and the value of the Ms. Word Test , and the Ms. Excel Test. The next stages, it determined the conformity assessment of every alternative at each criterion based on FMADM.Preference weights and calculation of decision matrix and forming the normalized matrix (R) were based on the attributes of Max benefit, the maximum value of each rowand column so that it was obtained the normalized matrix (R). The ranking process of the normalized matrix (R) was to obtain the biggest value that would be the best option.

TOPSIS method : step 1 which determines the criteria, Stage 2 to specify a rating of matches for each criterion, stage 3 forming Fuzzy (Gatete Marcel and Dr.N. Vetrivelan 2015) membership functions for each criterion, stage 4 form a matrix decision (X), stage 5 Determining the weights of preferences (W) to each criterion, stage 6 determines the decision matrix (X) be a weighted normalized decision matrix (R), stage 7 to Determine the distance between the value of each alternative with the ideal solution matrix positive and negative ideal solution, stage 8 determines the preference value for each alternative (V). This method will be analyzed.

A. Determining Criteria

Table 1 .Determining Criteria

Criteria	Information
C1	Interview
C2	Appearance
C3	Psychotest I
C4	Psychotest II
C5	Psychotest III
C6	Ms. Word Test
C7	Ms. Excel Test

Table 1 describes the criteria in employee recruitment where each criteria has a weighted value according to the level of importance of each criteria.

Table 2. Determining Weight Value

Criteria	Weight Value
C1	15
C2	15
C3	10
C4	10
C5	10
C6	20
C7	20

Table 2 describes the assigning of weighted values for each of the criteria for employee recruitment. The weighted value is taken from the HRD of the UniversitasPotensiUtama.

Table 3. Determining Crips Value on the Criteria

Criteria	Crips Value
C1	0-100

C2	0-100
C3	0-100
C4	0-100
C5	0-100
C6	0-100
C7	0-100

Table 3 explains the crisp value of each criteria for the input test score values from each criteria.

4. Results

Here is a sampling of existing data in employee recruitment:

Table 4. Sampling Data

No.	Employee Name	Interview	Appearance	Psychotest I	Psychotest II	Psychotest III	Ms. Word Test	Ms. Excel Test
1.	Susi	80	90	75	60	70	95	95
2.	Dadang	80	95	70	65	70	95	95
3.	Budi	75	85	65	60	65	80	80
4.	Herna	85	85	75	70	70	95	95
5.	Titin	80	60	75	60	65	65	60
6.	Indah	85	70	60	70	75	75	60
7.	Rida	70	75	75	85	80	75	70
8.	Dwi	75	65	60	65	94	65	70
9.	Santi	60	80	85	80	80	80	70

Table 4 describes the match rating of the alternatives for each criteria. Whereas each employee's name has the value of each criteria. Assessment is obtained from the HRD UniversitasPotensiUtama.

Fuzzy Value Conversion to match the crips value.

Table 5. Fuzzy Value Conversion to match the crips value

No.	Employe Name	C1	C2	C3	C4	C5	C6	C7
1.	Susi	80	90	75	60	70	95	95
2.	Dadang	80	95	70	65	70	95	95
3.	Budi	75	85	65	60	65	80	80

4.	Herna	85	85	75	70	70	95	95
5.	Titin	80	60	75	60	65	65	60
6.	Indah	85	70	60	70	75	75	60
7.	Rida	70	75	75	85	80	75	70
8.	Dwi	75	65	60	65	94	65	70
9.	Santi	60	80	85	80	80	80	70

4.1 Result Utilizing SAW for Employee Selection and Recruitment

The next step is to normalize the X matrix as follows, by using the formula of Equation (2) :

Table 6. Normalized Results

No.	Employe Name	C1	C2	C3	C4	C5	C6	C7
1.	Susi	0.94	0.95	0.88	0.71	0.74	1.00	1.00
2.	Dadang	0.94	1.00	0.82	0.76	0.74	1.00	1.00
3.	Budi	0.88	0.89	0.76	0.71	0.69	0.84	0.84
4.	Herna	1.00	0.89	0.88	0.82	0.74	1.00	1.00
5.	Titin	0.94	0.63	0.88	0.71	0.69	0.68	0.63
6.	Indah	1.00	0.74	0.71	0.82	0.80	0.79	0.63
7.	Rida	0.82	0.79	0.88	1.00	0.85	0.79	0.74
8.	Dwi	0.88	0.68	0.71	0.76	1.00	0.68	0.74
9.	Santi	0.71	0.84	1.00	0.94	0.85	0.84	0.74

Last step for fuzzy SAW method is to scale scores times values of each alternatives according to equation 4 = [15 15 10 10 10 20 20]

V_1= (15)(0.94) + (15)(0.95) + (10)(0.88) + (10)(0.71) + (10)(0.74) + (20)(1) + (20)(1) = 91.66

Table7 :Results Scores

No.	Ai	C1	C2	C3	C4	C5	C6	C7	SAW Scores
1.	Susi	14,12	14.21	8.82	7.06	7.45	20.00	20.00	91.66
2.	Dadang	14.12	15.00	8.24	7,65	7.45	20.00	20.00	92.45
3.	Budi	13.24	13.42	7.65	7,06	6.91	16.84	16.84	81.96
4.	Herna	15.00	13.42	8.82	8,24	7.45	20.00	20.00	92.93
5.	Titin	14.12	9.47	8.82	7,06	6.91	13.68	12.63	72.70
6.	Indah	15.00	10.59	7.06	8,24	7.98	15.79	12.63	77.28
7.	Rida	12.35	11.84	8.82	10,00	8.51	15.79	14.74	82.06
8.	Dwi	13.24	10.26	7.06	7.06	10.00	13.68	14.74	76.04
9.	Santi	10.59	12.63	10.00	10.00	8.51	16.84	14.74	83.31

4.2 Result Utilizing TOPSIS for Selection and Recruitment

The next step is to normalize the X matrix as follows:

80	90	75	60	70	95	95
80	95	70	65	70	95	95
75	85	65	60	65	80	80
85	85	75	70	70	95	95
80	60	75	60	65	65	60
85	70	60	70	75	75	60

70	75	75	85	80	75	70
75	65	60	65	94	65	70
60	80	85	80	80	80	70

X=

Decision matrix (X) which have been determined, the next stage is to determine normalized matrix (R) by using the formula of Equation (5). The results of the normalization calculations are obtained normalized matrix (R):

0.3461938579	0.3792205897	0.3494994093	0.2904453885	0.3117707615	0.3892168018	0.4037074237
0.3461938579	0.4002884002	0.3261994487	0.3146491709	0.3117707615	0.3892168018	0.4037074237
0.3245567418	0.3581527792	0.3028994881	0.2904453885	0.2895014214	0.3277615173	0.3399641463
0.367830974	0.3581527792	0.3494994093	0.3388529533	0.3117707615	0.3892168018	0.4037074237
0.3461938579	0.2528137265	0.3494994093	0.2904453885	0.2895014214	0.2663062328	0.2549731097
0.367830974	0.2949493476	0.2795995275	0.3388529533	0.3340401016	0.3072764225	0.2549731097
0.3029196257	0.3160171581	0.3494994093	0.4114643004	0.3563094417	0.3072764225	0.297468628
0.3245567418	0.273881537	0.2795995275	0.3146491709	0.418663594	0.2663062328	0.297468628
0.2596453934	0.3370849686	0.3960993306	0.3872605181	0.3563094417	0.3277615173	0.297468628

Below is the equation result calculated using equation (6): with value w = [15 15 10 10 10 20 20]

5.1929078689	5.6883088456	3.4949940935	2.9044538854	3.1177076148	7.784336037	8.0741484746
5.1929078689	6.0043260037	3.2619944872	3.1464917092	3.1177076148	7.784336037	8.0741484746
4.8683511271	5.3722916875	3.028994881	2.9044538854	2.8950142138	6.5552303469	6.7992829259
5.5174646107	5.3722916875	3.4949940935	3.388529533	3.1177076148	7.784336037	8.0741484746
5.1929078689	3.7922058971	3.4949940935	2.9044538854	2.8950142138	5.3261246569	5.0994621945

5.5174646107	4.4242402133	2.7959952748	3.388529533	3.3404010159	6.1455284503	5.0994621945
4.5437943853	4.7402573714	3.4949940935	4.1146430044	3.563094417	6.1455284503	5.9493725602
4.8683511271	4.1082230552	2.7959952748	3.1464917092	4.1866359399	5.3261246569	5.9493725602
3.8946809017	5.0562745295	3.9609933059	3.8726051806	3.563094417	6.5552303469	5.9493725602

To obtain a preference value for each alternative (Vi), using equation (10) with the following calculation example:

$$V1 = \frac{1.7405529744}{1.7405529744 + 4.5508628856} = 0.7233447902$$

Based on calculation the value of preferences or ranking, it is obtained the results of each alternative as in table 6 :

	Fuzzy TOPSIS	
Employee Name	Score	Ranking
Susi	0.7233447902	3
Dadang	0.7406012613	2
Budi	0.4990670041	5
Herna	0.7509773725	1
Titin	0.234214846	9
Indah	0.2972670947	8
Rida	0.3725652414	6
Dwi	0.3128655314	7
Santi	0.6750781565	4

Results of fuzzy SAW dan fuzzy TOPSIS as shown at Table 8.

Table 8. Normalize Score of fuzzy SAW dan fuzzy TOPSIS

	Fuzzy SAW		Fuzzy TOPSIS	
Employee Name	Score	Ranking	Score	Ranking
Susi	91.66	3	0.72	3
Dadang	92.45	2	0.74	2
Budi	81.96	6	0.50	5
Herna	92.93	1	0.75	1
Titin	72.70	9	0.23	9
Indah	77.28	7	0.30	8
Rida	82.06	5	0.37	6
Dwi	76.04	8	0.31	7
Santi	83.31	4	0.68	4

Visualization of Table 7 as shown graphic:

Gambar 1 : Graphic of fuzzy SAW dan fuzzy TOPSIS Methods :

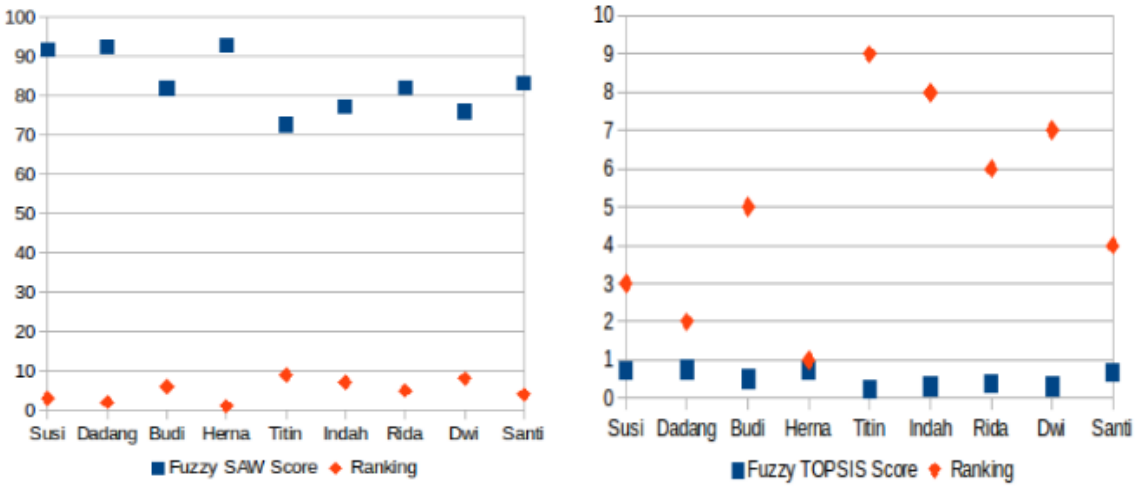

Table 7 and Diagram 1 shown results of fuzzy SAW and fuzzy TOPSIS methods as stipulated below :

Ranking according to fuzzy SAW method : 1. Herna, 2.dadang, 3.Susi, 4.Santi, 5.Rida, 6.Budi, 7.Indah, 8.Dwi dan 9. Titin.

Ranking results using fuzzy TOPSIS method shown the exact same results as in other methods Herna, Dadang, Susi, Santi, Budi, Rida, Dwi, Indah danTitin.

5. Conclusions

Conclusions :

Based on multi criteria using fuzzy SAW and fuzzy TOPSIS methods, has shown the same exact ranking : Herna with fuzzy SAW 92,93 , with fuzzy TOPSIS 0.75 , secondly Dadang with scores fuzzy SAW 92.45 , and fuzzy TOPSIS 0.74 methods.
As seen from both methods eventhough using different methods but has resulted the same exact sequence of ranks. Recommendation for further studies could apply Fuzzy MADM for better references.

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