Development of government employee performance measurement models: Using Analytical Network Process and Simple Additive Weighting methods

by Moh. Ramdhan Arif Kaluku

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Development of government employee performance measurement models: Using Analytical Network Process and Simple Additive Weighting methods

M R A Kaluku[1,2,*], R Dai[1], N Pakaya[1] and I R Padiku[1]

[1] Universitas Negeri Gorontalo, Gorontalo, Indonesia
[2] Department of Technology and Information, Faculty of Engineering, Universitas Negeri Gorontalo, Gorontalo, Indonesia

[*]aliaskaluku@ung.ac.id

Abstract. This paper describes how to measure the performance of government employees to society using different assessment methods and new services instruments, and providing opportunities for the community to assess the services provided to them. The Analytical Network Process (ANP) method is used to generate global weights obtained from the pairwise comparison matrix and supermatrix which will be used as preference weights. The final score of each employee is obtained from a questionnaire that has been filled in by respondents using the Simple Additive Weighting (SAW) method then the calculation will be combined with preference weights obtained from previous calculations. The results showed that the use of the ANP-SAW method resulted in good performance calculations with employee 5 getting the highest value at 0.9526, while employee 2 getting the lowest value at 0.7753. With the assessment carried out by the community and the use of appropriate decision making methods, leaders in government can easily assess the performance of their employees, not only from the achievement of work but also based on the assessment of the community.

1. Introduction

In modern organizations, Human Resource management is one of the most important units [1]. Implementation of HR policies and practices in organizations can lead to the relationship of these organizations [2]. The main factor in the process of doing business is the workmanship and good improvement in the organization [3]. Employee assessments are difficult and subjective to measure, because they do not have a fixed indicator of importance to measure them. Indicators need to be used as a measure to respect humans [3]. In local government, leadership is difficult to see and measure the performance of each employee, this is caused by the absence of standard measures that can be made benchmark in measuring performance [4].

In local government, performance measurement is only carried out by the leader. Customers from these agencies, in this case the public cannot assess the performance of these employees. This also causes the absence of accurate data because the community cannot measure the performance of the government apparatus [4]. Even though the community also has an important role in assessing the performance of government employees. Public satisfaction on employee performance is a benchmark of the success of existing human resources in every government agency [5]. Therefore it is necessary to make a measurement of the performance of government employees to support maximum community service.

It is necessary to assess performance using an appropriate measurement theory, using mathematical formulations and tested empirically using numerical analysis [6]. One method of decision making that can be used is the Analytic Network Process (ANP) method. Analytic Network Process (ANP) is used for multi-criteria decision making. ANP is a method developed from the Analytical Hierarchy Process (AHP) method [7]. The SAW (Simple Additive Weighting) method is a method that can be combined with the ANP method, this is because the SAW is an algorithm used for decision making which is also known as the weighted sum method. SAW method is a method of Multiple Criteria Decision Analysis (MCDA) which is quite popular and more transparent, this method provides a simple framework for interpretation of the resulting ranks [8]. A combined methodology using the ANP-SAW method is used to measure the performance of human resources in Gorontalo. This is because the Decision Support System is able to show the value of competence in accordance with predetermined criteria and is able to analyze data systematically to achieve certain goals.

2. Methodology

2.1. Analytic Network Process (ANP)

ANP method is a method developed from the AHP method [7]. AHP which still has a dependency between elements of the hierarchy still has many problems because the hierarchy considers more dependency with higher level elements in the hierarchy to lower level elements, whereas ANP which is represented by the network, not the hierarchy can overcome the problem [7]. ANP is a logical mathematical method that can be used to deal with the problem of dependence on elements of the hierarchy [7]. ANP method that is based on the network can be used to determine the relationship between each element that exists on the same criteria, or to the elements of different criteria. According to Saaty [7], the steps used to calculate the ANP method are basically the same as the AHP method, but there is the use of supermatrix at the end of the calculation. There are 3 stages of making supermatix, namely:

- Unweighted Supermatrix Stage
  Unweighted Supermatrix is obtained from the results of pairwise comparisons that have been carried out before weighting, by entering all the results of the calculation of priority vectors into columns that correspond to the cells.
- Weighted Supermatrix Stage
  Weighted Supermatrix is obtained by normalizing the results of the Unweighted Supermatrix stage so that it is worth one.
- Limiting Supermatrix Stage
  To obtain a supermatrix limiting, it is done by ranking the results of the Weighted Supermatrix with the highest rank, until it gets the same value on each row.

2.2. Simple Additive Weighting (SAW)

The use of decision making methods can provide many choices for decision makers [8]. SAW is a weighted sum method [8]. The basic concept of the SAW method is to find a weighted sum of the performance ratings for each alternative on all criteria [9]. The SAW method requires the process of normalizing the decision matrix to a scale that can be compared with all existing alternative ratings.

In the SAW method, the existing criteria can be grouped into 2 (two) attributes, namely the benefit attribute and the cost attribute [8].

3. Results and discussion

3.1. Result

This research resulted in a decision making model, using the ANP-SAW method. In this study using the attributes obtained from the results of interviews as a basis for determining the performance criteria for

government employees. From each criterion used as a question for respondents. These questions form the basis of weighting. The application of the ANP method to assess performance begins with analysing performance measurements using criteria. Evaluation is done by assessing the relationship between the influences of one criterion with other criteria.

In ANP, pairwise comparisons are performed using a matrix, which will then be used to form a supermatrix using values from priority vectors resulting from pairwise comparisons on the previous matrix [7]. The results of the analysis using ANP generate global weights obtained from supermatrix limits which will later be used for SAW calculations which are presented in tabular form in table 1.

Table 1. ANP supermatrix limit.

LS	C1	C2	C3	C4	C5	C6	C7	C8
C1	0.1784	0.1784	0.1784	0.1784	0.1784	0.1784	0.1784	0.1784
C2	0.1091	0.1091	0.1091	0.1091	0.1091	0.1091	0.1091	0.1091
C3	0.1753	0.1753	0.1753	0.1753	0.1753	0.1753	0.1753	0.1753
C4	0.1122	0.1122	0.1122	0.1122	0.1122	0.1122	0.1122	0.1122
C5	0.1224	0.1224	0.1224	0.1224	0.1224	0.1224	0.1224	0.1224
C6	0.1106	0.1106	0.1106	0.1106	0.1106	0.1106	0.1106	0.1106
C7	0.1249	0.1249	0.1249	0.1249	0.1249	0.1249	0.1249	0.1249
C8	0.0672	0.0672	0.0672	0.0672	0.0672	0.0672	0.0672	0.0672

Table 2 above shows the value of the global weights of each criterion resulting from the calculation of the matrix in ANP. In ANP, the value of the supermatrix limit can be accepted if all the columns are the same [7]. In table 3, the criteria for C1 have the highest value with 0.1784 while the control value is the C8 criterion with a value of 0.0672.

The SAW method will be used to rank based on global weights obtained from ANP calculations. In the SAW method, data obtained from respondents who had previously filled out questionnaires were distributed. Answers from the questions from respondents were analysed using the SAW method. The procedure of the SAW analysis is that respondents give weight to each alternative to the existing criteria by using match rating weights [9]. From the matching compatibility table obtained, a decision matrix is formed. Then the decision matrix is normalized by dividing the value of each attribute with the largest value on the criteria line if it is profitable, or dividing the smallest value from the criteria row by the attribute value if it is worth the cost. Normalization results obtained will then be multiplied by the preference value of each criterion obtained from the global weighting on the ANP method.

From the results obtained in the ANP-SAW method the assessment of the performance of government employees in Gorontalo has a different value based on the weight given by each respondent. Each employee has a final score based on the assessment of the respondent who can be a recommendation for future performance improvement. The final results of this evaluation can show the level of performance of each employee who has been ranked. The output of this assessment is ranking displayed in tables and graphs.

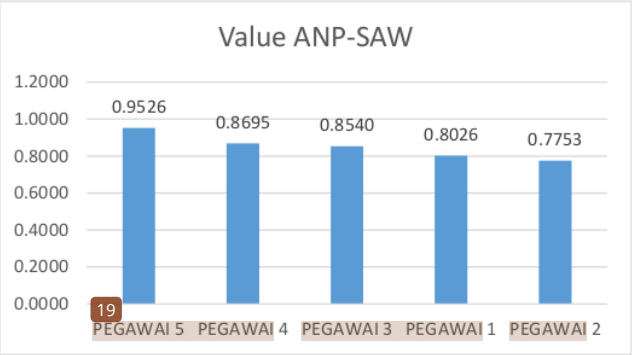

Figure 1. ANP-SAW ranking results.

From the graph in Figure 1 above clearly seen the total value obtained from the largest to the smallest of the five alternatives. So by using the ANP-SAW method, the highest value is employee 5 with a value of 0.9526, while the lowest value is obtained by employee 2 with a value of 0.7753.

3.2. Discussion

Human resource management services contribute greatly in terms of developing human resource management [10]. Good allocation of human resources, seen as a core process of information systems project management. However, it is not easy to manage human resources in an organization, especially in the field of services related to the community. There needs to be a strategy or assessment that can support management to make decisions in assessing the performance of government employees. The Criteria for measuring the performance of employees in the government as shown in table 2.

Table 2. Criteria of government employees.

NO.	Criteria
1.	Good Attitudes and Behaviour (C1)
2.	Friendliness in the Community (C2)
3.	Responsibility to Duties (C3)
4.	Good Service (C4)
5.	No Charges (C5)
6.	Easy File Handling (C6)
7.	Fast Settlement Time (C7)
8.	No Wasted Free Time (C8)

The determination of criteria is based on data obtained at the time of data collection. From the measurement of criteria, then weighting of existing criteria using ANP method. Determination of priority weights is done using a pairwise comparison matrix. After getting the priority weights obtained, ranking is done using the SAW method.

Another stage carried out in this study is the assessment of predetermined criteria. This assessment is done by pairing alternative choices with criteria. Assessment is carried out by respondents using a questionnaire. Respondents were asked to determine the level of importance of each criterion. Criteria evaluation can also be assessed because it is influenced by other sub-criteria that are not in the criteria group. To obtain the value of the questionnaire created using the Analytic Network Process (ANP) method, numerical values on all comparisons were obtained from a scale of ratio 1 to 9 set by Saaty [7].

Furthermore, the assessment of alternatives is carried out using a questionnaire that refers to the SAW method, where each criterion is grouped into a profit or cost dimension [8]. Respondents were

asked to fill in the answers to the questions on each attribute. Each question provides five choices of answer categories. To avoid the answerability of the respondents' answers, a method is used where the respondent chooses one of the 5 categories on a scale of 1 to 5 [8].

An assessment of the performance of government employees in Gorontalo is carried out by distributing 60 questionnaires to respondents, who will assess the performance of 5 people. To calculate employee performance, pairwise comparisons are made using the ANP method [7]. The ANP method identifies factors or criteria that influence each other by looking at the interrelation between each criterion with other criteria without having to be limited by higher criteria [7]. In the following table 3 can be seen an example of a pairwise comparison matrix between criteria. Table 3 shows that the C2 and C4 criteria are the criteria that have the highest priority vector value, namely 0.4097, followed by C7 and C8 with 0.0669 and 0.1173.

Table 3. Pairwise comparison matrix between criteria.

C1	C2	C4	C7	C8	Vektor Priority
C2	1	1	5	5	0.4079
C4	1	1	5	5	0.4079
C7	0.2000	0.2000	1	3	0.1173
C8	0.3333	0.3333	3	1	0.0669

In the ANP method, after the priority vector is obtained from the results of pairwise comparisons, the next step is to create a super matrix. The first step is to create an unweighted supermatrix that uses the results of priority vectors in the previously calculated pairwise comparisons as in table 4. After an unweighted supermatrix is formed, then it is normalized so that it becomes a weighted supermatrix that has the number of one in each column as shown in table 5 . From the weighted supermatriks obtained, then the supermatrix is raised to the largest number so that it gets the same value on each row [7]. The value of the supermatrix limit is then used to become a global weight which will later be used as the preference weight of each criterion for calculation in the SAW method. From the calculation of the ANP method obtained global weights from supermatrix limits, respectively, the values are 0.1784, 0.1091, 0.1753, 0.1122, 0.1224, 0.1106, 0.1249, 0.0672.

Table 4. Unweighted supermatrix.

US	C1	C2	C3	C4	C5	C6	C7	C8
C1	0.0000	1.0000	0.1250	0.2500	0.8750	1.0000	1.0000	1.0000
C2	1.0000	0.0000	0.8750	0.7500	0.1250	0.0000	0.0000	0.0000
C3	0.7500	1.0000	0.0000	1.0000	0.8333	0.1250	0.2500	0.8333
C4	0.2500	0.0000	1.0000	0.0000	0.1667	0.8750	0.7500	0.1667
C5	0.8333	0.0000	0.8333	0.7500	0.0000	1.0000	0.0000	0.0000
C6	0.1667	0.0000	0.1667	0.2500	1.0000	0.0000	1.0000	1.0000
C7	0.7500	0.0000	0.7500	0.7500	0.0000	0.7500	0.0000	1.0000
C8	0.2500	0.0000	0.2500	0.2500	0.0000	0.2500	1.0000	0.0000

Table 5. Weighted supermatrix.

WS	C1	C2	C3	C4	C5	C6	C7	C8
C1	0.0000	0.5000	0.0313	0.0625	0.2917	0.2500	0.2500	0.2500
C2	0.2500	0.0000	0.2188	0.1875	0.0417	0.0000	0.0000	0.0000
C3	0.1875	0.5000	0.0000	0.2500	0.2778	0.0313	0.0625	0.2083
C4	0.0625	0.0000	0.2500	0.0000	0.0556	0.2188	0.1875	0.0417
C5	0.2083	0.0000	0.2083	0.1875	0.0000	0.2500	0.0000	0.0000
C6	0.0417	0.0000	0.0417	0.0625	0.3333	0.0000	0.2500	0.2500
C7	0.1875	0.0000	0.1875	0.1875	0.0000	0.1875	0.0000	0.2500
C8	0.0625	0.0000	0.0625	0.0625	0.0000	0.0625	0.2500	0.0000

After the weighting process using ANP is completed, the next step is ranking using the SAW method. Data processing using SAW begins by filling in the decision table of each criterion on each alternative obtained from the results of the questionnaire. The SAW method process is continued by normalizing the matrix of the decision table. The element of normalization of the decision matrix is multiplied by the criteria weight (which is calculated in the ANP process) so that the final value of each alternative is obtained. Preference value is the final value obtained in ranking all available alternatives from the assessment results.

Table 6. Final rating of ANP-SAW.

NO	RANK	
1	Employee 5	0.9526
2	Employee 4	0.8695
3	Employee 3	0.8540
4	Employee 1	0.8026
5	Employee 2	0.7753

In table 6 show the an assessment of the performance of government employees in Gorontalo using the ANP-SAW method shows the results of the final grades in the form of rankings for each employee, ranked from the employee with the highest value to the employee with the smallest value. The value of employee 5 is the biggest value with 0.9526 followed by employee 4 with 0.8695, employee 3 with 0.8540, employee 1 with 0.8026 and employee 2 with 0.7753. Thus it can be concluded that the performance of employee 5 is the highest compared to the performance of other employees according to the respondents who rate.

4. Conclusion

The results of research and discussion on the application of the ANP-SAW comparison to measure the performance of government employees in Gorontalo shows that, the incorporation of this method can identify assessments of employees based on the attributes given. the use of the ANP method can give a relevant weight of each of the existing criteria which is sourced from a pairwise comparison matrix which is processed into a supermatrix limit. In addition, giving weight by each respondent also has an influence on the amount of value obtained by each employee. So that the use of the ANP-SAW method by using the community as the main assessor of the services provided is better than the assessment process carried out by the agency.

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