RedWhitepress https://series.gci.or.id

Global Conferences Series:
Sciences and Technology (GCSST), Volume 2, 2019
The 1st International Conference on Education, Sciences and Technology
DOI: https://doi.org/10.32698//tech1315127

Decision Support System for Educational Staff Promotion in Universitas Negeri Gorontalo

M Rohandi[1]
[1]Universitas Negeri Gorontalo, Indonesia

Abstract. This study aims to develop a decision support system for promotion of education staff based on work performance and work behavior using the Fuzzy AHP method to avoid subjective judgments. AHP method is chosen to overcome doubts and uncertainties in the assessment of educational staff performance. There are 2 criteria (work performance and work behavior) and 10 sub-criteria (quantity, quality, time, cost, service orientation, integrity, commitment, discipline, teamwork, and leadership) for assessing the performance of educational staff. The system developed was able to provide the best alternative in selecting educational staff to be promoted in certain positions. Nevertheless there are shortcomings, namely the absence of standard rules in determining the weight and level of interest in each criterion.

1. Introduction

Job promotion is an award given by an agency or company to someone by making a transfer of a position from one position to a position that has a higher status and responsibility which has implications for the amount of responsibility, rights, and income [1],[2]. Following the government regulation number 17 of 2010, article 177, concerning the management and implementation of education, promotion and appreciation for educators and educational staff carried out by looking at educational background, experience, abilities and work performance in education [3]. Assessment based on educational background and experience is not as difficult as an assessment based on work performance. Therefore the assessment of work performance is very vulnerable with subjectivity in its assessment.

The implementation of the work performance evaluation for educational staff in state universities (PTN) is a government effort in reforming the arrangement of human resources (HR). HR reform at PTN aims to strengthen institutional work culture, job analysis, and evaluation, competency-based employee structuring, strengthening individual performance measurement systems and developing workload and performance-based remuneration systems [4]. The legal basis of civil servant work performance appraisal is the Republic of Indonesian Law No. 43 of 1993 concerning staffing matters, government regulation No. 53 of 2010 concerning civil servant discipline, government regulation No. 46 of 2011 concerning civil servant work performance evaluation, national civil service agency Regulation No. 1 of 2013 concerning the implementation of SKP assessments and the ministry of administrative and bureaucratic reform handbill No. 2 of 2013 concerning the implementation of civil servant work performance assessments.

The work performance appraisal of government employees is divided into two, namely the assessment of employee work goals (SKP) and the assessment of government employees work behavior. The SKP must be compiled by a civil servant (PNS) as a design reference for the implementation of tasks and positions under their main tasks and functions within the organization. The assessment of work behavior is carried out by superiors to their subordinates. Employee Work Objectives are a mandatory requirement in the assessment of employees for promotion in addition to the period of employment, education, and job position [5]. The problems that often occurs is that promotion is still based on subjectivity (likes or dislikes), not based on objectivity such as the assessment of work behavior and SKP. To overcome these problems, it is necessary to make a decision support system (DSS) that can assist in the promotion of educational staff so that it reduces the element of subjectivity. Research on decision support systems for previous promotion has been carried out, including by [5] - [7] whose main goal is to reduce subjectivity in promotion by the leadership.

2. Methodology

In the decision-making process, the following four phases are carried out [6]: 1) Searching, problem scope identification, and problems introduction phase; 2) The designing phase is the process of finding, developing and analyzing workable alternatives; 3) The phase of choosing an alternative that might be done, namely by looking for or matching algorithms. The results of the election are then used in the decision-making process.

One method of DSS that is very useful in overcoming the fuzzy or uncertain problems is Fuzzy AHP [8]. This method was first proposed by Chang and is an extension of the AHP method proposed by Saaty [9]. Fuzzy AHP method uses triangular fuzzy number (TFN) which is used for fuzzification. The TFN consists of three membership functions, namely the lowest value (l), the middle value (m), and the highest value (u). The fuzzy AHP steps proposed by Chang are as follows [10], [11]:

Step 1*:* The fuzzy synthetic extent value *(S_i)* with respect to the i^{th} criterion is defined as equation 1.

$$S_i = \sum_{j=1}^{m} M_{g_i}^{j} \otimes [\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^{j}]^{-1} \quad (1)$$

where g_i is the goal set and $M_{g_i}^{j}$ (j = 1,2,3,…,*m)* are TFN.

to obtain equation 2:

$$\sum_{j=1}^{m} M_{g_i}^{j} \quad (2)$$

Perform the "fuzzy addition operation" of *m* extent analysis values for a particular matrix given in equation 3 below, at the end step of calculation, new *(l, m, u)* set is obtained and used for the next:

$$\sum_{j=1}^{m} M_{g_i}^{j} = \left(\sum_{j=1}^{m} l_j , \sum_{j=1}^{m} m_j , \sum_{j=1}^{m} u_j\right) \quad (3)$$

Where *l* is the lower limit value, *m* is the most promising value and *u* is the upper limit value. and to obtain equation 4:

$$[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^{j}]^{-1} \quad (4)$$

Perform the "fuzzy addition operation" of $M_{g_i}^{j}$ *(j = 1, 2, 3, 4, 5, ..., m)* values give as equation 5:

$$\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^{j} = \sum_{i=1}^{m} l_i , \sum_{i=1}^{m} m_i , \sum_{i=1}^{m} u_i \quad (5)$$

and then compute the inverse of the vector in the equation (5) equation (6) is then obtained such that :

$$\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^{j} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i},\right) \quad (6)$$

Step 2*:* The degree of possibility of

$M_2 = (l_2, m_2, u_2) \geq M_1 = (l_1, m_1, u_1)$ *is* defined as equation 7:

$$V\ (M_2\ \geq\ M_1) = Sup_{y \geq x}[\min\left(\mu_{M_1}(x), \mu_{M_2}(y)\right)] \quad (7)$$

and x and y are the values on the axis of membership function of each criterion. This expression can be equivalently written as given in equation 8 below:

$$V(M_2 \geq\ M_1) = \begin{cases} 1, & if\ m_2 \geq m_1, \\ 0, & if\ l_1 \geq u_2, \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}, & otherwise, \end{cases} \quad (8)$$

where d is the highest intersection point μ_{M_1}dan μ_{M_2}. To compare M_1 and M_2; we need both the values of $V(M_2 \geq M_1)$ and $V(M_1 \geq M_2)$

Step 3. The degree possibility for a convex fuzzy number to be greater than k convex fuzzy numbers.
M_i $(i = 1, 2, 3, 4, 5, ..., k)$ can be defined by $V(M \geq M_1, M_2, M_3, M_4, M_5, M_6, ..., M_k) = V[(M \geq M_1)$ and $(M \geq M_2)$ and $(M \geq M_3)$ and $(M \geq M_4)$ and ..... and $(M \geq M_k)] = min\ V(M \geq M_i)$, $i = 1, 2, 3, 4, 5, ..., k$.

Assume that equation 9 is $d'(A_i) = min\ V(S_i \geq S_k)$ (9)
For $k = 1, 2, 3, 4, 5, ..., n;\ k \neq i$. Then the weight vector is given by equation 10:
$W_t = (d'(A_1), d'(A_2), d'(A_3), d'(A_4), d'(A_5), ..., d'(A_n))^T$ (10)
Where A_i $(i = 1, 2, 3, 4, 5, 6, ..., n)$ are n elements.

Step 4. Via normalization, the normalized weight vectors are given in equation 11:
$W = (d(A_1), d(A_2), d(A_3), d(A_4), d(A_5), d(A_6), ..., d(A_n))^T$ (11)
Where W is non-fuzzy numbers.

2.1 The implementation phase is part of the alternative selection phase, where this phase is the implementation of the decisions taken.
After the hierarchy is determined, a question form has been prepared to determine the importance levels of these criteria. To evaluate the questions, people only select the related linguistic variable, then for calculations they are converted into the following scale including triangular fuzzy numbers developed by Chang and generalized for such analysis as given in table 1.

Table 1. TFN values, own study based on [12]

Statement	TFN	Reciprocal
Absolute	(7,9,9)	(1/7,1/9,1/9)
Very Strong	(5,7,9)	(1/5,1/7,1/9)
Fairly Strong	(3,5,7)	(1/3,1/5.1/7)
Weak	(1,3,5)	(1,1/3,1/5)
Equal	(1, 1, 1)	(1,1,1)

3. Results and Discussion

3.1. Define the problem and identify objectives, criteria, sub-criteria and decision alternatives.
The purpose of this study was to build a DSS for educational staff promotion and finding the most influential criteria in decision making using fuzzy AHP. The criteria, sub-criteria, and alternatives taken from the performance of civil servants assessments are contained in the List of Job Implementation Assessments (DP3).

3.2. Construct the Fuzzy AHP hierarchy

The goal of this Fuzzy AHP is to choose educational staff for promotion. The criterions are consists of two criteria, namely SKP and work behavior. SKP is consists of 4 sub-criterions (quantity, quality, time, and cost), while work behavior consists of 6 sub-criterion (service orientation, integrity, commitment, discipline, teamwork, and leadership).

3.3. Perform fuzzy AHP calculations

Since the main criterion is taken from government regulation, where the weight of SKP is set to 60% and the work behavior is set to 40%. So we can continue by counting the weight of the sub-criterion of each criterion. The pairwise comparison matrix of SKP and work behavior sub-criterion displayed in tables 2 and 3. The results of Fuzzy AHP steps are shown in tables 4 to 8:

Table 2. Pairwise comparison matrix for sub-criterion of SKP

	Quantity			**Quality**			**Time**			**Cost**		
	l	***m***	***u***	***l***	***m***	***U***	***l***	***m***	***u***	***l***	***m***	***u***
Quantity	1	1	1	1	2	4	1	3	5	3	5	7
Quality	1/4	0.5	1	1	1	1	1	3	5	3	5	7
Time	1/5	1/3	1	1/5	1/3	1	1	1	1	3	5	7
Cost	1/7	1/5	1/3	1/7	1/5	1/3	1/7	1/5	1/3	1	1	1

Table 3. Pairwise comparison matrix for sub-criterion of work behavior

	Service Orientation			**Integrity**			**Commitment**			**Discipline**			**Teamwork**			**Leadership**		
	l	***m***	***u***	***l***	***m***	***u***	***l***	***m***	***u***	***l***	***m***	***u***	***l***	***m***	***u***	***l***	***m***	***u***
Service Orientation	1	1	1	1/7	1/5	1/3	1/5	1/3	1	1/5	1/3	1	1/7	1/5	1/3	1/5	1/3	1
Integrity	3	5	7	1	1	1	1	3	5	1	3	5	1	3	5	1	3	5
Commitment	1	3	5	1/5	1/3	1	1	1	1	1	3	5	3	5	7	3	5	7
Discipline	1	3	5	1/5	1/3	1	1/5	1/3	1	1	1	1	1/5	1/3	1	1	3	5
Teamwork	3	5	7	1/5	1/3	1	1/7	1/5	1/3	1	3	5	1	1	1	1	3	5
Leadership	1	3	5	1/5	1/3	1	1/7	1/5	1/3	1/5	1/3	1	1/5	1/3	1	1	1	1

Table 4. Step 1 for sub-criterion of SKP

Equation 3			*Equation 6*			*Equation 1*		
∑l	***∑m***	***∑u***	***∑u***	***∑m***	***∑l***	***l***	***m***	***u***
1.32	2.34	3.44	0.13	0.21	0.35	0.18	0.48	1.21
0.93	1.65	2.43				0.12	0.34	0.86
0.59	0.86	1.63				0.08	0.18	0.57
0.23	0.30	0.44				0.03	0.06	0.15
2.84	4.86	7.50						

Table 5. Step 1 for sub-criterion of work behavior

Equation 3			*Equation 6*			*Equation 1*		
∑l	***∑m***	***∑u***	**∑u**	***∑m***	***∑l***	***l***	***m***	***u***
0.24	0.39	0.76	0.15	0.23	0.42	0.04	0.09	0.32
1.25	2.59	3.64				0.19	0.60	1.52

0.90	1.32	2.24	0.14	0.31	0.94
0.38	0.76	1.50	0.06	0.18	0.63
0.61	1.00	1.85	0.09	0.23	0.77
0.61	1.00	1.85	0.09	0.23	0.77
2.39	4.29	6.63			

Table 6. Step 2 for sub-criterion of SKP

	Equation 8				*Equation 9*
	s1	***s2***	***s3***	***s4***	
Quantity *(s1)*	-	1.27	1	1	1
Quality *(s2)*	1.01	-	1	1	1
Time *(s3)*	0	0	-	1	0
Cost *(s4)*	0	0.11	0.72	-	0

Table 6. Step 2 for sub-criterion of work behavior

	Equation 8						*Equation* 9
	s1	***s2***	***s3***	***s4***	***s5***	***s6***	
Service Orientation *(s1)*	-	1	1	1	1	1	1
Integrity *(s2)*	0.16	-	0.77	0.56	0.67	0.67	0.16
Commitment *(s3)*	0.63	1	-	0.92	1.01	1.01	0.63
Discipline *(s4)*	1.02	1	1	-	1	1	1
Teamwork *(s5)*	0.85	1	1	1.05	-	1	0.85
Leadership *(s6)*	0.85	1	1	1.05	1	-	0.85

Table 7. Steps 3 and 4 for sub-criterion of SKP

Equation 11				Normalization			
Quantity	Quality	Time	Cost	Quantity	Quality	Time	Cost
1	1	0	0	0.5	0.5	0	0

Table 8. Steps 3 and 4 for sub-criterion of work behavior

Equation 11						Normalization					
Service Orientation	Integrity	Commitment	Discipline	Teamwork	Leadership	Service Orientation	Integrity	Commitment	Discipline	Teamwork	Leadership
1	0.16	0.63	1	0.85	0.85	0.22	0.03	0.14	0.22	0.19	0.19

Table 7 shows that quality and quantity sub-criteria are greatly influencing the SKP assessments. The Staff with high quality and quantity assessments tend to have good SKP scores. While table 8 shows that service orientation and discipline are the most influence sub-criteria, follows by teamwork, leadership, commitment and integrity for work behavior assessments.

3.4. Obtained the overall rating for the alternatives by aggregated the relative weights of decision elements.

4. Conclusion

The use of DSS in the promotion of educational staff is very necessary to eliminate subjectivity in decision making. The assessment for educational staff promotion based on work performance is more difficult than educational and background assessments. This is due to the assessments based on educational background and experiences are discrete data with categorical attributes (appropriate or inappropriate), while work performance continues data with numerical attributes. In addition, the absence of government rules in determining the weight of sub-criteria in work performance assessments results in uncertainty or ambiguity in objective decision making.

Fuzzy AHP is a very useful DSS method to solve the fuzziness and uncertainty problems. Fuzzy AHP is an extension of AHP method that has not been able to reflect human thinking for complex problems. The work performance assessments of a civil servant are contained in the DP3, which consists of assessing civil servant SKP (such as quantity, quality, time and cost), and work behavior (such as service orientation, integrity, commitment, discipline, cooperation, and leadership). According to the rules of work performance Assessments, the weight of SKP criteria evaluation is 60% and work behavior is 40%, while the weight of the sub-criteria is not yet regulated.

The fuzzy AHP calculation on SKP sub-criteria shows that quality and quantity both influence the SKP assessment by 50%, while the time and costs do not affect judgment at all. In fuzzy AHP calculations for work behavior, the most influential sub-criteria were service orientation and discipline with the weight of 22%, followed by teamwork and leadership with 19%, followed by commitment with 14% and finally integrity with 4%. All of these weights then applied to the overall alternatives by aggregated the relative weights of decision elements. Fuzzy AHP method is proven to be able to help give the weight to sub-criteria that exist in SKP and work behavior which are not set beforehand.

References

[1] Martoyo S 2007 *Manajemen Sumber Daya Manusia [Human Resource Management]* Edisi 5 Cetakan pertama BPFE Yogyakarta.

[2] Hasibuan M S P 2008 *Manajemen Sumber Daya Manusia [Human Resource Management]* PT bumi aksara Jakarta.

[3] Peraturan Pemerintah Republik Indonesia No. 17 Tahun 2010. http://luk.staff.ugm.ac.id/atur/PP17-2010Lengkap.pdf. Accsess February 5 2019.

[4] Politeknik Negeri Bandung 2013 *Pelaksanaan Penilaian Prestasi Kerja PNS (Pengganti DP3)* Slide Presentasi.

[5] Primarizky A 2013 *Pembangunan Sistem Pendukung Keputusan Promosi Jabatan Menggunakan Weighted Product (WP) Studi Kasus: Badan Kepegawaian Negara Kantor Wilayah III Bandung [Decision Support System for Job Promotion Using Weighted Product (WP) Case Study National Civil Service Agency Region III Bandung]* Universitas Pendidikan Indonesia.

[6] Abdullah D, Djanggih H, Suendri S, Cipta H, and Nofriadi N 2018 *Fuzzy Model Tahani as Decision Support System for Employee Promotion*. International Journal of Engineering and Technology. 7. 10.14419/ijet.v7i2.5.13958.

[7] Taufiq R and Sugiharto A 2011 *The Decision Support System Design of Employee Performance Appraisal Using Analytical Hierarchi Process (AHP) Method* Univ. Diponegoro 283–8

[8] Wang Y M and Chin K S 2011 *Fuzzy Analytic Hierarchy Process: A Logarithmic Fuzzy Preference Programming Methodology* Int. J. Approx. Reason. **52** 541–53.

[9] Lu J, Zang G, Ruan D and Wu F 2007 *Multi-objective group decision making: methods, software and applications with fuzzy set technique* Imperial College Press, London.

[10] Özdağoğlu A and Özdağoğlu G 2007. *Comparison of AHP And Fuzzy AHP For The Multi-criteria Decision Making Processes with Linguistic Evaluations*. İstanbul Ticaret Üniversitesi Fen Bilimleri Dergisi. *Yıl: 6 Sayı:11Bahar 2007/1 s. 65-85*

[11] Chan F T S, Kumar N, Tiwari M K, Lau H C W and Choy K L 2008 *Global Supllier Selection: A Fuzzy-AHP Aprroach.* International Journal of Production Research, No. 14, Vol. 46, 3825-3857

[12] Stoltmann A, Bućko P and Jaskólski M 2016 *Multi-criteria investment decision support model using fuzzy analytic hierarchy process (F-AHP) method for power industry Zesz. Nauk. Wydz. Elektrotechniki i Autom. Politech. Gdańskiej* **47** 179–82.